विज्ञान

(सैद्धांतिक एवं प्रायोगिक)

कक्षा 9

सत्र 2022–23

DIKSHA एप कैसे डाउनलोड करें?

विकल्प 1 : अपने मोबाइल ब्राउज़र पर diksha.gov.in/app टाइप करें।

विकल्प 2 : Google Play Store में DIKSHA NCTE ढूंढ़े एवं डाउनलोड बटन पर tap करें।

DIKSHA

मोबाइल पर QR कोड का उपयोग कर डिजिटल विषय वस्तु कैसे प्राप्त करें ?

DIKSHA App को लॉच करे → App की समस्त अनुमति को स्वीकार करें → उपयोगकर्ता Profile का चयन करें।

पाठ्यपुस्तक में QR Code को Scan करने के लिए मोबाइल में QR Code tap करें।

मोबाईल को QR Code पर केन्द्रित करें।

सफल Scan के पश्चात् QR Code से लिंक की गई सूची उपलब्ध होगी।

डेस्कटॉप पर QR Code का उपयोग कर डिजिटल विषय–वस्तु तक कैसे पहुँचे ?

1 QR Code के नीचे 6 अंक का Alpha Numeric Code दिया गया है।

2 ब्राउज़र में diksha. gov.in/cg टाईप करें।

3 सर्च बार पर 6 डिजिट का QR CODE टाईप करें।

4 प्राप्त विषय–वस्तु की सूची से चाही गई विषय–वस्तु पर क्लिक करें।

राज्य शैक्षिक अनुसंधान और प्रशिक्षण परिषद् छत्तीसगढ़, रायपुर

निःशुल्क वितरण हेतु

प्रकाशन वर्ष : **2022**

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मार्गदर्शक : कमल महेंद्रू, (विद्याभवन, उदयपुर), स्निग्धा दास (विद्याभवन, उदयपुर), उमा सुधीर (एकलव्य भोपाल)

सहयोग : विद्याभवन सोसायटी, उदयपुर, एकलव्य, भोपाल, अजीम प्रेमजी फाउंडेशन

कार्यक्रम समन्वयक : डॉ. विद्यावती चन्द्राकर

विषय समन्वयन : अनिता श्रीवास्तव, पुष्पा किस्पोट्टा, ज्योति चक्रवर्ती

लेखन समूह : पुष्पा किस्पोट्टा, नीलम अरोरा, ज्योति चक्रवर्ती, अनुपमा नलगुंडवार, अनिता श्रीवास्तव, अभय जायसवाल, राजेश कुमार चंदानी, रीता चौबे, अनिता सौंधी, राजेश चंद्राकर, जयश्री राठौर, प्रीति जैन, गौरव शर्मा, राजेश पिल्ले, नीलम सिंह, अर्चना वर्मा, कुसुमलता गोपाल, साक्षी खरे, कमला राजपाल, शंकरलाल यादव, पातंजल कुमार यादव, पी.के. लहरे, प्रीति मिश्रा, यशोधरा कनेरिया, विनिता विश्वनाथन, अश्विनी कुमार भारती, पूजा झा

56P28T

आवरण पृष्ठ : रेखराज चौरागड़े

चित्रांकन : प्रशान्त सोनी

ले आउट : शाकिर अहमद

टंकण : अमन शर्मा

प्रकाशक

राज्य शैक्षिक अनुसंधान और प्रशिक्षण परिषद् छत्तीसगढ़, रायपुर

मुद्रक

छत्तीसगढ़ पाठ्यपुस्तक निगम, रायपुर (छ.ग.)

मुद्रणालय

मुद्रित पुस्तकों की संख्या – .....

vke[k

jk"Vh; ikB;p;k dh :ij[kk 2005 d vuqkj foKku dh vPNh f'k{kk og g tk fo|kFkh d ifr] thou d ifr vkj foKku d ifr bekunkj gkA blh nf"Vdk.k dk /;ku e j[kdj foKku] d{kk 9 d ikB;Øe dk fuek.k rFkk fo"k;oLr dk fodkl fd;k x;k gA

i;kl ;g jgk g fd /;ku doy fo"k;oLr ij gh ugh cfYd foKku lh[ku&fl[kku d fofoèk rjhdk ij Hkh gkA foKku dh f'k{kk bl ckr ij Hkh fuHkj djrh g fd ge fo"k;oLr dk fo|kfFk;k d vuHkok o ifjo'k l dl tkM] ftll lh[kuk LFkk;h gk ldA bldk vFk ;g ugh fd ;gk fo"k;oLr dk utj vnkt fd;k x;k gA fo"k;oLr dk le>u d fy, fofHkUu rF;k] fu;ek] fl)krk vkj ifj?kVukvk dk mi;kx fd;k x;k g vkj okLro e ;g gh foKku dk ey gA ikB;iLrd e ,u-lh-,Q- 2005 e fufgr lHkh oèkrkvk ¼lKkukRed] fo"k;oLr] ifØ;k] ,frgkfld] i;koj.kh; ,o ufrd½ dk Hkh è;ku j[kk x;k gA

y[ku dk; djr le; ,lh Hkh fLFkfr;k vkb tc mu fl)krk o vo/kkj.kkvk l t>uk iMk tk fo|kfFk;k vkj ifjo'k l lh/k tMh ugh FkhA vr% ,l volj jp x, ftul fo|kfFk;k dk vueku yxku] mUg tkpu] fu"d"k ij igpu tl dk;k vkj xfrfof/k;k l tMu d ekd feyA f'k{kdk l ;gk vkxg g fd o ,l voljk l u doy lfØ;rk l tM oju ,l vf/kdkf/kd volj Lo; Hkh jp ftul ;g iLrd fo|kfFk;k] f'k{kdk] lenk; d fy, vkj Hkh vf/kd mi;kxh fl) gk ldA

bl ijh ifØ;k e fo'k"k rkj ij bl ckr dk Hkh /;ku j[kk x;k fd fo|kfFk;k ij ekufld ck> u c< vkj mud ikl fØ;kdykik dk dju] ppk dju vkj [kkt&ij[k d fy, le; feyA

ikB;iLrd y[ku dk dk; f'k{kdk] f'k{kd if'k{kdk rFkk lg;kxh lLFkkvk d lkfFk;k }kjk fd;k x;k gA

Ldy f'k{kk foHkkx ,o jkT; 'kf{kd vul/kku vkj çf'k{k.k ifj"kn] N-x- }kjk f'k{kdk ,o fo|kfFk;k e n{krk lo/ku gr vfrfjDr ikB; llkèku miyC;k djku dh nf"V l Energized Text Books ,d vfHkuo ç;kl g] ftl vku ykbu ,o vkQ ykbu ¼MkmuykM dju d mijkr½ mi;kx fd;k tk ldrk gA ETBs dk çe[k mnn'; ikB;oLrd vfrfjDr vkfM;k&ohfM;k] ,uhe'ku QkjeV e vfèkxe lkexh] lcfèkr vH;kl] ç'u ,o f'k{kdk d fy, lnHk lkexh çnku djuk gA

ifj"kn mu lHkh d ifr vkHkkj 0;Dr djrh g tk bld fuek.k e iR;{k vFkok viR;{k :i l tMA bl iLrd d y[ku e fo|kHkou lklk;Vh mn;ij] ,dy0; Hkkiky] vthe ieth QkmM'ku dk egRoi.k lg;kx iklr gvk] ifj"kn mud ifr vkHkkj 0;Dr djrh gA vkid l>ko bl iLrd dk vkj cgrj cuk ldr g] vkid l>kok dk lno Lokxr gA

lpkyd

jkT; 'kf{kd vul/kku vkj if'k{k.k ifj"kn

NÙkh lx<] jk;ij

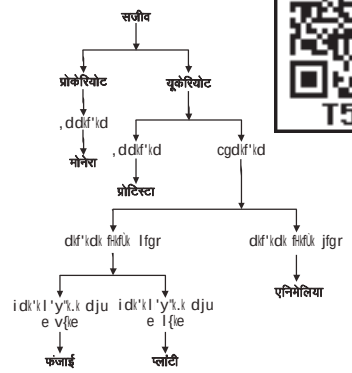
fo"k;&lph

Øekd	v/;k;	i"B l[;k	dky [k.M	vd
1-	to fofo/krk ,o oxhdj.k	1&16	11	05
2-	inkFk % idfr ,o 0;ogkj	17&31	09	04
3-	ijek.k ljpuk	32&44	10	05
4-	xfr	45&66	10	04
5-	cy ,o xfr d fu;e	67&81	12	04
6-	thou dh ekfyd bdkb % dkf'kdk	82&99	12	04
7-	cgdkf'kdh; ljpuk % Ård	100&117	11	04
8-	jklk;fud vkc/ku	118&132	07	04
9-	jklk;fud l= vkj eky ldYiuk	133&146	06	04
10-	jklk;fud vfHkfØ;k, ,o lehdj.k	147&163	06	04
11-	x#Rokd"k.k	164&177	08	04
12-	dk; ,o Åtk	178&198	12	05
13-	gekjk LokLF;	199&212	06	06
14-	/ofu	213&226	08	04
15-	gkbMkdkcu	227&238	08	04
16-	dk;yk] iVkfy;e ,o iVkjlk;u	239&248	06	04
17-	ikdrokl % ikdfrd vkokl	249&258	04	03
18-	dpjk vkj mldk ic/ku	259&266	04	03
	l)kfrd		150	75
	mÙkjekyk	267&269		
	ik;kfxd ,o ik;ktuk	270&302	30	25
	dy		180	100

vè;k;&1

to fofoèkrk ,o oxhdj.k

(Biodiversity and Classification)



1-1 to fofoèkrk (Biodiversity)

ge viu vkl&ikl n[k rk ge db idkj d thok d leg fn[kkb nr gA bu tho leg d lnL;k e fHkUurk, Hkh g o lekurk, HkhA t l fd ?kkM] fcYyh] dÙk vkfn tkuojk d leg dk n'kkr g rFkk uhe] cjxn] tkeu] vukj vkfn iM&ikèkk d leg dk n'kkr gA ;fn ge bu nkuk legk d lnL;k d y{k.kk dh ryuk dj rk ge ikr g fd ,d leg fo'k"k d lnL; vU; leg dh vi{kk vfèkd leku y{k.k j[kr gA

bu legk d lnL;k dk vkj Hkh NkV&NkV legk e ckVk tk ldrk gA mnkgj.k d fy, ?kkMk dk leg] fcfYy;k dk leg] dÙkk dk leg] uhe d iMk dk leg] /krjk d ikèkk dk leg vkfnA bu NkV&NkV legk d lnL;k dh ryuk dju ij ge ikr g fd bue vfèkdk'k y{k.k leku gkr g rFkk ; y{k.k mUg vU; NkV legk l vyx djr gA ; y{k.k bl leg d lHkh lnL;k e feyr g] pkg og lnL; iFoh d fdlh Hkh {k= fo'k"k e jgrk gkA ;gh ml leg fo'k"k d y{k.k dgykr g rFkk bUgh d vkèkkj ij ml leg dk ^^tkfr** dh lKk nh tkrh gA mnkgj.k d fy, ge eu";k d leg dh gh ckr djr gA lHkh eu"; pkg o iFoh d fdlh Hkh {k= e fuokl djr gk] lHkh e lfodflr efLr"d] Ropk ij de ?ku cky ik, tkr gA bl idkj ge dg ldr g fd ; lkj y{k.k eu"; tkfr d g tk bUg vU; tkfr d lnL;k l fHkUu cukr gA

- D;k ,d gh tkfr d lHkh lnL; lkj y{k.kk e lekurk j[kr g\ viu lkfFk;k l ppk djA

vHkh rd geu ,d gh tkfr d lnL;k e lekurkvk dh ckr dh gA vkb,] ge dN fØ;kdykik dh lgk;rk l bue ik, tku oky vrjk dk le>r gA

fØ;kdyki&1

leku fn[ku oky dkb Hkh nk ikèkk dk voykdu

viu vklikl l yxHkx leku vkdkj d nk ikèk bdë djA budk è;ku l voykdu dj o fuEufyf[kr lkj.kh dk Hkj&

lkj.kh Øekd&1

Ø-l-	ikèk dk uke	ru dh yckb	ifÙk;k dh l[;k	ifÙk;k d vkdkj o vk—fr	ifÙk;k dk dk jx	ifÙk;k d fdukj	f'kjk foU;kl
1-	ikèkk&1						
2-	ikèkk&2						

- ,d leku fn[ku oky nk ikèkk e vkidk D;k&D;k vrj fn[kkb fn,\
- D;k vki gcg ,d tl nk ik/k ¼;k nk ifÙk;k½ << ldr g \

fØ;kdyki&2

eu";k dk voykdu

;g fØ;kdyki de l de 10 cPpk d leg e djA uhp cuh lkj.kh d vulkj tkudkjh ,df=r djA ikIr tkudkjh dk lkj.kh e nt djA

lkj.kh Øekd&2

Ø-l-	fo|kFkh dk uke	yckb	otu	rtuh vxyh dh yckb	vxB dk fu'kku	gFkyh	
						yckb	pkMkb

- dku&dku l y{k.k lHkh e leku :i l ik, x,\
- dku lk y{k.k ,lk g tk lHkh lnL;k e vyx&vyx g\
- D;k vkidk viuh d{kk d fdUgh nk fo|kfFk;k d y{k.k ijh rjg leku fn[kkb nr g\

vki ik,x fd iR;d fo|kFkh d vxB dk fu'kku vU; fo|kfFk;k l vyx gkrk gA vFkkr ge dg ldr g fd vxB dk fu'kku iR;d 0;fDr dk fof'k"V y{k.k gA

mi;Dr fØ;kdykik d vkèkkj ij ge dg ldr g fd iR;d tkfr d lHkh lnL;k e lekurkvk d lkFk&lkFk vrj Hkh ik, tkr gA bu vrjk dk fofHkUurk, dgr gA fofHkUurkvk d dkj.k gh ge ,d gh tkfr d lnL;k e leku y{k.k gku ij Hkh mUg 0;fDrxr Lrj ij igpku ikr gA bu fofHkUurkvk d dkj.k gh ge fdlh {k= fo'k"k e fofoèk idkj d tho fn[kkb nr gA fdlh {k= fo'k"k e ik, tku oky thok d fofoèk idkjk dk ml {k= fo'k"k dh to&fofoèkrk dgk tkrk gA

;fn ge to fofoèkrk dk vkèkkj cukr g, inkFkk vkj thok d ckj e foLrr o 0;ofLFkr tkudkjh ikIr djuk pkg rk ge ,lh ifØ;k dh vko';drk gkxh ft ll ge vklkuh l bu lHkh dk vè;;u dj ldA ¼n[k i"B 293½

vkb,] dN mnkgj.kk dh lgk;rk l bl ifØ;k dk le>u dk i;kl djr gA

1-2 leghdj.k ,o oxhdj.k dh ifØ;k (Grouping and classification)

fØ;kdyki&3

ge jktkuk db rjg dh oLr, viu vkl&ikl n[kr gA bUg fofHkUu dk;k e mi;kx e yku d fy, vyx&vyx leg Hkh cukr gA tl& jlkb ?kj dk lkeku] [ky l tMk lkeku vkfnA ;gk dN oLrvk dh lph nh xb gA bu lHkh oLrvk dk mud x.kk d vkèkkj ij lkj.khc) djA

lykfLVd dk Ldy] iLrd] iu] ij[kuyh] ydMh dk xVdk] yl] lery ni.k] dkp dk VdMk] lykfLVd dk VdMk] jcj dh xn] cYyk] jLlh] lb] ydMh dk Ldy] iflyA

lkj.kh Øekd&3

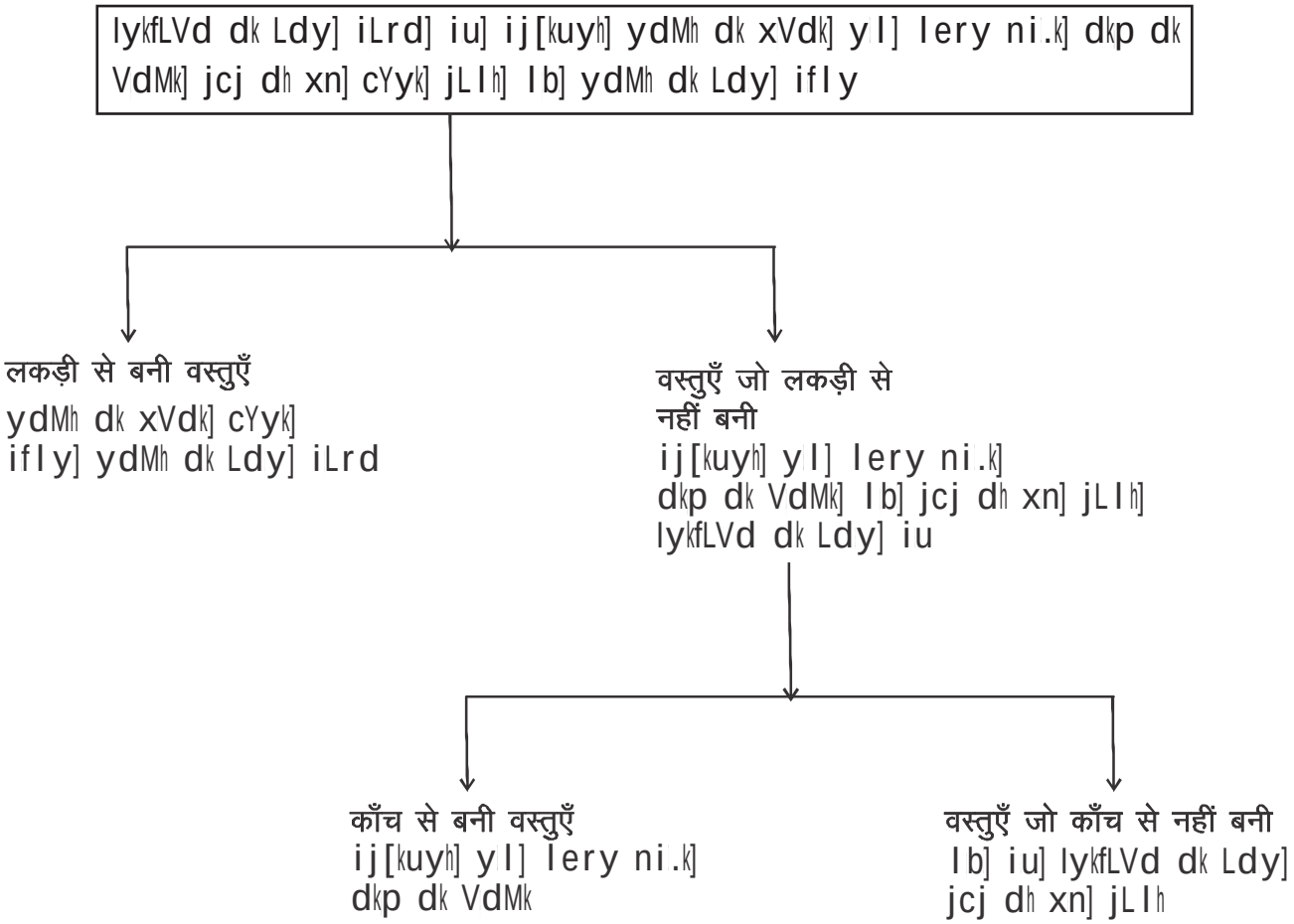
Ø-l	leg dk uke	leg e vku okyh oLr,
1	ydMh dh oLr,	
2	vk;rkdkj oLr,	
3		
4		
5		

- vkiu leg cukr le; oLrvk d fdu&fdu x.kk dk è;ku e j[kk\
- dku&lk ,lk leg g ft le vki vfèkdre oLrvk dk lkFk e j[k ik,\
- fdl fof'k"V x.k d vkèkkj ij ,lk leg cuk ft le cgr de oLr, Fkh\

vkiu n[kk] ,d leg dh lHkh oLrvk e dkb ,d x.k leku gkrk gA blh leku x.k dk ge leg dk x.kèke dgr gA jcj dh xn] cYyk] jLlh] lery ni.k vkfn dk mi;kx ge [kyu e djr gA vr^[kyu e mi;kx* x.kèke d vkèkkj ij bUg ,d leg e j[kk tk ldrk gA

mi;Dr oLrvk d x.kk dk igpkuu d fy, geu db vkèkkj puA ; oLr dk vkdkj] oLr fdl pht l cuh g o mldk mi;kx vkfn gk ldr gA blh idkj ge vU; vkèkkjk ij Hkh oLrvk d x.kk dk igpku ldr gA bl idkj fdlh ,d x.k e lekurk d vkèkkj ij cuk, x, leg dk leghdj.k ;k leg cukuk dgr gA leghdj.k e ,d oLr nk ;k nk l vfèkd legk e vk ldrh gA

uhp bUgh oLrvk dk leghdr dju dk ,d vkj rjhdk fn;k x;k gA



fp= Øekd&1 % oLrvk dk oxhdj.k

bl nlj rjhd e ,d fo'k"k idkj dk leghdj.k fd;k x;k gA ble iR;d Lrj ij ,l leg cuk, x, g ftudk vkèkkj x.k fo'k"k dh mifLFkfr o vuifLFkfr gA bl idkj l fd, x, leghdj.k dk oxhdj.k dgr gA

ble ge oLrvk dk oxk e ckVr gA ,d ox dh lHkh oLrvk e vfèkd l vfèkd lekurk, gkrh g vkj mUg vU; ox e ugh j[kk tk ldrk gA

leghdj.k o oxhdj.k dk mi;kx ge lHkh fo"k;k e djr g] tl fd inkFkk dk] foy;uk dk] feêh dk] cyk dk] thok dk oxhdj.kA bu lHkh d ckj e vki vxy vè;k;k e i<xA bl vè;k; e ge thok d oxhdj.k dk vè;;u djxA

vkb,] ge ;g tkuu dk i;kl djr g fd thok dh fofoèkrkvk vkj lekurkvk d vkèkkj ij mudk oxhdj.k le; d lkFk fdl rjg vkx c<kA

1.3 leghdj.k ,o oxhdj.k d io i;kl (Former attempts of grouping and classification)

,frgkfld nLrko tk l ge irk yxrk g fd loiFke vjLr u thok dk mud vkokl d vkèkkj ij leghdr dju dk i;kl fd;k FkkA bl vkèkkj ij mUgku thok d tyh; o LFkyh; tl leg cuk, FkA

vjLr d ckn thok d oxhdj.k d vkj Hkh i;kl g, gkx ijr gekj ikl dN i;kk d ckj e gh tkudkjh miyCèk gA

1686 e tku j u ikèkk d oxhdj.k e ikèkk d cká y{k.kk dk vkèkkj cuk;kA tku j d ckn djkyl yhfu;l uke d ,d oKkfud u nfu;kHkj d reke ikèkk dk oxhdr dju dk i;kl fd;kA yhfu;l u lcl egRoi.k dke ;g fd;k fd dN fof'k"V x.kk tl Qyk e uj o eknk vxk dh mifLFkfr o l[;k d vkèkkj ij ,d ljy oxhdj.k fn;kA bl yfxd oxhdj.k dgr gA bldk fooj.k mudh 1735 e idkf'kr iLrd ^^flLVek upj** e feyrk gA

yhfu;l u lthok dk oxhdr dju d fy, trvk o ouLifr;k d gtkjk ueuk dk ,df=r dj ryUkkRed vè;;u fd;k rFkk ,d ,lk oxhdj.k fodflr dju e lQy g, ftll trvk o ouLifr;k dh iR;d tkfr dk iFkd&iFkd oxhdr fd;k tk ldrk FkkA trvk o ouLifr;k dh 'kkjhfjd fo'k"krkvk d ckj e yhfu;l u 0;ofLFkr :i l tk Kku gkfly fd;k Fkk mldk lep tho&foKku ij xgjk vlj jgk gA bl i)fr e li.k tho&txr dk nk txr e ckVk x;k g& ikni txr ,o tr txrA

djkyl yhfu;l u oxhdj.k e lcl igy inkuØe 'kCn dk i;kx fd;k FkkA inkuØe og ifØ;k g ftle thok dk mud x.kk vkj fodkl d vkèkkj ij ,d fuf'pr Ük[yk d vrxr fofHkUu legk e 0;ofLFkr fd;k tkrk gA tl&

eu"; dk inkuØe (Linnaean hierarchy for man)

txr (Kingdom) & ,fuefy;k ¼cgdkf'kdh;] ;dfj;kfVd] vrxg.k ik"k.k fofèk½
l?k (Phylum) & dkMVk ¼d'k:d nM] tkMhnkj mikx½
ox (Class) & eefy;k ¼'kjhj jk, l <dk] ckád.k mifLFkr½

x.k (Order) & ik;eVl ¼vxB dh fLFkfr foijhr] vx o i'p ikn e ikp&ikp vxfy;k½

dy (Family) & gkekuhfM ¼f}ikn pyu½

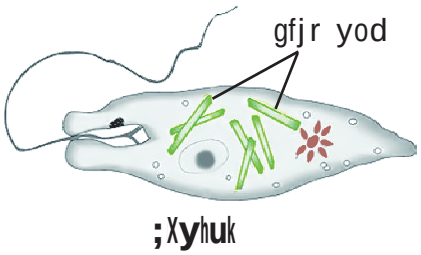
o'k (Genus) & gkek ¼lfodflr efLr"d½

tkfr (Species) & lfi;l

f}txr oxhdj.k e dN dfe;k FkhA tl fd bl oxhdj.k e yhfu;l u lHkh thok dk flQ nk oxk l lhekc) fd;kA ijr db ,l tho ik, x, tk ikni ,o tr nkuk d y{k.k n'kkr gA

D;k vki tkur g

;Xyhuk ,d ,lk tho g ftle tr vkj ikèk nkuk d y{k.k feyr gA ;g ,ddkf'kdh; tho gA ble gfjr yod ik;k tkrk gA ble dkf'kdk fHkfÙk dk vHkko gkrk gA ;g Loik"k.k rFkk fo"keik"k.k nkuk idkj l Hkk tu ikIr dj ldrk gA



yhfu;l dh tkudkjh d nk;j e dkf'kdkvk ,o mudh vkrfjd ljpukvk d lnHk e dkb tkudkjh ugh FkhA le; d lkFk l{en'kh dh vkoèku {kerk c<ku d vkfo"dkj gkr jg] ftl l thok e fofoèkrk dk vkj xgu vè;;u lHko gvkA vr% yhfu;l thok dh dkf'kdkvk dh vkrfjd ljpuk dk viu oxhdj.k e LFkku ugh n ik,A

tl&tl dkf'kdkvk dh vkrfjd ljpuk d fo"k; e tkudkjh c<rh xb ,o u; thok dk irk pyrk x;k ol&ol oxhdj.k d u; vkèkkj feyr x,A bld lkFk gh oxhdj.k d u; rjhd Hkh [kkt x,A ,lk gh ,d oxhdj.k 1969 e vkj-,p- f0gVdj u fn;kA

f0gVdj u li.k tho&txr dk ikp txr e oxhdr fd;kA bl oxhdj.k d e[; vkèkkj Fk&

1- dUnd f>Yyh dh vuifLFkfr o mifLFkfr ¼ikdfj;kfVd o ;dfj;kfVd½

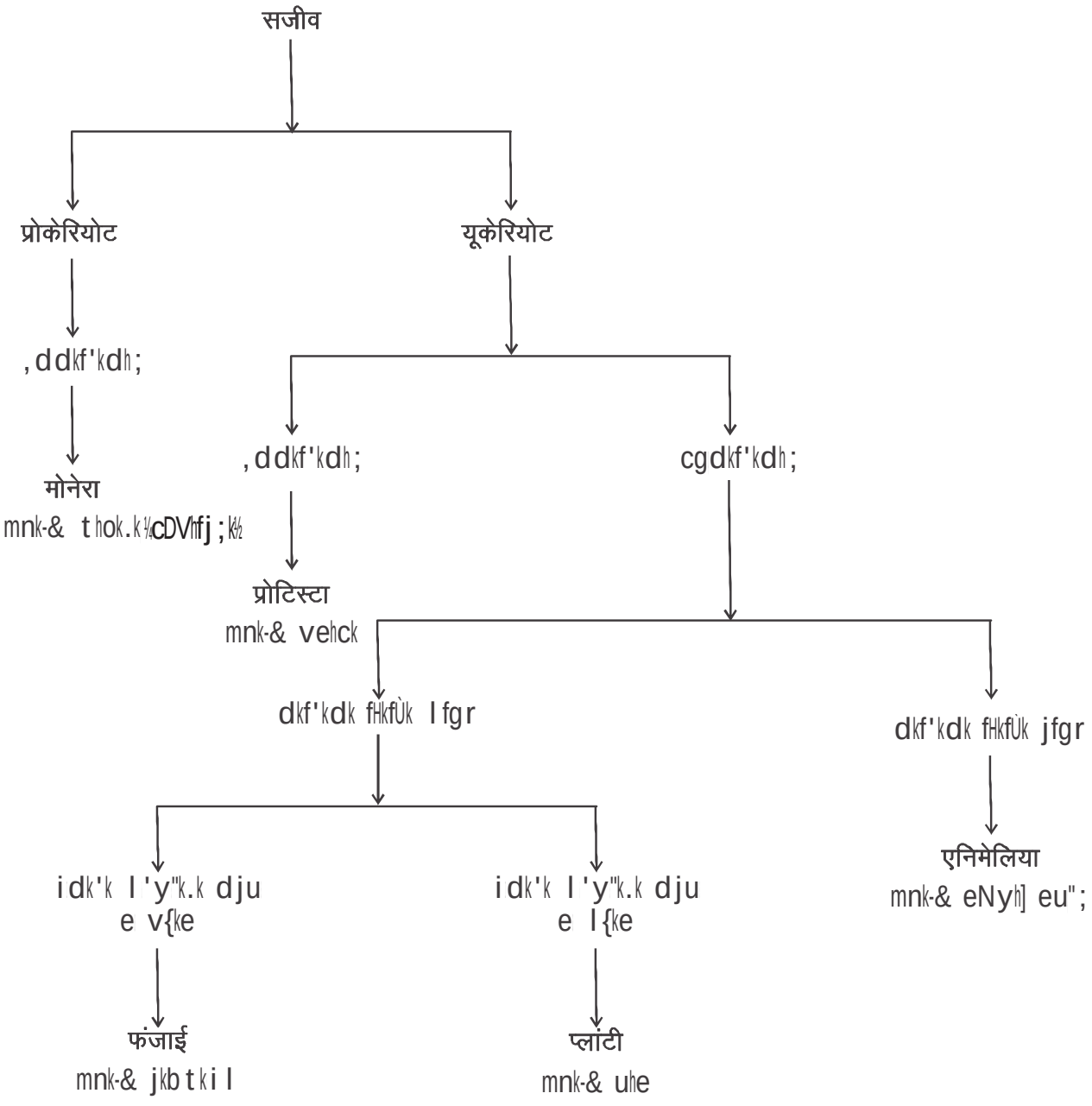
2- lxBu dk Lrj ¼,ddkf'kdh; o cgdkf'kdh;½

3- ik"k.k ikIr dju dh fofèk ¼Loik"kh o fo"keik"kh½

1-4 f0gVdj dk oxhdj.k (Whittekar's classification)

io i)fr;k dh vi{kk oxhdj.k dh ^^ikp txr** dh i.kkyh vfèkd fodflr irhr gkrh gA ble thok dh fofoèkrk ij vkj vfèkd cgrj rjhd l fopkj fd;k x;k gA bl i.kkyh e li.k tho&txr dk fuEufyf[kr ikp txr e oxhdr fd;k x;k gA

1- txr ekujk 2- txr ikfVLVk 3- txr Qtkb
4- txr lykVh 5- txr ,fuefy;k



fp= Øekd&2 % oxhdj.k dh ,d ;ktuk

1-4-1 txr ekujk (Kingdom monera)

1- ekujk txr d vrxr lHkh ,ddkf'kdh;] f>Yyh jfgr dUnd ;kuh ikdfj;kfVd dkf'kdk oky tho vkr gA

2- bl txr d tho Loik"kh ;k fo"keik"kh nkuk idkj d gk ldr gA

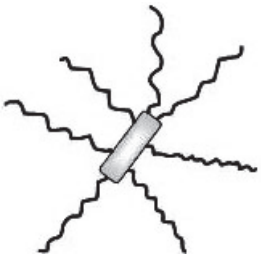
3- budh dkf'kdk f>Yyh d pkjk vkj dkf'kdk fHkfÙk gkrh gA

4- budh dkf'kdk fHkfÙk ikèkk dh dkf'kdk fHkfÙk l fHkUu idkj dh gkrh gA ;g e[;r% iflVMkXykbdu ¼ikVhu ,o dkckgkbMV l cuk inkFk½ l cuh gkrh gA

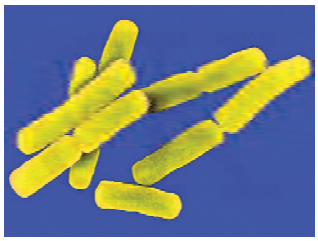
mnkgj.k& thok.k o ,ukchuk

D;k vki tkur g

,d xke mitkÅ feVVh e yxHkx 1 vjc rFkk yxHkx 1 feyhyhVj rkt nèk e 30 vjc thok.k ik, tkr gA



b- dkykb



cflyl ,Fkfll

¼v½ thok.k

¼c½ lk,ukcfDVfj;k ¼,ukfcuk½

fp= Øekd&3

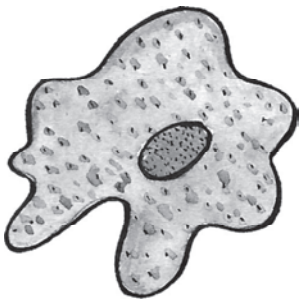
1-4-2 txr ikfVLVk (Kingdom Protista)

1- ikfVLVk txr d lHkh tho ,ddkf'kdh;] f>Yyh lfgr dUnd ;kuh ;dfj;kfVd dkf'kdk oky gkr gA

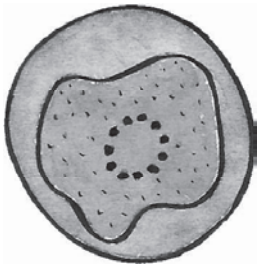
2- bl txr e Loik"kh o fo"keik"kh nkuk gh idkj d tho gk ldr gA

3- thou dh lHkh fØ;k, ,d gh dkf'kdk }kjk liUu gkrh gA

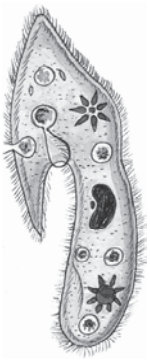
mnkgj.k& vehck] ijkehf'k;e] ,V vehck] ;XyhukA



¼v½ vehck



¼c½ ,V vehck



¼l½ ijkehf'k;e

fp= Øekd&4

- dkb ,d ,lk x.k crk, ftud vulkj ikfVLVk vkj ekujk dk vyx&vyx fd;k tk ldrk gA

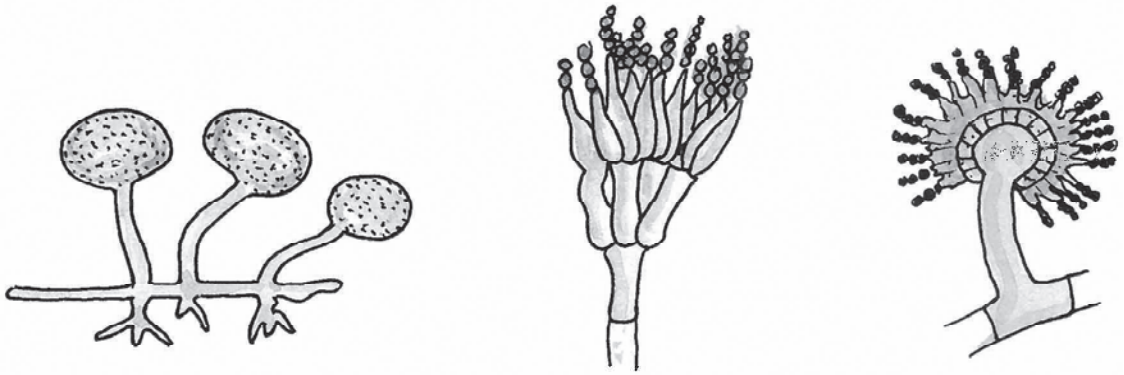
1-4-3 txr Qtkb ¼dod½ (Kingdom fungi)

1- vfèkdk'k dod rre;h gkr gA ; rrvk dk tky cukr g ftl dod tky ;k ekblhfy;e dgr gA

2- bl txr d tho ,ddkf'kdh; ,o cgdkf'kdh;] ;dfj;kfVd o fo"keik"kh gkr gA

3- budh dkf'kdkvk e gfjr yod ¼Dykjkl ykLV½ ugh ik;k tkrk gA

mnkgj.k& E;dj] ;hLV] ,xfjdl ¼e'k:e½] jkbtkil ¼cM ekYM½] ,Liftyl] ifulhfy;eA



¼v½ jkbtkil ¼cM ekYM½ ¼c½ ifulhfy;e ¼l½ ,Liftyl

fp= Øekd&5

vkiu ueh;Dr Mcyjkvh ij] cjlkr d fnuk e peM d trk e rFkk dHkh&dHkh vpkj e tky;Dr ljpuk, n[kh gkxhA ;g Qtkb ¼dod½ gA ddjeRrk Hkh dod gA ; dod lgthoh] erkithoh rFkk ijthoh d :i e ik, tkr gA dN dod gkfudkjd gkr g rk dN ykHknk;d Hkh gkr gA dN dod jkx mRiUu djr g rk dN dod tl ;hLV dk mi;kx jkVh ¼cM½ ;k fc;j cuku d fy, fd;k tkrk gA lkFk gh dN dodk l ifrtfod ¼,Vhck;kfVd nok½ Hkh cuk, tkr gA

- ge viu Hkktu dk jfÝtjVj e D;k j[kr g\

D;k vki tkur g

ykbdu dod vkj 'koky dh lgthfork l cuk ,d lenk; gA ble nkuk tho bruh ?kfu"Brk l vkil e tM gkr g fd ; ,d gh tho irhr gkr gA 'koky dh idk'k l'y"k.k dh fØ;k e cu Hkktu dk mi;kx dod dj yr gA dod d }kjk vo'kkf"kr ty vkj [kfut yo.k 'koky dk ikIr gk tkr gA fyVel ,d idkj d ykbdu l gh cur gA

ykbdu

1-4-4 txr lykVh ¼ikni½ (Kingdom Plantae)

1- ikni txr d lHkh tho cgdkf'kdh; o ;dfj;kfVd dkf'kdk oky gkr gA

2- vfèkdk'k ikèkk dh dkf'kdkvk e gfjr yod ik;k tkrk g ftll ; ikèk idk'k l'y"k.k dh fØ;k djd HkkT; inkFkk dk fuek.k djr gA vFkkr ; Loik"kh gkr gA

3- bue lyykt dh cuh dkf'kdk fHkfÙk ikb tkrh gA

mnkgj.k& Likbjkxkbjk ¼'koky½*] ¶;ufj;k ¼ekl½**] Qu***] lkbdl] [ktj] uhe] èkkuA

Likbjkxkbjk

¶;ufj;k

ekjdf'k;k

Qu

lkbdl

uhe

ukfj;y

ukxQuh

fp= Øekd&6

*f0gVdj u 'kokyk dk lykVh txr e 'kkfey fd;k gA vU; iknik dh rjg 'koky d 'kjhj e tM] ruk o iÙkh e foHknu ugh fd;k tk ldrk gA ckfj'k d fnuk e vkiu unh o rkykck d fdukj o Q'k ij pednkj gjh ijr teh gb n[kh gkxhA bl ge LFkkuh; Hkk"kk e dkb dgr gA ;gh 'koky gA

**¶;ufj;k ¼ekl½& bldk 'kjhj e[; :i l ifÙk;k rFkk tM tlh ljpuk] jkbtkbMl dk cuk gkrk gA jkbtkbMl }kjk ty o [kfut yo.kk dk vo'kk"k.k fd;k tkrk gA bl rjg d ikèkk dk ck;kQkbVk leg e j[kk x;k gA bl leg d vkj mnkgj.k g& fjfDl;k] ekdf'k;kA

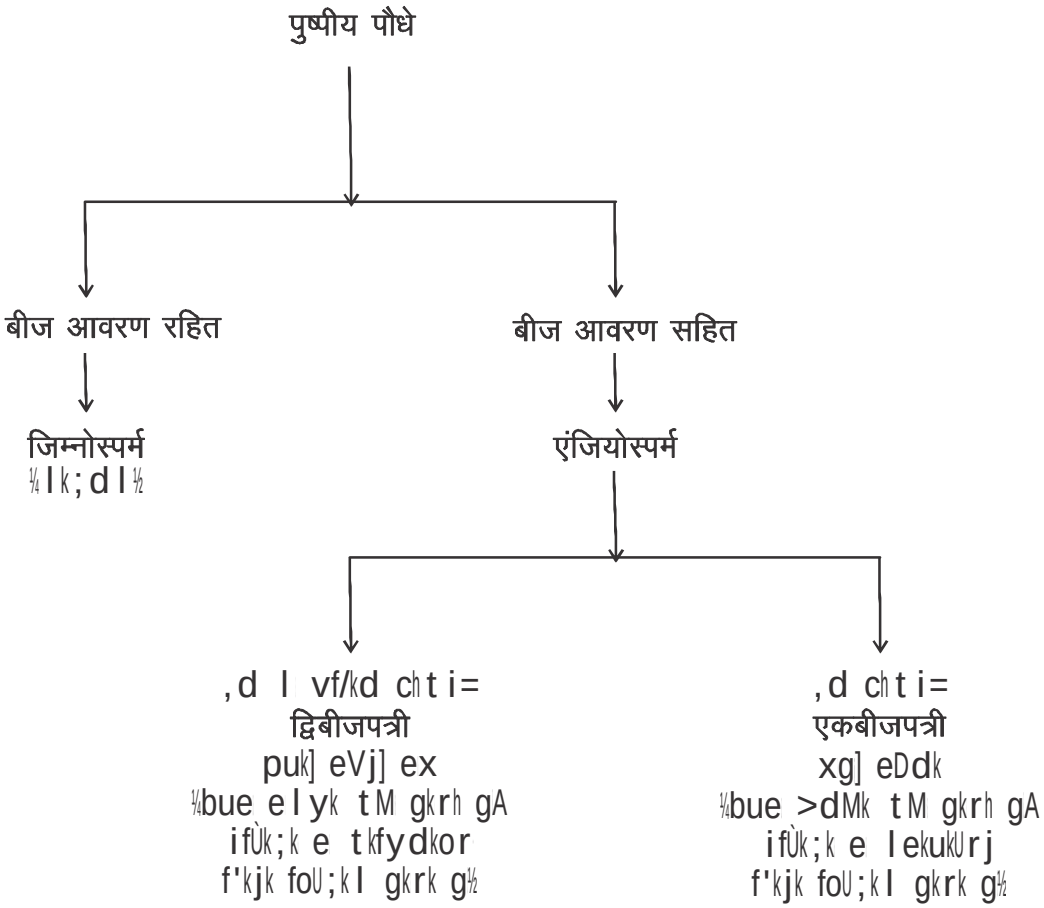
***Qu ,d vU; idkj dk ikèkk g ftl vki viu ifjo'k e Hkh <<u dk i;kl djA ;g VfjMkQkbVk ox dk ,d ikèkk gA bl ox d vfèkdk'k iknik e i"ih; iknik dh rjg gh 'kjhj dk foHkktu gkrk gA vFkkr bu iknik dk 'kjhj tM] ruk o iÙkh e foHkkftr gkrk g rFkk bue logu Ård Hkh ik;k tkrk gA ijr bl ox d ikni vi"ih; gkr g vrh ; cht mRiUu ugh dj ldrA eklhfy;k bl leg dk ,d vU; mnkgj.k gA

D;k vki tkur g

vejcy lykVh txr dk ,d lnL; gA ;g ,d ijthoh ikèkk g tk nlj ikèkk d ru l fyiVk gkrk gA ble i.kgfjr ugh ik;k tkrk gA ;g nlj ikèkk l viuk Hkkstu ikIr djrk gA bld fy, vejcy e fo'k"k idkj dh tM ikb tkrh g tk vU; ikèkk l Hkkstu dk vo'kkf"kr djrh gA

vejcy

ikni txr d oxhdj.k dk ,d mnkgj.k i"ih; ikèkk d lnHk e&



fp= Øekd&7¼ i"ih; ik/kk dk oxhdj.k

- vki viu vklikl ik; tku oky dN ikèkk t l vke] èkku] egvk] ?kkl] eDdk vkfn dh ifÙk;k dk voykdu djA mudh tMk d idkj ,o f'kjk foU;kl e D;k lcèk feyrk g\ fy[kA

1-4-5 txr ,uhefy;k ¼tr txr½ (Kingdom Animalia)

1- bl txr d tho cgdkf'kdh;] ;dfj;kfVd ,o fo"keik"kh gkr gA

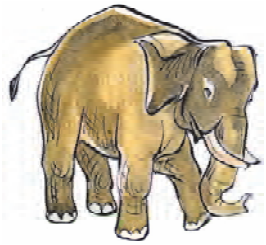
2- budh dkf'kdkvk d pkjk vkj dkf'kdk fHkfÙk ugh ikb tkrh gA

3- budh dkf'kdkvk e gfjr yod ugh ik;k tkrk gA

4- bu thok e ik"k.k vrxg.k }kjk gkrk gA bue Hkk tu dk xg.k dju d fy, fof'k"V vx gkr gA tl frryh e jl plu dh uyh] eu"; e eg] if{k;k e pkp vkfnA

5- vfèkdk'k trvk e ipyu vx ik, tkr gA

mnkgj.k& 'kj] euk] eNyh] eu";] gkbMk] Qhrkdfe] dpvk] ?kk?kk] fcPN] fl rkjk eNyh vkfnA



gkFkh

Mxu ¶ykb

rkrk

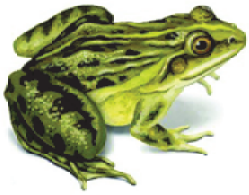
piVk dfe

tkd

eNyh

?kk?kk

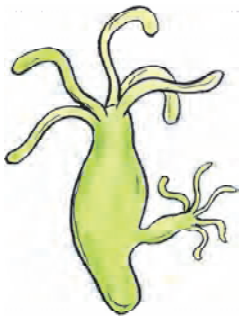
lhih



e<d

lki

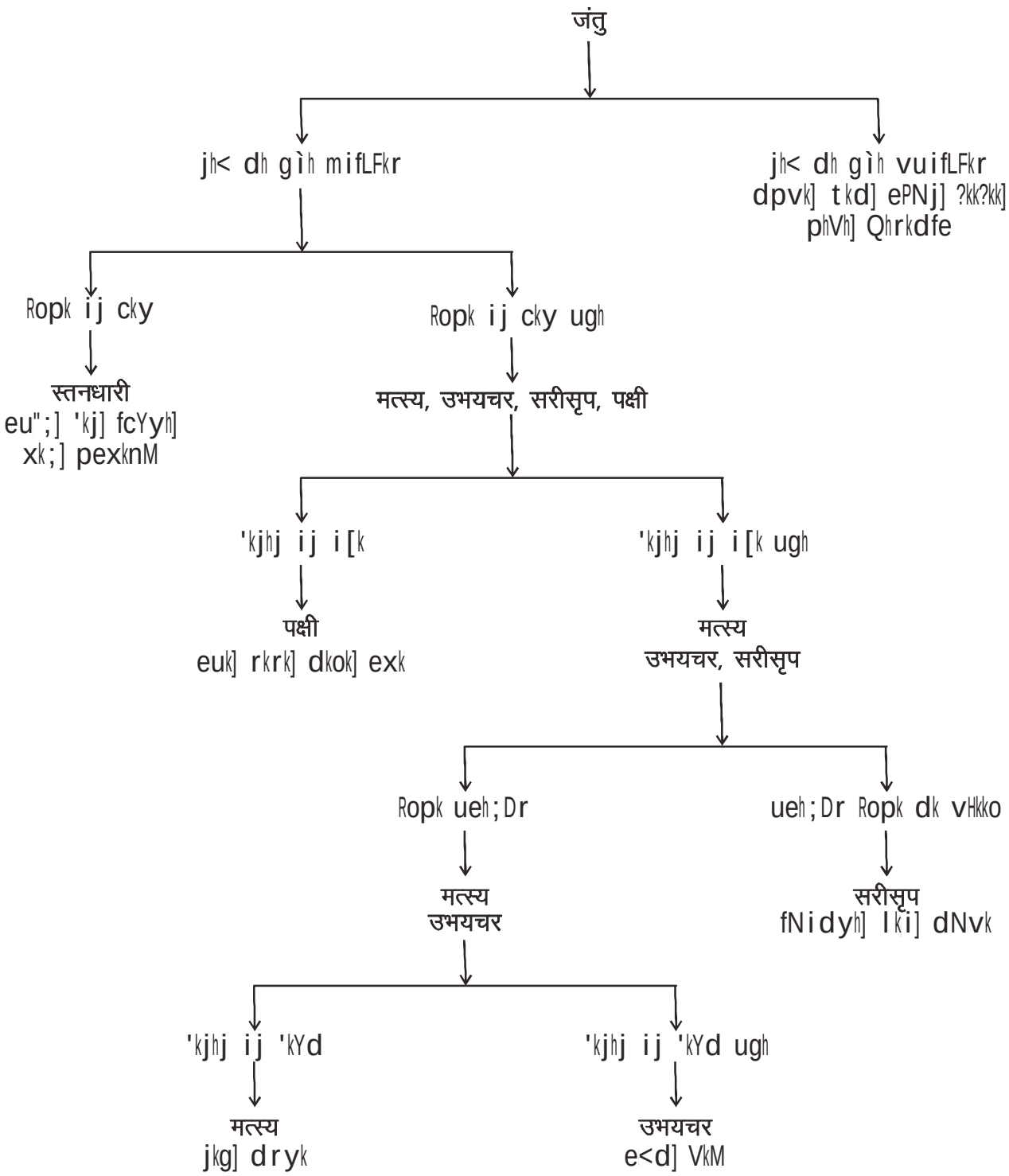
pexknM



gkbMk

fp= Øekd&8

tr txr dk ,d oxhdj.k jh< dh gMMh oky trvk d lnHk e&



fp= Øekd&9 tr txr dk oxhdj.k

- eRL; o Lruèkkjh e ,d ie[k vrj fy[kA

1.5 ukedj.k dh vko';drk ,o ifØ;k

fdlh Hkh tho dk oxhdj.k e LFkku fuèkkfjr djd ml ,d fuf'pr uke nuk ukedj.k dgykrk gA

fdlh Hkh oLr ;k tho dk fofHkUu {k=k e LFkkuh; Hkk"kk o ckyh d vulkj idkjk tkrk gA tl vky dk rfey e m:yfdyd gx] ejkBh e cVkVk] fgUnh e vky rFkk vxth e ikVVk dgk tkrk gA

,d gh oLr d bru lkj uke l igpku e vlfoèkk gkrh gA blh vlfoèkk dk n[kr g, yhfu;l u thok d ,l uke dh vko';drk egll dh ftl lkj llkj e ,d gh uke l idkjk tk,A bu uke dk mUgku oKkfud uke dgkA ftle iR;d tho dk uke nk 'kCnk e j[kk tkrk gA bl f}uke i)fr dgk tkrk gA bl i)fr e&

1- iR;d tho d uke e igyk 'kCn o'k rFkk nljk 'kCn tkfr dk gkrk gA

2- tho d o'k d uke dk igyk v{kj vxth d cM v{kj l rFkk vU; v{kj NkV fy[k tkr gA tkfr dk uke vxth d NkV v{kjk l fy[kk tkrk gA

3- o'k ,o tkfr d uke dk frjN v{kjk (Italic) e fy[kk tkrk gA ;fn ; uke lhèk v{kjk e fy[k tkr g rk mud uhp j[kk [kkpr gA

dN thok d oKkfud uke bl idkj g&

tho & oKkfud uke

e<d & *Rana tigrina*

'kj & *Panthera leo*

xkj;k & *Passer domestics*

eu"; & *Homo sapiens*

le;≤ ij idfr e itkfr;k dh foyflr ,o ub&ub itkfr;k dk fodkl ,d lrr pyu okyh ifØ;k gA blh dkj.k oxhdj.k dh dkb Hkh ,d i.kkyh lHkh thok dk lhekc) ugh dj ldrh gA f0gVdj dh ikp txr i)fr d fodflr gku d ckn Hkh db ub i.kkfy;k Hkh vkrh jgh gA ,lk irhr gkrk g fd ikp txr i.kkyh Hkh Kkr to fofoèkrk dk leVu d fy, vi;kIr g D;kfd tl&tl u,&u, thok dh [kkt gkrh jgxh vkj to fofoèkrk d vk;ke cnyr tk,x] ol&ol gh oxhdj.k d vkèkkj Hkh cnyr tk,x ,o oxhdj.k dk Lo:i HkhA

e[; 'kCn (Keywords)

fofHkUurk, (variations)] to fofoèkrk (biodiversity)] leghdj.k (grouping)] oxhdj.k (classification)] y{k.k (characteristic)] tkfr (species)] o'k (genus)] ukedj.k (nomenclature)

geu lh[kk

- idfr e fofoèk idkj d inkFk o tho ik, tkr gA
- x.kk e lekurk d vkèkkj ij leg cuku dh ifØ;k leghdj.k dgykrh gA
- oKkfudk u thok dk mue ikb tku okyh lekurkvk ,o fofHkUurkvk d vkèkkj ij oxhdr fd;k gA
- oxhdj.k thok dh fofoèkrk o lekurk dk Li"V dju e lgk;d gkrk gA
- idfr e fofHkUu thok dk ,d lkFk] ljyrk] lxerk l ,o Øec) vè;;u d fy, oxhdj.k dh vko';drk gkrh gA
- yhfu;l u li.k tho&txr dk nk txr ¼ikni txr ,o trtxr½ e foHkkftr fd;k gA
- thok dk ikp txr e oxhdr dju d fy, fuEufyf[kr vkèkkjk dk è;ku e j[kk x;k g&
  1- dnd f>Yyh dh vuifLFkfr o mifLFkfr & ikdfj;kfVd o ;dfj;kfVd
  2- tho dk 'kkjhfjd lxBu& ,ddkf'kdh; o cgdkf'kdh;
  3- ik"k.k fofèk & Loik"kh o fo"keik"kh
- mi;Dr vkèkkj ij lHkh thok dk ikp txrk e ckVk x;k gA
  1- ekujk 2- ikfVLVk 3- Qtkb 4- lykVh 5- ,uhefy;k
- thok d 'kjhj dh jpuk e c<rh gb tfVyrkvk d vkèkkj ij bUg vkx vkj Øfed :i l oxk e j[kk x;k gA
- thok e ik, tku oky fofHkUu y{k.k oxhdj.k d inkuØe dk fuèkkfjr djr gA
- djkyl yhfu;l u f}uke i)fr dk ifriknu fd;k ftle tho dk oKkfud uke fn;k tkrk gA ble tho dk uke nk 'kCnk e gkrk g& igyk o'k ;k thul dk] nljk tkfr ;k Lih'kht dkA
- u,&u, thok dh [kkt ,o to fofoèkrk d cnyr vk;ke d vulkj oxhdj.k dk vkèkkj ,o Lo:i cnyr jgxA

vH;kl

1- lgh fodYi pu&

(i) oxhdj.k e&

¼v½ x.k dh igpku t:jh ughA

¼c½ ox d lnL;k e vf/kd l vf/kd lekurk gA

¼l½ leg d lnL;k e lekurk, ugh gkrhA

¼n½ dkb vk/kkj ugh gA

(ii) fuEu e l f}cht i=h ikèkk g&

¼v½ l;kt ¼c½ ?kkl

¼l½ dyk ¼n½ ljlk

(iii) eNyh ,o dcrj d chp ,d tlk feyu okyk y{k.k ugh g&

¼v½ èkkjkjf[kr 'kjhj ¼c½ vM nuk

¼l½ d'k:d nM dh mifLFkfr ¼n½ i[kk dh mifLFkfr

2- fjDr LFkku dh ifr dj&

(i) leghdj.k o ---------- dh ifØ;k e vkèkkj puuk vko';d gA

(ii) ---------- txr e ikdfj;kfVd thok dk 'kkfey fd;k tkrk gA

(iii) ikp txr oxhdj.k ---------- u fn;kA

3- Qtkb txr d dkb nk foHknd y{k.k fy[kA

4- mHk;pj ,o ljhli e dkb nk vrj fy[kA

5- Qtkb dh dkf'kdkvk e dkf'kdk fHkfÙk ikb tkrh g] fQj Hkh mUg lykVh txr d vrxr ugh j[kk tk ldrk D;k\ dkb ,d dkj.k fy[kA

6- li ,o dN, dk ,d lkFk j[ku dk D;k vkèkkj gA

7- ,l ikp ikèkk d uke crk, ftud cht e nk cht i= ik, tkr g\

8- oxhdj.k dh vko';drk D;k iMh\

9- f}ukei)fr l vki D;k le>r g\ bld vrxr thok d uke fdl idkj fy[k tkr g\ dkb nk mnkgj.k nA

10- pgk vkj pexknM e leku y{k.k dku&dku l g\ fy[kA

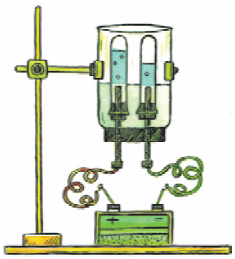
11- ikp txr oxhdj.k d D;k vkèkkj g\ o ikp txr dku&dku l g foLrkj l le>k,A

12- ^^vkèkkj cny tku ij oxhdj.k dk Lo:i Hkh cny tkrk gA** bl dFku l vki lger g ;k ugh\ dkj.k lfgr fy[kA

vè;k;&2

inkFk % iÑfr ,o 0;ogkj

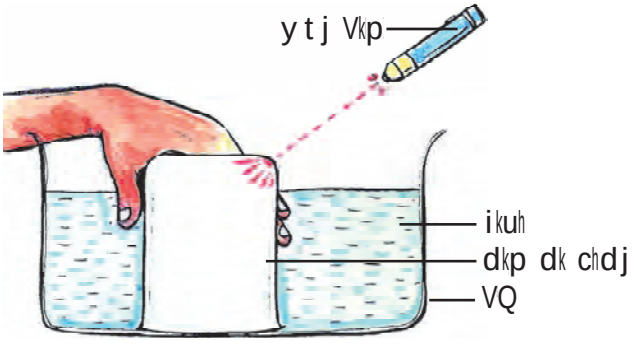
(Matter : Nature and Behaviour)



idk'k] ykg dh dhy] <kyd dh vkokt] dlh&Vcy] eLdku] Hkki vkfn mnkgj.kk e D;k vkidk dN lekurk, ;k vrj fn[kkb nrk g\ vkb,] bl le>u d fy, ,d fØ;kdyki dj&

fØ;kdyki&1

- ,d VQ ;k ckyVh y] ml ikuh l rhu&pkFkkb Hkj yA
- vc ,d dkp dk chdj vFkok fxykl y] ml myVkdj ikuh e fp= Øekd&1 d vulkj MkyA
- D;k ij chdj e ikuh Hkj x;k\
- D;k ;g chdj [kkyh g\
- vc bl chdj ij ytj Vkp l idk'k MkyA
- D;k idk'k dh fdj.k chdj d vnj tkrh g\



fp= Øekd&1 % inkFk LFkku ?kjrk g

vkb,] vc ge le>u dh dkf'k'k dj fd chdj d vnj ikuh D;k ugh x;k rFkk idk'k D;k tk ldk\ chdj e ,lk D;k Fkk ft lu ikuh dk vnj ugh tku fn;k\ ge tkur g fd gok] ikuh] dlh&Vcy bR;kfn LFkku ?kjr gA blh dkj.k chdj e mifLFkr gok d }kjk LFkku ?kju d dkj.k ikuh chdj e ugh x;kA

vkiu vuHko fd;k gkxk fd ikuh l Hkjh ckry] [kkyh ckry dh vi{kk vfèkd Hkkjh gkrh gA fdlh oLr dk Hkkj mle n0;eku d dkj.k gkrk gA ykg dh dhy] dlh&Vcy] Hkki ftudk mYy[k fd;k x;k g] LFkku ?kjr g rFkk mue n0;eku gkrk gA tcfd idk'k] <kyd dh vkokt] eLdku vkfn e n0;eku ugh gkrk vkj u gh o LFkku ?kjr gA bl dkj.k idk'k] chdj d vnj tk ldkA tk oLr, LFkku ?kjrh g rFkk ftue n0;eku gkrk g mUg inkFk dgr gA pfd <kyd dh vkokt] eLdku] idk'k e ;g x.k ugh ik;k tkrk blfy, ; inkFk ugh gA

vc vki crk ldr g fd gok] ikuh rFkk idk'k e l dku l inkFk g vkj dku l ugh\

ukV %& ytj Vkp dk idk'k vk[kk dk udlku igpk ldrk g blfy, bldk mi;kx lko/kkuh iod f'k{kd d ekxn'ku e gh djA

T7C1XX

2.1 n0;eku dk lj{k.k (Conservation of mass)

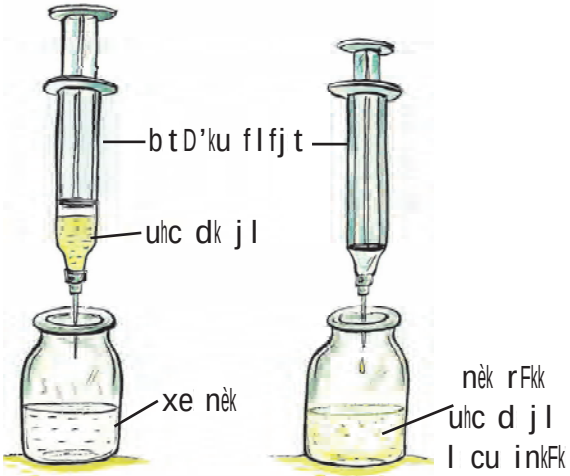
vki viu vkl&ikl ik, tku oky inkFkk ij è;ku n rk mue dN ifjoru gkr fn[kkb nr g tk jx] xèk] voLFkk e vk, cnyko d }kjk igpku tkr gA

vkb,] bl ,d mnkgj.k }kjk le>] tc ge ,d ekecÙkh dk tykr g rk dN nj ckn og ijh ty tkrh gA lkfp,] fd ekecÙkh d inkFkk ¼eke rFkk èkkx dh cÙkh½ dk D;k gvk gkxk\ cgr le; rd ;g ekuk tkrk Fkk fd og tydj lekIr gk tkrh gA tc bl le>u dk i;kl fd;k x;k rc ;g Li"V gvk fd ekecÙkh dk tyuk ,d jklk;fud fØ;k g ftle eke d vfrfjDr vkDlhtu Hkh Hkkx yrh g vkj fØ;k d i'pkr dkcu MkbvkDlkbM rFkk tyok"i mRikn d :i e ikIr gkr g] ftudh igpku io e ugh dh tk ldh FkhA tc lHkh vfHkdkjdk dk dy n0;eku Kkr fd;k x;k rc og mRiknk d dy n0;eku d cjkcj ik;k x;kA bll igyh ckj ;g Li"V gvk fd jklk;fud vfHkfØ;k e Hkkx yu oky vfHkdkjd] mRikn e cnyr g] o u"V ugh gkr gA

,lk gh db vU; jklk;fud vfHkfØ;kvk d vè;;u e Hkh ik;k x;k fd vfHkdkjdk dk dy n0;eku cuu oky mRiknk d dy n0;eku d cjkcj gkrk gA

bl Hkh dj

- btD'ku dh [kkyh] lkQ 'kh'kh e 10 mL xe nèk Mkydj mldk <Ddu yxk nA
- btD'ku flfjt e 2 mL uhc dk jl yA
- bl fp= *d* d vulkj btD'ku dh 'kh'kh d <Ddu e 0;ofLFkr dj ij midj.k dk otu ukV djA è;ku jg fd 0;oLFkk bl idkj dh gk fd nèk rFkk uhc dk jl vkil e u feyA
- vc flfjt e j[k uhc d jl dk èkhj&èkhj fiLVu }kjk 'kh'kh e MkyA
- 'kh'kh e j[k nèk e gku oky ifjoru dk voykdu djA
- D;k vki lkpr g fd ;gk dkb jklk;fud vfHkfØ;k gb g\
- vc ij midj.k dk otu iuh Kkr dj ukV dj ¼fp= [k½A
- D;k i;kx d igy rFkk ckn e midj.k d otu e dkb ifjoru gvk\



¼d½ fØ;k d igy ¼[k½ fØ;k d ckn inkFk vfouk'kh gkrk g

ukV % bl i;kx l lgh fu"d"k rHkh ikIr gkxk tc ekiu gr fy, x, midj.k }kjk 'k)rkiod ekiu fd;k tk ldA

bl le> dk ,d fu;e d :i e 0;Dr fd;k x;k % fdlh jklk;fud vfHkfØ;k e n0;eku dk u rk mRiUu fd;k tk ldrk vkj u gh u"VA bl inkFk dh vfoukf'krk dk fu;e ;k n0;eku lj{k.k dk fu;e dgr gA bl fu;e dk yokbft, u ifrikfnr fd;k FkkA

yokbft, (Lavoisier) dk ;kxnku

inkFk dh idfr dk le>u dk i;kl lfn;k l pyk vk jgk gA yfdu vkèkfud midj.kk d vHkko e db Hkkfr;k cuh jghA ,d le; ekU;rk ;g Fkh fd ,d inkFk dk nlj e :ikrfjr fd;k tk ldrk g mnkgj.k d fy, tc dkp d cru e vfèkd ek=k e ikuh dk vklou fd;k x;k rc vklou d i'pkr cru e jr tl d.k ik, x,A vr% ;g ekuk x;k fd ty dk cgr nj rd xe dju ij og enk e :ikrfjr gk tkrk gA ;g le> gekjh vkt dh jklk;fud vfHkfØ;kvk dh le> l fHkUu FkhA

yokbft, u blh i;kx dk nkgjk;kA mUgku dkp d ij midj.k dk i;kx d io lkoèkkuhiod rkyk rFkk ikuh d vklou d i'pkr iu% rkykA mUgku n[kk fd dkp d midj.k d n0;eku e dN deh vk jgh g vkj ;g deh mu jr tl d.kk d n0;eku d cjkcj gA rc og igpku ik, dh ml fdLe dk dkp FkkMk ikuh e ?ky tkrk g vkj ikuh d okf"ir gk tku ij mld d.k nku d :i e iklr gkr g vFkkr o ;g fu"d"k fudky ik, fd ikuh dk enk e :ikrj.k ugh gkrk gA bld ckn gh ge jklk;fud vfHkfØ;kvk dh vkèkfud le> dh rjQ c< ik,A

i'u

1- fuEufyf[kr e l inkFkk dk igpkfu,&

ikuh] gok] dlh] iRFkj] Qy dh lxèk] ykgk] fopkj

2- ,d vfHkfØ;k e 20 g A rFkk 40 g B d l;kx l 25 g C, 15 g D rFkk 20 g E curk gA bu i{k.kk }kjk n0;eku lj{k.k fu;e dk le>kb,A

2.2 gekj pkjk vkj d inkFk (Matter around us)

D;k vkiu dHkh jr e pcd ?kekdj n[kk g\ ,lk dju ij ykg d d.k] jr l vyx gk tkr gA blh rjg cru e j[kk gvk ikuh tc mM tkrk g rk lQn jx d d.k cru e fn[kkb nr gA vr% ge dg ldr g fd gekj vkl&ikl ikb tku okyh vfèkdrj oLr, ,d l vfèkd inkFkk dk feJ.k g ftUg ge vyx dj ldr gA

lenh ty Hkh ty rFkk mle ?ky yo.kk dk feJ.k gA lenh ty e ?ky g, yo.k ¼lkfM;e Dykjkb M½ dk ok"ihdj.k ;k vklou fofèk }kjk ty l iFkd fd;k tk ldrk gA blh idkj 'khry i;] 'kDdj] ued rFkk dkcu MkbvkDlkbM dk ty e feJ.k g] ftld vo;ok dk Hkkfrd fofèk;k }kjk iFkd fd;k tk

ldrk gA vr% ge dg ldr g fd feJ.k e ,d l vfèkd inkFk ¼vo;o½ gkr g rFkk ftUg lkekU;r% lkèkkj.k Hkkfrd fofèk;k }kjk vyx fd;k tk ldrk gA tc ge feJ.k dk le>u dk i;kl djr g rk n[kr g fd feJ.k fHkUu&fHkUu idkj d gkr gA

2.3 feJ.k d idkj (Types of mixture)

vo;ok dh i—fr vkj mudh vkil e fØ;k d vkèkkj ij fofHkUu idkj d feJ.k cur gA vkb,] bl fØ;kdyki }kjk le>&

fØ;kdyki&2

- d{kk d fo|kFkh ^d*] ^[k*] ^x*] ^?k* legk e cV tk,A
- leg *d* chdj e 100 mL ty ydj mle ,d pEep ued feyk,A
- leg *[k* chdj e 100 mL ty ydj mle ,d pEep 'kDdj feyk,A
- leg *x* chdj e 100 mL ty ydj mle ,d pEep pkd ikmMj feyk,A
- leg *?k* chdj e 100 mL ty ydj mle 10 mL [kku dk ry feyk,A
- iR;d leg dkp dh NM dh lgk;rk l chdj d inkFkk dk feyk, rFkk mld ckn ml dN nj d fy, fLFkj NkM nA
- lHkh leg chdjk e j[k ueuk dk voykdu dj fuEufyf[kr i'uk d mÙkj n&
  - fdl&fdl chdj e vo;o ijh rjg l fefJr gkdj ,d lkj fn[kkb n jg g\
  - fdl&fdl chdj e vo;oh inkFk vc Hkh vyx&vyx fn[kkb n jg g\

vkiu n[kk fd leg ^d* rFkk ^[k* dk ,lk feJ.k ikIr gvk ftld vo;o ijh rjg l ,d lkj ¼leku :i l forfjr½ fn[kkb n jg gA ,l feJ.kk dk lekxh feJ.k dgr gA

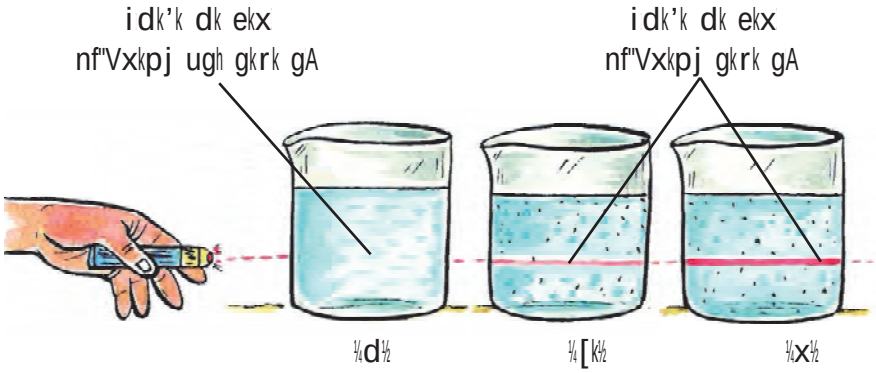
leg ^x* rFkk ^?k* dk tk feJ.k ikIr gvk g mle vo;oh inkFk vyx&vyx fn[kkb n jg g vFkkr leku :i l forfjr ugh g] ,l feJ.kk dk fo"kekxh feJ.k dgr gA

vkb,] lekxh rFkk fo"kekxh feJ.k d x.kk dk tkuu d fy, ,d fØ;kdyki dj&

fØ;kdyki&3

- d{kk d fo|kFkh iu% leg ^d*] ^[k* vkj ^x* e cV tk,A
- leg *d* chdj e 100 mL ty ydj] 1 pEep ued feyk,A
- leg *[k* chdj e 100 mL ty ydj] 1 ;k 2 cn nèk ;k L;kgh feyk,A
- leg *x* chdj e 100 mL ty ydj] 1 pEep pkd ikmMj feyk,A
- iR;d leg dkp dh NM dh lgk;rk l inkFkk dk ty e vPNh rjg feyk, rFkk voykdu dj fd fdl chdj e d.k ty e vyx&vyx fn[kkb n jg g\

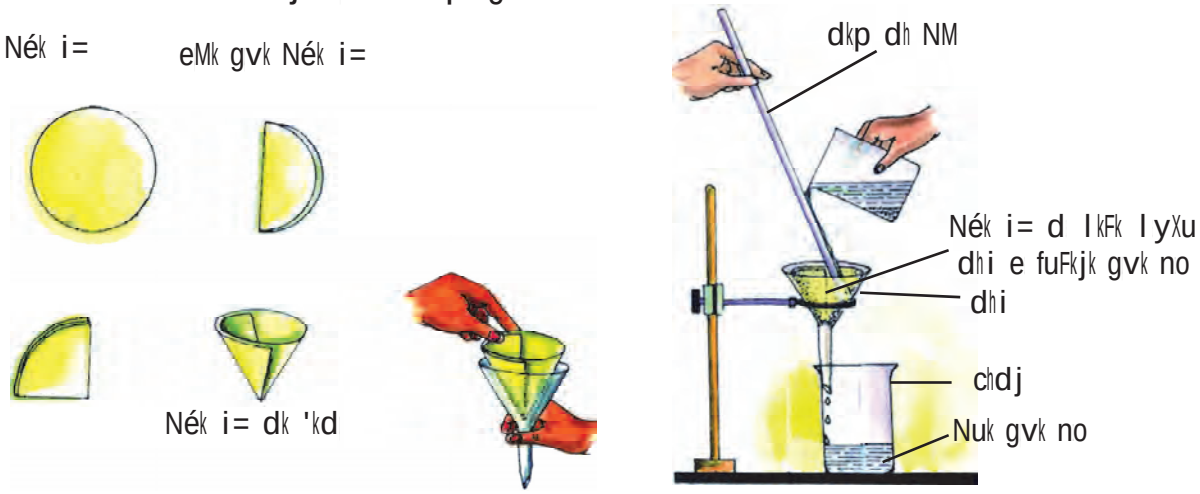
- vc ytj Vkp l idk'k dh fdj.k dk Øe'k% *d*] *[*] *x* chdj ij Mky vkj ml idk'k fdj.k d ycor fn'kk l n[kA fdl&fdl chdj e idk'k fdj.k dk ekx ¼fp= Øekd&2½ fn[kkb n jgk g\



fp= Øekd&2

¼d½ ued dk foy;u ¼[k½ nèk rFkk ikuh dk feJ.k ¼x½ pkd ikmMj rFkk ikuh dk feJ.k

- vc rhuk chdj dk 15 feuV rd fLFkj NkM n fQj voykdu dj fd fdl&fdl chdj e feJ.k fLFkj g rFkk fdle dN le; ckn d.k uhp cBu yx g\
- rhuk chdj d feJ.kk dk vyx&vyx NUuk i= dh lgk;rk l Nku ¼fp= Øekd&3½ rFkk ukV dj fd fdl NUuk i= ij dN 'k"k cpk g\



fp= Øekd&3 ¼ Nkuu dh fofèk

bu rhuk feJ.kk d x.kk d vkèkkj ij ge dg ldr g fd&

- leg *d* d feJ.k e vo;ok d d.k fn[kkb ugh n jg g] bue idk'k dk iFk Hkh fn[kkb ugh n jgk gA bld vo;oh d.k ryh e ugh cBr g vkj mUg Nkudj vyx ugh fd;k tk ldrkA ,l feJ.k dk foy;u dgr g] bue vo;oh d.k leku :i l forfjr jgr gA

- leg *[k* d feJ.k e vo;ok d d.kk dk n[kk rFkk Nkuk ugh tk ldrk g vkj u gh dkb d.k ryh e cBrk g yfdu leg *d* d foijhr bl chdj e idk'k dk iFk fn[kkb nrk gA bl idkj d feJ.k dk dfyy ;k dkykbM dgr gA
- leg *x* d feJ.k e vo;oh d.kk dk Nkudj vyx dj ldr g lkFk gh dN nj j[ku ij ;g d.k ryh ij cB tkr gA bl chdj e d.k bru cM gkr g fd u flQ ; idk'k dh fdj.kk dk fc[kj nr g cfYd d.k fn[kkb Hkh nr gA ,l feJ.k dk fuycu dgr gA

fØ;kdyki 2 rFkk 3 d vkèkkj ij geu tkuk fd nk inkFkk dk lekxh feJ.k foy;u dgykrk g rFkk fo"kekxh feJ.k dkykbM vFkok fuycu gkrk gA

vkb,] foy;u] dkykbM rFkk fuycu dk foLrkj l le>A

2.4 foy;u D;k g\ (What is a solution?)

ge viu nfud thou e uhc d 'kjcr] lkMkokVj vkfn foy;uk dk mi;kx djr gA lkekU;r% foy;u nk Hkkxk& foyk;d rFkk foy; l feydj curk gA foy;u dk og vo;o ftldh ek=k nlj vo;o l vfèkd gkrh g rFkk tk nlj vo;o dk Lo; e feykrk g ml foyk;d rFkk ftldh ek=k de gkrh g rFkk foyk;d e ?kyrk g ml foy; dgr gA foy; Bkl] no ;k xl gk ldr gA foy;u e foy; rFkk foyk;d d d.kk dk ,d leku forj.k gkrk gA bl idkj ,d leku forj.k gku d dkj.k ;fn bl foy;u d fdlh Hkh NkV Hkkx dh tkp dj rk ge ,d leku x.k ikIr gkr g vFkkr ,l feJ.k lekxh feJ.k gkr g mnkgj.k d fy, ued rFkk ikuh dk foy;u gj Lrj ij leku Lokn j[krk gA

pkV yxu ij yxk;k tku okyk fVDpj vk;kMhu] ,Ydkgky ¼foyk;d½ e cuk vk;kMhu ¼foy;½ dk foy;u gA lkekU;r% ge ;g ekur g fd foy;u e fdlh no e Bkl] no ;k xl ?kyh jgrh g yfdu xlh; foy;u ¼gok&vkDlhtu 21%] ukbVk tu 78% rFkk vU; xlk dh vYi ek=k½ rFkk Bkl foy;u ¼feJ èkkr½ Hkh ik, tkr gA

feJ èkkr, (Alloys)

feJ èkkr,] èkkrvk d ,l lekxh feJ.k g ftud vo;ok dk Hkkfrd fofèk;k d }kjk vyx ugh fd;k tk ldrk yfdu bUg feJ.k ekuk tkrk g mnkgj.k d fy, ihry (brass) e 60&80% rkcck rFkk 20&40% tLrk gkrk gA feJ èkkr, ftu vo;ok l feydj curh g mud x.kk dk n'kkrh gA

2.4.1 foy;u d x.k (Properties of a solution)

- foy;u d vo;ok dk foy; vkj foyk;d dgr gA ,d foy;u e ,d l vfèkd foy; gk ldr gA
- foy;u e ml d vo;o] ijek.k ;k v.k d Lrj rd ,d leku :i l fefJr gkr g vFkkr bud d.k vR;r NkV gkr gA

- vR;r NkV gku d dkj.k bu d.kk dk u rk Nkuk tk ldrk g vkj u gh ; d.k bru Hkkjh gkr g fd uhp ryh ij cB ik,A
- viu NkV vkdkj d dkj.k ;g d.k idk'k dh fdj.kk dk ugh Qyk ldr blfy, foy;u e idk'k dk iFk fn[kkb ugh nrkA

2-4-2 foy;u d idkj (Types of a solution)

foy;u e mifLFkr foy; inkFk dh ek=k d vkèkkj ij foy;u dk oxhdr fd;k tk ldrk gA vkb,] bl fØ;kdyki }kjk le>A

fØ;kdyki&4

- nk chdj e 100&100 mL ty yA
- ,d chdj e ,d pEep ued rFkk nlj e ,d pEep 'kDdj Mky rFkk foy;u dk dkp dh NM l fgyk,A
- vc nkuk chdj e Øe'kh ued o 'kDdj rc rd Mkyr tk, tc rd mudk ?kyuk cn u gk tk,A
- D;k ?kyu oky ued o 'kDdj dh ek=k, leku g\
- vc nkuk chdj dk fLiV yi dh lgk;rk l xe dj] D;k vfoy; ued o 'kDdj ikuh e ?ky x,\
- vc nkuk chdj e Øe'kh ,d&,d pEep ued o 'kDdj vkj Mky] D;k o Hkh foy;u e ?ky x,\

bl fØ;kdyki l ;g fu"d"k fudyrk g fd ,d fuf'pr rki ij fdlh foyk;d e dkb foy; mruk gh ?kyrk g ftruh foyk;d dh {kerk gkrh gA fdlh fuf'pr rki ij foyk;d d fuf'pr vk;ru e vkj vfèkd foy; ?kkyuk lHko ugh gk rk og foy;u lrlr foy;u dgykrk gA foy; inkFk dh og ek=k tk ml rki ij lrlr foy;u e mifLFkr jgrh g mldh ?kyu'khyrk ;k foy;rk dgykrh gA ;fn foy;rk Lrj l de foy; fdlh foyk;d e ?kyk gk rk ml vlrlr foy;u dgr gA fØ;kdyki&4 e geu n[kk fd fdlh rki ij fdlh foy; d lrlr foy;u dk xe dju ij mle vkj vfèkd foy; ?ky ldrk gA vc vxj bl foy;u dk BMk dj rc ik;h ; vfrfjDr foy; ?kfyr voLFkk e gh jgrk gA bl foy;u dk ml rki ij vfrlrlr foy;u dgk tkrk gA vudy ifjfLFkfr;k feyu ij gh bl vfrfjDr foy; d jo cur g mnkgj.k&pk'kuh] 'kDdj dk ikuh e vfrlrlr foy;u gA

fØ;kdyki&4 d vkèkkj ij ge ;g Hkh dg ldr g fd ,d fuf'pr rkiØe ij vyx&vyx inkFkk dh foy;rk fHkUu&fHkUu gk ldrh gA D;k foy;u e foy; inkFk dh ek=k d vkèkkj ij ml lkn ;k ru foy;u e foHkkftr fd;k tk ldrk g\ bld fy, ge foy;uk dh lknrk dk Kku gkuk vko';d gA vkb,] bl ge fØ;kdyki }kjk le>A

fØ;kdyki&5

- nk chdj y vkj mUg ^d* rFkk ^[k* ukekfdr dj] iR;d e 100 mL ikuh MkyA

- chdj *d* e ½ pEep rFkk chdj *[k* e 2 pEep ued MkyA
- nkuk chdj d foy;uk dk vPNh rjg dkp dh NM dh lgk;rk l feyk,A
- chdj *d* e foy; ¼ued½ dh ek=k chdj ^[k* d foy; l de gA vr% chdj *d* dk foy;u ru foy;u rFkk chdj ^[k* dk foy;u lkn foy;u g] ru o lkn ryukRed 'kCn gA

• Nutritional Facts g/100g	
Calories K cal	58
Protein	3.0
Carbohydrate	4.7
Fat	3.0
Saturate	1.8
Trans Fat	ND

fp= Øekd&4 % nèk e vo;ok dh ifr'kr lknrk

fdlh foy;u dh lknrk ek=kRed :i l 0;Dr dh tk, rk og ml foy;u dh nh gb ek=k ¼n0;eku ;k vk;ru½ e mifLFkr foy; dh ek=k gA

ge viu nfud thou e ,l db mnkgj.k n[kr g ftue foy;u dh lknrk dk mYy[k gkrk g tl nèk d idV ¼nèk d ifr 100 g e 3-0 g ikVhu] 4-7 g dkckgkbMV rFkk 3-0 g olk(fp= Øekd&4½] nokb dh ckry vkfn e Hkh vo;ok dh ifr'kr e lknrk nh tkrh gA

foy;u dh lknrk inf'kr dju d db rjhd gA mue l ,d g&

$$\text{foy;u dk n0;eku ifr'kr} = \frac{\text{foy; dk n0;eku}}{\text{foy;u dk n0;eku}} \times 100$$

mnkgj.k&1 % ,d foy;u d 520 g foyk;d ty e 40 g lkèkkj.k ued foy; g] foy;u dh lknrk Kkr djA

gy % foy; inkFk ¼ued½ dk n0;eku = 40 g

foyk;d ¼ty½ dk n0;eku = 520 g

foy;u dk n0;eku = foy; inkFk dk n0;eku $ foyk;d dk n0;eku

= 40 g $ 520 g

= 560 g

$$\text{foy;u dk n0;eku ifr'kr} = \frac{\text{foy; dk n0;eku}}{\text{foy;u dk n0;eku}} \times 100$$

$$= \frac{40}{560} \times 100 = 7.14\%$$

2-5 fuycu D;k g\ (What is a suspension?)

fØ;kdyki 3 e leg ^x* dk tk feJ.k ¼pkd dk ty e½ ikIr gvk og fuycu gA xnyk ty] dhpM dk] ty e ,lk gh feJ.k gA ble foy; d d.k ekè;e e ?kyr rk ugh g fdr ekè;e e fuyfcr

jgr gA ; fuyfcr d.k vk[kk l n[k tk ldr gA jr vkj ty dk feJ.k] gYnh vkj ty dk feJ.k vkfn Hkh fuycu d vU; mnkgj.k gA

ikIr voykduk l ge fuycu d fuEufyf[kr x.k igpku ldr g&

- fuycu ,d fo"kekxh feJ.k g D;kfd ;g vyx&vyx Hkkxk ij vyx&vyx l?kVu inf'kr djrk gA
- ble d.k bru cM gkr g fd mUg vk[kk l n[kk tk ldrk g vkj ;g idk'k dk Qykr gA ftl bldk ekx fn[kkb nrk g vkj d.k Hkh fn[kkb nr gA
- fuyfcr d.k vkdkj e cM gkr g vkj feJ.k dk fLFkj NkMu ij o ry e cBuk ikjHk dj nr gA bUg NUuk i= l iFkd fd;k tk ldrk gA

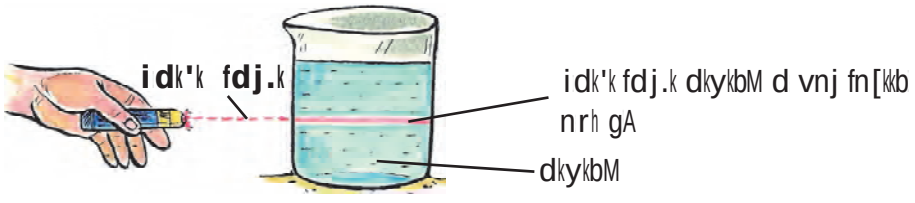
T84P3V

2.6 dkykbM D;k g\ (What is a colloid?)

fØ;kdyki 3 e leg ^[k* dk tk feJ.k ¼nèk@L;kgh rFkk ty½ ikIr gvk og D;k g] foy;u ;k fuycu\ ;fn og nkuk gh ugh g rk D;k g\

voykdu d vkèkkj ij ;g fu"d"k fudyrk g fd ;g feJ.k dh foy;u rFkk fuycu d chp dh voLFkk g] bl dkykbM dgk tkrk gA bld d.k fuycu d d.kk l NkV gkr g blfy, ;g fo"kekxh gkr g, Hkh lekxh irhr gkrk gA

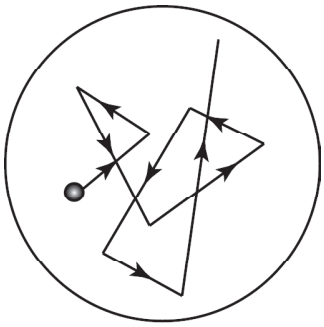
- dkykbM d d.kk dk vkdkj bruk NkVk gkrk g fd bUg vk[kk l ugh n[kk tk ldrkA ; ryh ij Hkh ugh cBr vkj u gh bUg Nkudj vyx fd;k tk ldrk gA fdr bUg vidnh; cy (centrifugal force) yxkdj vyx fd;k tk ldrk gA ?kjk e ngh dk eFkuh l fcykdj ;k feDlj e ?kekdj eD[ku fudkyk tkrk gA ;gk Hkh vidnh; cy d mi;kx }kjk dkykbM l d.kk dk vyx fd;k tkrk gA ;fn vkidh 'kkyk e vidnh; ;= gk rk ,d ij[kuyh e nèk ydj 2 feuV rd ?kekdj n[k] D;k nèk l Øhe iFkd gkrh g\
- bld d.k idk'k dh fdj.k dk vklkuh l Qyk nr g ftld dkj.k idk'k fdj.k dk ekx fn[kkb nrk gA ;g iHkko fVMy iHkko (Tyndall effect) dgykrk g ¼fp= Øekd 5½A bl iHkko dh [kkt tku fVMy uked oKkfud u dh FkhA



fp= Øekd&5 ¼ fVMy iHkko

bl iHkko dk vèkj dej e NkV l Nn l vku oky idk'k e Hkh n[k ldr gA vèkj dej e ;g iHkko èky vkj èk, ¼dkcu½ d d.kk d }kjk idk'k d Qyu d dkj.k gkrk gA

- dkykbM e foy; d d.kk ij foyk;d d d.k vlefer <x l cy Mkyr g ft ld dkj.k foy;u e foy; d d.k vfu;fer (zig-zag) <x l xfr djr g ¼fp= Øekd&6½A bl ?kVuk dk vè;;u jkcV ckmu u 1887 e fd;k Fkk vr% d.kk dh bl idkj dh vfu;fer xfr dk ckmuh xfr (Brownian motion) dgr gA



fp= Øekd&6
ckmuh xfr

i'u

1- fuEufyf[kr feJ.kk e l foy;u] dkykbM rFkk fuycu dh igpku dj& dhpM] nèk] ued dk ty e ?kkyA

2- fuEufyf[kr feJ.kk e l dku fVMy iHkko inf'kr djxk& 'kDdj dk foy;u] L;kgh dk ty e foy;u] LVkp foy;u] ued dk foy;uA

3- 250 g diM èkku d lkM dk 1 kg ty e ?kkydj foy;u cuk;k x;kA bl foy;u dh lknrk ifr'kr e Kkr dhft,A

4- pkoy dh ekM ¼ifl;k½ dh 1&2 cn dk 100 mL ty e ?kky dkykbM g ;k fuycu\ dkj.k lfgr le>kb,A

ge tkur g fd feJ.k db idkj d gkr g rFkk bld vo;ok dk iFkDdj.k dh fofHkUu fofèk;k }kjk iFkd dj ldr gA iFkd fd, tku ij ;fn ge ,l inkFk feyr g ftUg vkj ljy :i e iFkd ugh fd;k tk ldrk] mUg 'k) inkFk dgr gA

iFkDdj.k dh ub&ub fofèk;k d vku d dkj.k ,lk gk ldrk g fd ftUg ge vkt 'k) inkFk dgr g o Hkfo"; e feJ.k fudy mnkgj.k d fy,] io e yc le; rd gok dk 'k) inkFk le>k tkrk Fkk yfdu vc ge tkur g fd gok db xlk dk feJ.k gA vkb,] vc ge 'k) inkFkk dk foLrkj l le>A

2.7 'k) inkFkk d dku&dku l idkj g\ (What are the types of pure substance?)

jklk;fud l?kVu d vkèkkj ij 'k) inkFkk dk rRok ;k ;kfxdk e oxhdr fd;k tkrk gA

2.7.1 rRo (Elements)

vki tkur g fd rRo o inkFk g ftUg jklk;fud fofèk;k ¼Å"ek] idk'k] fo|r ;k vU; jklk;fud inkFkk l fØ;k½ }kjk nk ;k nk l vfèkd ljy inkFkk e foHkkftr ugh fd;k tk ldrk gA gkbMkstu ,d rRo g blh idkj lkfM;e (Na)] vk;ju (Fe)] dkij (Cu) vkfn Hkh rRo gA rRok dh bl lph e vkj uke tkfM,A vki fdru uke vkj tkM ld\

Ýkl d jlk;u'kkL=h ,Vkuh ykjV yokbft, ¼lu 1743&1794½ u loiFke rRo dh vkèkfud ifjHkk"kk dk i;kxk }kjk ifrikfnr fd;kA mud vulkj rRo fdlh inkFk dk og ey :i g ftl jklk;fud fofèk;k }kjk vU; ljy inkFkk e foHkkftr ugh fd;k tk ldrk gA

rRo dk ljy inkFkk e blfy, foHkkftr ugh fd;k tk ldrk D;kfd o ,d gh idkj d ijek.kvk l cu gkr g mnkgj.k d fy, rkck flQ rkc d ijek.kvk l rFkk vk;ju flQ vk;ju d ijek.kvk l cuk gkrk gA rRo Bkl] no rFkk xlh; voLFkk e ik, tkr gA

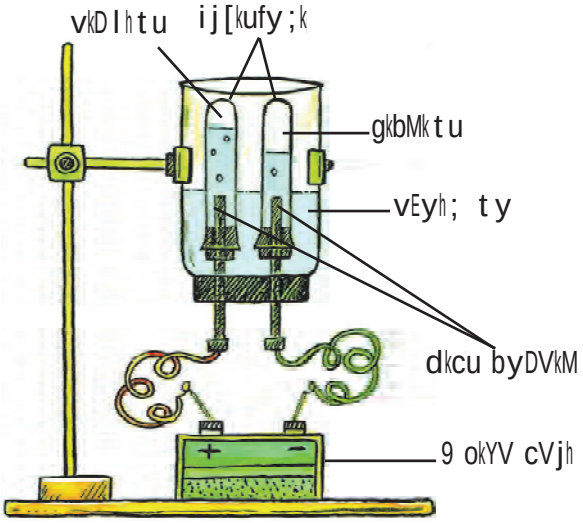
D;k vki tkur g

- vHkh rd Kkr rRok dh l[;k 118 gA bue l 94 rRo ikdfrd] 'k"k ekuo fufer gA
- vfèkdk'k rRo Bkl gA
- ikjk rFkk ckehu rRo dej d rkieku ij no gA
- xfy;e rFkk lhft;e rRo dej d rkieku ¼300 K½ l dN vfèkd rkieku ij no voLFkk e cny tkr gA
- 11 rRo dej d rkieku ij xl gA

2-7-2 ;kfxd (Compounds)

gekj vkl&ikl ,l db inkFk g tk nk ;k nk l vfèkd rRok d fuf'pr vuikr e jklk;fud l;ktu l cur gA ; inkFk ;kfxd dgykr gA jklk;fud vfHkfØ;k d i'pkr cu ;kfxd d x.k vo;oh rRok l fHkUu gkr g mnkgj.k d fy, ikuh (H_2O) ,d ;kfxd g tk Toyu'khy xl gkbMktu (H_2) rFkk tyku e lgk;d xl vkDlhtu (O_2) d jklk;fud l;ktu l curk g yfdu ikuh u rk Toyu'khy gkrk g vkj u gh tyku e lgk;d gkrk gA cfYd og Tokyk dk c>krk gA ikuh e mifLFkr vo;ok d vuikr dk tkuu d fy, ,d fØ;kdyki fd;k x;kA ftle &

- ,d pkM eg dh lykfLVd dh ckry ydj mldh ryh dkV nh xbA ckry d eg ij nk fNn okyk jcj dkd yxkdj bu fNnk e dkcu dh nk NM yxk nh xbA ckry dk fp= Øekd&7 d vulkj 0;ofLFkr fd;k x;kA
- mYVh j[kh ckry e nk&frgkb ty Hkjdj dN cn ru lY¶;fjd vEy dh Mkyh xbA
- ty l Hkjh dkp dh nk ij[kufy;k dk dkcu byDVkMk ij bl idkj j[kk x;k fd ij[kufy;k e gok fcYdy u tk, vkj ij[kufy;k ikuh l ijh Hkjh jgA
- nkuk byDVkMk dk 9 okYV dh cVjh l tkMk x;kA



fp= Øekd&7 ¼ ty dk fo|r vi?kVu

- nkuk ij[kufy;k e ,d= gk jgh xlk dk è;ku l n[ku ij irk pyk fd nkuk ij[kufy;k e leku nj l xl ,df=r ugh gkrh gA
- tc ,d ij[kuyh e ijk ikuh uhp mrj x;k vFkkr ij[kuyh xl l ijh Hkj xb rc nljh ij[kuyh e ,df=r xl dk vk;ru yxHkx vk/kk FkkA
- bl idkj nkuk ij[kufy;k e ,df=r xlk d vk;ru e vrj FkkA
- tc vkèkh Hkjh ij[kuyh xl l ijh Hkj xb rk ml Hkh chdj l ckgj fudky fy;k x;kA
- Øe'kh nkuk ij[kufy;k d e[k d ikl tyrh gb ekfpl dh rhyh y tkb xbA
- rc n[kk x;k fd tyku e lgk;d xl (O_2) rFkk Lo; tyu okyh xl (H_2) dk vk;ru d vulkj ikuh e vuikr 2 % 1 FkkA

mi;Dr fØ;kdyki d vkèkkj ij ;g fu"d"k fudyk fd ikuh ,d ;kfxd g tk nk rRok gkbMktu rFkk vkDlhtu d vk;ru vulkj vuikr 2%1 e jklk;fud l;kx l curk g rFkk bl cu g, inkFk d x.k gkbMktu rFkk vkDlhtu l fHkUu gkr gA bld vo;ok dk jklk;fud fofèk;k t l& fo|r vi?kVu }kjk ikIr fd;k tk ldrk gA

;fn ty e Hkkj dh nf"V l gkbMktu ,o vkDlhtu d n0;ekuk d vuikr dh x.kuk dh tk, rk ;g lno 1%8 gkrk g] pkg ty dk lkr dkb Hkh gkA blh idkj ;fn 9 xke ty dk vi?kVu dj rk lno 1 xke gkbMktu rFkk 8 xke vkDlhtu gh ikIr gkxhA ,l gh ifj.kke vU; ;kfxdk d vè;;u l Hkh ikIr gkr g t l& dkcu MkbvkDlkbM d fy, fd, x, i;kx e dkcu rFkk vkDlhtu dk n0;eku d vulkj vuikr ge'kk 12%32 ikIr gvkA

ikmLV u bl idkj d i;kxk }kjk ;g ifrikfnr fd;k fd dkb Hkh ;kfxd tk nk ;k nk l vfèkd rRok l cuk gkrk g mle rRok dk vuikr fLFkj gkrk g pkg ml fdlh Hkh idkj l ikIr fd;k x;k gk ;k cuk;k x;k gkA bl fuf'pr ;k fLFkj vuikr dk fu;e (law of definite or constant proportions) dgr gA

vekfu;k] [kku dk lkMk vkfn Hkh ;kfxdk d vU; mnkgj.k gA bue Hkh vo;oh rRok dk vuikr fLFkj vuikr fu;e d vulkj gh ik;k tkrk gA

i'u

1- fuEufyf[kr dk rRo rFkk ;kfxd e oxhdr dj&

ikVf'k;e] puk] xèkd] diM èkku dk lkMk] dkcu] yM] fljdkA

2- eXuhf'k;e d rkj dk gok e tyku ij lQn jx dk vkDlkbM curk gA ;g rRo gkxk ;k ;kfxd dkj.k lfgr crkb,A

3- ued D;k g& rRo] ;kfxd ;k feJ.k\ le>kb,A

e[; 'kCn (Keywords)

foy;u (solution)] dkykbM (colloid)] fuycu (suspension)] lekxh feJ.k (homogeneous mixture)] fo"ekxh feJ.k (heterogeneous mixture)] lrlr foy;u (saturated solution)] vlrlr foy;u (unsaturated solution)] vfrlrlr foy;u (supersaturated solution), lkUnrk (concentration)] foy;rk (solubility)] foyk;d (solvent)] foy; (solute)] fVMy iHkko (Tyndall effect)] ckmuh xfr (Brownian motion)] vidnh; cy (centrifugal force)] n0;eku dk lj{k.k (Conservation of mass)

geu lh[kk

- inkFk LFkku ?kjrk g rFkk mle n0;eku gkrk gA
- inkFkk dk feJ.k rFkk 'k) inkFk e oxhdr fd;k tkrk gA
- feJ.k e ,d l vfèkd inkFk fdlh Hkh vuikr e fey gkr g] ble vo;oh inkFkk d x.k ik, tkr gA T;kUkrj vo;oh inkFkk dk lkekU; Hkkfrd fofèk;k }kjk vyx fd;k tk ldrk gA
- feJ.k e tc vo;oh d.kk dk forj.k leku gk rk ml lekxh rFkk forj.k vleku gk rk ml fo"ekxh feJ.k dgr gA
- foy;u nk ;k nk l vfèkd inkFkk dk lekxh feJ.k gA foy;u dk og vo;o ftldh ek=k vfèkd gk ml foyk;d rFkk ftldh ek=k de gk ml foy; dgr gA
- foy;u dh lkUnrk dk vFk g fdlh foy;u dh nh xb ek=k e mifLFkr foy; dh ek=kA
- og feJ.k ftle d.kk dk vkdkj bruk cMk gk fd ml vk[kk l n[kk tk ld] fuycu dgykrk gA
- dkykbM e d.kk dk vkdkj bruk NkVk gkrk g fd mUg n[kk ugh tk ldrk] ; d.k idk'k d ekx dk Qyk nr g vr% mldk ekx fn[kkb nrk gA
- 'k) inkFk rRo ;k ;kfxd gkr gA rRo dk jklk;fud fofèk;k }kjk ljy inkFkk e foHkkftr ugh fd;k tk ldrk gA ;kfxd og inkFk g tk nk ;k nk l vfèkd rRok d fuf'pr vuikr e jklk;fud l;kx l curk gA ;kfxd d x.k mle mifLFkr rRok d x.kk l fHkUu gkr gA
- jklk;fud vfHkfØ;k d vfHkdkjdk dk dy n0;eku mRiknk d dy n0;eku d cjkcj gkrk gA ;g inkFk dh vfoukf'krk dk fu;e dgykrk gA
- fdlh Hkh ;kfxd e vo;oh rRo n0;eku d vkèkkj ij lno ,d fuf'pr vuikr e gkr g] bl fuf'pr ;k fLFkj vuikr dk fu;e dgr gA

vH;kl

1- lgh fodYi pfu,&

(i) lekxh feJ.k g&

¼v½ ykgk ¼c½ dkyk

¼l½ 24 djV lkuk ¼n½ vkDlhtu

(ii) fo"kekxh feJ.k g&

¼v½ 'k) ty ¼c½ dkØhV

¼l½ ued dk ty e foy;u ¼n½ puk

(iii) vkDlhtu g&

¼v½ rRo ¼c½ ;kfxd

¼l½ lekxh feJ.k ¼n½ fo"kekxh feJ.k

(iv) 'kDdj g&

¼v½ rRo ¼c½ ;kfxd

¼l½ lekxh feJ.k ¼n½ fo"kekxh feJ.k

(v) fVMy iHkko inf'kr djrk g&

¼v½ ued dk ikuh e foy;u ¼c½ LVkp foy;u

¼l½ [kku d lkM dk foy;u ¼n½ fljdk

(vi) 'k) inkFk ugh g&

¼v½ cQ ¼c½ ykgk

¼l½ ikjk ¼n½ nèk

2- fuEufyf[kr feJ.kk e l foy;u dh igpku dhft,&

feêh] lenh ty] ok;] lkMkokVj] xkn dk ty e ?kkyA nèk dk ty e ?kkyA

3- fuEufyf[kr dk rRo] ;kfxd ,o feJ.k e iFkd dhft,&

uhc dk 'kjcr] pêku] rkck] ghjk] ued] fuvku xl] lykn] 'k) ikuh] ,yfefu;e] pknh] lkcu] jDr] dkcu MkbvkDlkbM] lkfM;eA

4- lgh mÙkj pudj fjDr LFkku dh ifr dhft,&

(i) fdlh rRo e ---------- d d.k gkr gA ¼,d idkj d@vyx&vyx idkj d½

(ii) dkykbMy d.kk }kjk idk'k dk Qykuk ---------- dgykrk gA ¼fVMy iHkko@ckmuh xfr½

(iii) fVpj vk;kMhu foy;u e vk;kMhu ---------- gA ¼foy;@foyk;d½

(iv) ---------- d d.kk dk NUuk i= }kjk Nkudj iFkd fd;k tk ldrk gA ¼fuycu@dkykbM½

(v) ---------- d d.k vk[kk l ugh n[k tk ldr gA ¼foy;u@fuycu½

5- fuEufyf[kr dh mnkgj.k lfgr 0;k[;k dhft,&

'k) inkFk] lrlr foy;u] dkykbM] fuycu

6- fdlh ,d fØ;kdyki d }kjk fl) dhft, fd 'kDdj e ikuh dk ?kkyk] foy;u gA

7- fdlh Bkl dh no e foy;rk ij rkieku dk D;k iHkko iMrk g\ fØ;kdyki }kjk le>kb,A

8- foy;u] dkykbM rFkk fuycu e vrj fyf[k,A

9- lekxh rFkk fo"kekxh feJ.k e vki dl vrj djx\

10- lhek u rhu Bkl inkFk v] c ,o l fy,A fofHkUu rkiØek ij 100 g ty e bud lrlr foy;u cuku d fy, vko';d inkFkk dh lkj.kh fuEukulkj r;kj dh&

foy; inkFk	rkieku K e			
	293 K	313 K	333 K	353 K
v	35 g	36 g	37 g	38 g
c	32 g	62 g	106 g	167 g
l	34 g	40 g	46 g	54 g

¼d½ 293 K ij rhuk inkFkk d lrlr foy;u cuku d fy, vko';d inkFkk dh ek=k, fdruh&fdruh g\ bld vkèkkj ij vki D;k fu"d"k fudky ldr gA

¼[k½ 500 g ty e 313 K rkieku ij foy; inkFkk d lrlr foy;u cuku d fy, vko';d foy; inkFkk dh ek=k dh x.kuk dhft,A

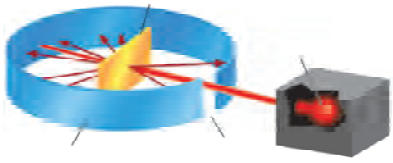
¼x½ 353 K ij ^v* rFkk ^l* foy;u dh lknrk ifr'kr e Kkr dhft,A

TJRTL3

vè;k;&3

ijek.k lajpuk

¼Atomic Structure½



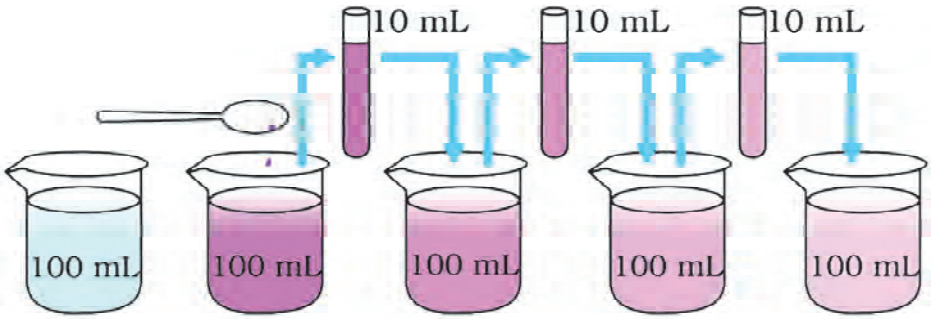
ge viu pkjk rjQ n[k rk ge fofHkUu vkdkj] vk—fr] jx vkj cukoV okyh oLr, fn[kkb nrh g tk fofHkUu inkFkk l cuh gkrh gA inkFk d.kk l cu gkr gA vc i'u ;g mBrk g fd vkf[kj ; d.k fdru NkV gkr g\

tc ge ,d fxykl ikuh e 1&2 cn fMVky dh Mkyr g rc ikuh l fMVky dh xèk vku yxrh gA ble ;fn vkj ikuh feyk, rc Hkh ml dh xèk vkrh g] ,lk D;k gkrk gkxk\

vkb,] bl le>u d fy, ,d fØ;kdyki dj&

fØ;kdyki&1

- ikVf'k;e ijexuV d nk ;k rhu fØLVy dk 100 mL ikuh e ?kky y] ?kky d jx dk è;ku l n[kA ¼fp= Øekd&1½
- bl ?kky e l yxHkx 10 mL ?kky fudkydj ml 90 mL ikuh e feyk nA
- fQj bl ?kky ¼mi;Dr½ e l 10 mL fudkydj ml Hkh 90 mL ikuh e feyk nA
- bl idkj bl ?kky dk 5 l 8 ckj rd ru—r djr tk,A
- D;k ?kky vc Hkh jxhu g\



fp= Øekd&1 % inkFk d d.k fdru NkV gkr g

ru ?kky d jx dk n[ku d fy, ij[kuyh d ihN lQn dkxt j[kdj nf[k, ,o ryuk dju d fy, ,d ij[kuyh e lknk ikuh y yhft,A

bl fØ;kdyki e vkiu voykdu fd;k g fd ikVf'k;e ijexuV d 2 ;k 3 fØLVy ikuh dh cgr vfèkd ek=k dk jxu d fy, lk;klr gA lkfp,] ikVf'k;e ijexuV d ,d fØLVy e fdru vfèkd d.k gkx vkj o fdru l{e gkx\

okLro e ; bru l{e gkr g fd ml inkFk dk bll NkVk d.k gk gh ugh ldrkA inkFkk d ; l{e d.k nk idkj d gkr g& v.k rFkk ijek.kA ijek.k ,d vkèkkjHkr ¼cfu;kn½ d.k gA ijek.k vkil e tMdj v.k cukr gA lfn;k l ijek.k dk le>u d i;kl fd, tk jg gA ijek.k dh oreku voèkkj.kk rd ge dl igp g\ vkb,] bl tkuA

3.1 ijek.k dh dgkuh fdruh ub] fdruh ijkuh (The story of the atom)

ijek.k dk tkuu d i;kl dh dgkuh cMh jkpd g tk blk l 500 o"k io l 'k: gbA Hkkjrh; nk'kfud egf"k d.kkn u ifrikfnr fd;k Fkk fd ;fn ge inkFk ¼n0;½ dk foHkkftr djr tk, rk ge NkV&NkV d.k ikIr gkr tk,x rFkk vr e ,d lhek vk,xh tc ikIr d.k dk iu% foHkkftr ugh fd;k tk ldxk vFkkr og l{ere d.k vfoHkkT; jgxkA ,d xhd n'ku'kkL=h fYk;lhil ¼Leucippus½ vkj mud fo|kFkh MekfØVl ¼Democritus½ u bl ckj e lkpuk 'k: fd;k fd vxj fdlh inkFk d VdM djr tk, rk ,d fLFkfr ,lh vkrh gkxh tc ml vkj vfèkd NkV VdMk e ugh rkMk tk ldrkA MekfØVl u ml ^^,Vekl** dgk vFkkr ftl vkj rkMk ugh tk ldrkA lkFk gh ;g Hkh dgk fd ijh nfu;k bUgh l cuh gb gA

ge tkur g fd foKku e doy fpru&euu l dke ugh pyrk] mUg tkpu d fy, fofHkUu i;kxk] fo'y"k.kk] rdk vkj vkèkkjk dh vko';drk gkrh gA pfd MekfØVl d ikl dkb vkèkkj ugh Fkk] blfy, mudk ijek.kokn ipfyr ugh gk ik;kA blk l 306 o"k io ,Fkl e bfiD;jl ¼Epicurus½ u viuh fdrkc e fy[kk fd gekj vkl&ikl tk Hkh pht g] o ijek.kvk l cuh gA Y;Øfl;l (Lucretius) u Hkh ^^phtk dh i—fr** ¼Nature of Things½ uked dfork e ijek.k lcèkh ckr dh FkhA bl er dk vBkjgoh 'krkCnh e jlk;u'kkL= dh ub rduhd d fodkl d dkj.k cy feykA

vkiu i<k g fd fdlh jklk;fud vfHkfØ;k e inkFk dk n0;eku ljf{kr jgrk gA o"k 1799 e ikÅLV dk fLFkj vuikr dk fu;e (law of constant proportions) vk;k] ftld vulkj iR;d jklk;fud ;kfxd rRok l feydj cuk gkrk gA jklk;fud ;kfxdk e Hkkjkulkj rRok dk vuikr lno fuf'pr gkrk gA bl fu;e dk db oKkfudk u i;kx djd n[kk ,o fofHkUu ;kfxdk d cuu dk le>k vkj ij[kkA bu fu;ek dh 0;k[;k dju d fy, fd, x, fey&ty i;klk u ijek.k dk le>u e cMh enn dhA

fcVu d ,d Ldy vè;kid vkj oKkfud tku MkYVu (John Dalton) u ;g crk;k fd ; lkj ik;kfxd fu;e lgh D;k g vkj bu fu;ek dh 0;k[;k dju d fy, mUgku ijek.k fl)kr fn;kA MkYVu u viu i;kl dk 1808 e fdrkc (A New System of Chemical Philosophy)) d :Ik e idkf'kr fd;kA MkYVu d fl)kr dh foopuk fuEufyf[kr idkj l dj ldr g&

1- lHkh inkFk ijek.kvk l cu gkr gA

2- ijek.k vfoHkkT;] l{ere d.k gkr g tk jklk;fud vfHkfØ;k e u rk cur g vkj u gh mudk fouk'k gkrk gA

3- fdlh ,d rRo d ijek.kvk dk n0;eku ,o jklk;fud x.kèke leku gkr gA

4- vyx&vyx rRok d ijek.kvk dk n0;eku ,o jklk;fud x.kèke vyx&vyx gkr gA

5- vyx&vyx rRok d ijek.k ijLij NkVh i.k l[;k d vuikr e l;kx djd ;kfxd cukr gA

6- fdlh Hkh ;kfxd e ijek.kvk dh lki{k l[;k ,o idkj fuf'pr gkr gA

MkYVu dk xf.kr vuikr fu;e

tku MkYVu

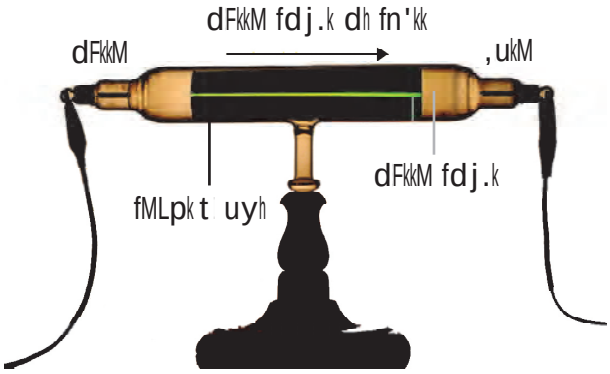
MkYVu u n[kk fd 3 xke dkcu] 4 xke vkDlhtu d lkFk l;kx djd dkcu ekukvkDlkbM cukrk g vkj 3 xke dkcu] 8 xke vkDlhtu d lkFk l;kx djd dkcu MkbvkDlkbM Hkh cukrk gA 8 xke vkDlhtu] 4 xke vkDlhtu dk nxuk gA bl rjg tc Hkh MkYVu u rRok d l;kx dk fofHkUu vuikrk e n[kk rk ik;k fd bue ,d ljy xf.kr vuikr fn[krk g vFkkr gj ckj ijek.k vfoHkkT; gA bl mUgku ckn e xf.kr vuikr fu;e d :Ik e idkf'kr fd;kA bl idkj ge dg ldr g fd tc nk rRo l;kftr gkdj ,d l vfèkd ;kfxd cukr g rc ,d rRo d lkFk nlj rRo d l;Dr gku oky n0;eku NkV i.kkdk d vuikr e gkr gA mi;Dr mnkgj.k e Li"V g fd dkcu] vkDlhtu d lkFk l;Dr gkdj nk idkj d ;kfxd dkcu ekukvkDlkbM vkj dkcu MkbvkDlkbM cukrk g vkj ;gk vkDlhtu d n0;eku ¼4 xke vkj 8 xke½ tk dkcu d fuf'pr n0;eku ¼3 xke½ d lkFk l;Dr gkr g ,d ljy vuikr 4¾8 ;k 1½2 e gkr gA

3.2 D;k ijek.k vfoHkkT; g\ (Is atom indivisible ?)

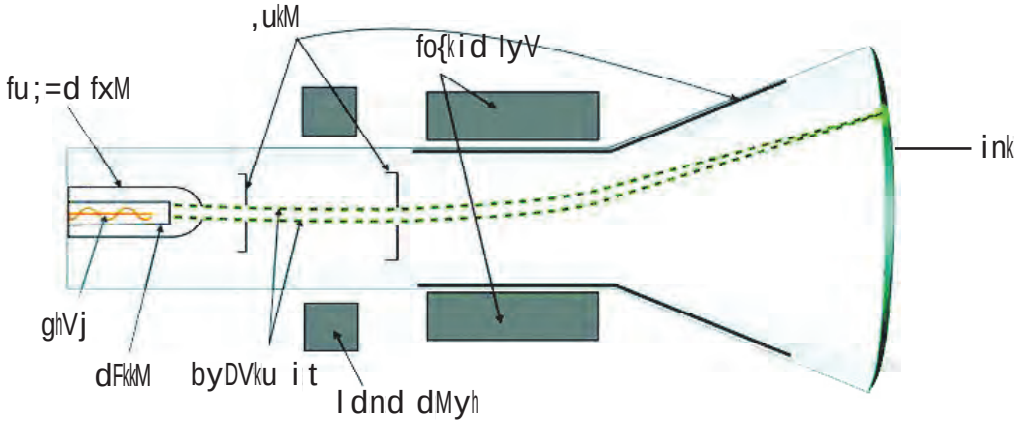
,d idkj l vfoHkkT; ijek.k d fopkj d lkFk jlk;u'kkL=h] lkj fu;ek vkj fl)krk dh 0;k[;k dj ik jg Fk vkj vfHkfØ;kvk dk le> jg FkA yfdu ;g ekU;rk T;knk fnu rd ugh jg ikb] D;kfd inkFk dh i—fr dk le>u d fy, vkj Hkh db i;kl fd, tk jg Fk] tk ijek.kokn dk ub fn'kk dh vkj y x,A

,d rjQ tgk ijek.k dk ydj vyx&vyx vueku yxk, tk jg Fk] ogh nljh rjQ xlk dh pkydrk ij Hkh fofHkUu i;kx fd, tk jg FkA blh Øe e fcfV'k Hkkfrd'kkL=h t-t- Fkke lu ¼J.J.Thomson½ vkj ,d teu oKkfud xkYMLVhu (Goldstein) dk ;kxnku ljkguh; gA ;g n[kk x;k fd tc de nkc ij xl l Hkjh uyh e mPp foHkokUrj ij fo|r iokfgr dh tkrh g rk dFkkM ¼_.kkof'kr byDVkM½ l ,d pedhyh fdj.k fudyrh g] ft l xkYMLVhu u dFkkM fdj.k dgk ¼fp= Øekd&2½A

ckn e bl i;kx dk db ckj vyx&vyx fLFkfr;k e fd;k x;kA 'kLVj ¼Schuster½ uke d oKkfud u dFkkM fdj.k d ekx d nkuk vkj ,d&,d èkkfRod lyV dFkkM rFkk ,ukM yxkb vkj mu nkuk d chp foHkokrj mRiUu fd;kA mUgku n[kk fd tc dFkkM fdj.k bu lyVk d chp l xtjrh g rc o èkukRed lyV vFkkr ,ukM ¼èkukof'kr byDVkM½ dh vkj eM tkrh g ¼fp= Øekd&3½A bl rjg ;g fuf'pr gk x;k fd dFkkM fdj.k _.kkof'kr d.kk l cuh gkrh gA



fp= Øekd&2 ¼ dFkkM fdj.k



fp= Øekd&3 ¼ dFkkM fdj.kk dk ,ukM dh vkj eMuk

vkx tkdj Fkkelu u bu _.kkof'kr d.kk d n0;eku vkj vko'k nkuk dh x.kuk dh vkj n[kk fd dFkkM pkg fdlh Hkh inkFk dk cuk gk mll fudyu okyh dFkkM fdj.k d d.kk dh i—fr ,d tlh gh jgrh gA mUgku bl d.k dk byDVku dgk ftl ij _.kko'k gkrk gA byDVku iR;d rÙo d ijek.k dk ,d voijek.kd d.k gA bl rjg yc le; l pyh vk jgh ekU;rk ^^ijek.k vfoHkkT; g** dk Fkkelu u pukrh nhA t-t- Fkkelu dk byDVku dh [kkt d fy, Hkkfrd'kkL= e lu 1906 e ukcy ijLdkj feykA

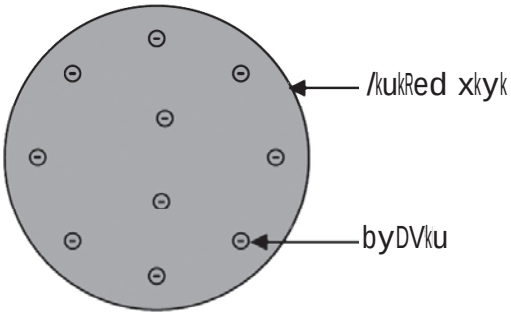
3·3 xkYMLVhu vkj duky fdj.k (Goldstein and canal rays)

tgk ,d vkj dFkkM fdj.k dh [kkt gb] ogh 1886 e xkYMLVhu u èkukof'kr fdj.kk dh [kkt dh ftUg mUgku ,ukM ;k duky fdj.k dgkA xkYMLVhu d i;kx vkèkkfjr voykdu l ;g Li"V gvk fd ; duky fdj.k èkukof'kr d.kk l cuh gkrh g vkj mudh i—fr V;c e Hkjh xl ij fuHkj djrh gA mUgku ;g n[kk fd ikIr ,ukM fdj.k dk vko'k vkj n0;eku vyx&vyx FkkA bll mUgku ;g fu"d"k fudyk fd ;g fdj.k V;c e Hkjh xl d vk;uhdj.k l mRiUUk gk jgh FkhA bl rjg duky fdj.k dh [kkt l ijek.k dh mnkIhu i—fr dh 0;k[;k gb vFkkr ijek.k e èkukof'kr vkj _.kkof'kr Hkkx gkr gA

TK1PMQ

3-4 Fkkelu dk ijek.k ekMy (Thomson's atomic model)

t-t- Fkkelu d lye ifMx ekMy d vulkj ijek.k e èku vko'k dk ckny&lk jgrk g vkj _.k vkof'kr d.k bl ckny e ;gk&ogk èkl gkr gA bl ijek.k ljpuk ekMy dk rjct d mnkgj.k }kjk le>k tk ldrk g ftle rjct dk ijk yky fgLlk èkuko'k dk Qyko g vkj dky cht _.kkof'kr byDVku g ¼fp= Øekd&4½A ijek.k e _.kkRed vkj èkukRed vko'k ifjek.k e leku gkr g blfy, ijek.k o|r :i l mnklhu gkrk gA



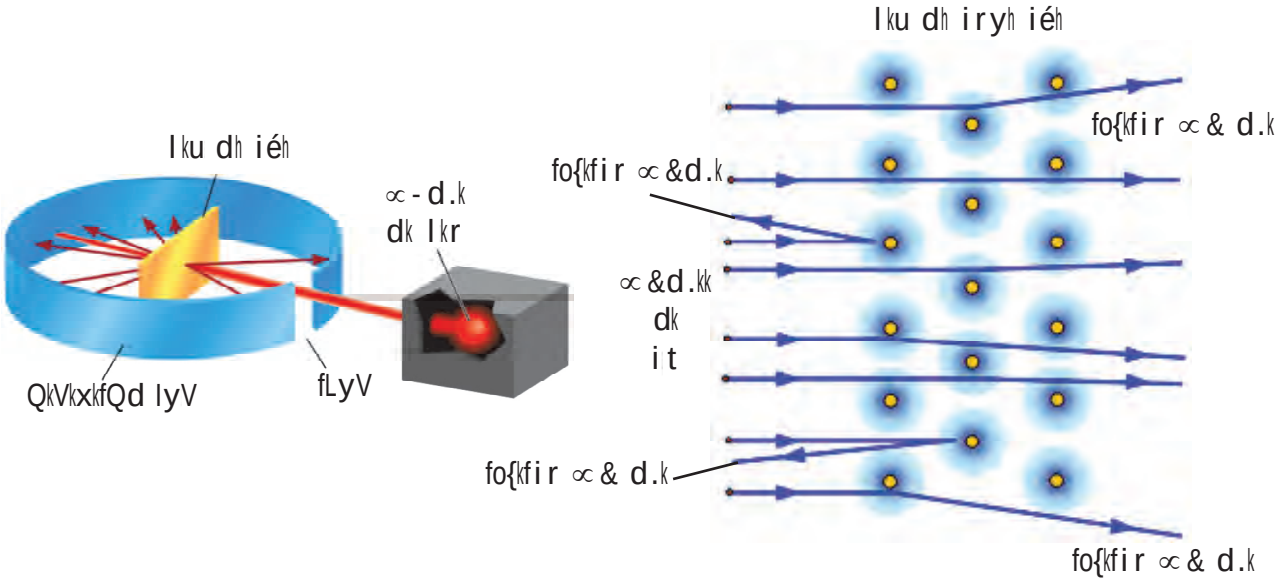
fp= Øekd&4
Fkkelu dk ijek.k ekMy

ijek.kokn lu 1908 l 1913 d chp u,&u, i;kxk vkj fofHkUu rdk d vkèkkj ij cnyrk x;kA vkb,] n[kr g fd ; i;kl dku&dku l FkA

TKAKPD

3-5 vYQk d.k idh.ku i;kx vkj jnjQkM dk ijek.kokn

b- jnjQkM ¼E. Rutherford½ vkj mud fo|kfFk;k xhxj ¼Geiger½ vkj ekLMu ¼Marsden½ u ijek.k dk le>u d fy, ,d i;kx fd;k ftle mUgku lku d vR;r eghu iéh ij mPp Åtk oky vYQk d.kk dh rt ckNkj dh ¼fp= Øekd 5 d vkj [k½A vYQk d.kk dk n0;eku ghfy;e ijek.k d cjkcj gkrk g vkj o èkukof'kr gkr gA



¼d½ jnjQkM dk idh.ku i;kx **¼[k½ Lo.k i= dk 0;oLFkkRed fp=**

fp= Øekd&5 % jnjQkM d idh.ku i;kx dk j[kkfdr fp=

Fkkelu d ijek.k ekMy d vulkj lku ¼Lo.kZ½ d iR;d ijek.k dk n0;eku leku :Ik l forfjr gkrk gA blfy, mUg vi{kk Fkh fd vYQk d.k FkkM fopfyr gkdj fudy tk,x] ij ,l ugh gvkA mUgku voykdu d nkjku ;g n[kk fd&

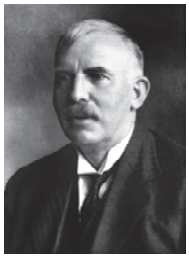
1- vfèkdk'k vYQk d.k Lo.kiÙkj d vkj&ikj lhèk fudy tkr g ftll irk pyrk g fd ijek.k e vfèkdrj LFkku [kkyh gA

2- cgr de d.k viu ekx l fo{kfir gkr g ftll ;g Kkr gkrk g fd ijek.k e èkukof'kr Hkkx cgr de txg ?kjrk gA

3- yxHkx 20]000 d.kk e l ,d d.k lku d vR;r eghu iÙkj l Vdjkdj mlh fn'kk e ykV x;k ftl fn'kk l og fudyk FkkA ;fn vYQk d.k Vdjkdj okil vk jgk g rk bldk rkRi;g fd ogk ij n0;eku okyk Hkkx dkQh ldfpr g u fd Qyk gvk vFkkr ijek.k dk n0;eku okyk Hkkx ijek.k d cgr gh de vk;ru e lhfer gA

bl rjg jnjQkM u ;g fopkj j[kk fd ijek.k e èkuko'k rFkk n0;eku ,d cgr gh NkV vk;ru e gkrk g ftl mUgku ukfHkd dgk vkj mld pkjk rjQ byDVku ifjØek djr g rFkk iR;d byDVku dk ifjØek iFk vyx gkrk gA bl rjg jnjQkM u i;kx d vkèkkj ij ijek.k dk ukfHkdh; ekMy fn;k yfdu byDVku dl forfjr gkr g] ;g Muekd d ,d Hkkfrd 'kkL=h uhYl ckj u crk;kA

U;thyM d b-jnjQkM ¼1871&1937½ ftUg ukfHkdh; jlk;u d tud d :Ik e Hkh tkuk tkrk g] mUg ijek.k d ukfHkd dh [kkt d fy, 1908 e ukcy ijLdkj fn;k x;kA vYQk d.k idh.ku i;kx ftle mUgku lku d vR;r eghu iÙkj ¼yxHkx 100 uukehVj iryh½ ij vkof'kr vYQk d.kk dh rt ckNkj dh vkj bl i;kx l mUgku fu"d"k fudyk fd ukfHkd dh f=T;k ijek.k dh f=T;k l 10^5 xuk NkVh gA



jnjQkM

i'u

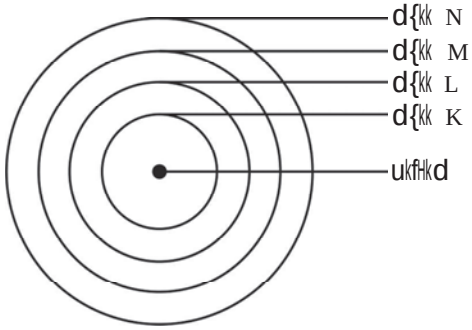
1- D;k vYQk d.kk dk idh.ku i;kx Lo.ki= d vfrfjDr jtr iÙkj ¼pknh½ ;k ,l gh vU; rRok d iÙkj l lHko gkxk\ rd lfgr mÙkj nhft,A

2- Fkkelu u ijek.k d vfoHkkT; gku dh ifjdYiuk dk fdu vkèkkjk ij pukrh nh\

3.6 fofHkUu d{kkvk e byDVku dl forfjr gkr g\

jnjQkM }kjk iLrr ijek.k d ukfHkdh; ekMy u ijek.k e ,d NkV l ukfHkd vkj mld pkjk vkj ?keu oky byDVku d ckj e crk;kA ij bl ekMy l ;g Li"V ugh gkrk g fd ; byDVku ijek.k e fdl rjg l forfjr gA byDVku e _.kko'k gkrk g] rc D;k leku vko'k oky byDVku ,d&nlj dk ifrdf"kr djr gkx ;k vkil e Vdjk tkr gkx\ vkf[kj ijek.k d vnj dlh 0;oLFkk g] tk bu voijek.kd d.kk dk 0;ofLFkr djd j[krh g\ uhYl ckj (Niels Bohr) u viu lg;kxh cjh (Bury) d lkFk feydj i'uk

l t>r g, bu byDVkuk d forj.k dk Li"V fd;kA ftl ckj&cjh ;ktuk d uke l tkuk tkrk gA ckj&cjh ;ktuk (Bohr-Bury scheme) d vulkj byDVku ukfHkd d pkjk vkj mifLFkr d{kk e pDdj yxkr g vkj bu d{kkvk dk K, L, M, N..... bR;kfn d }kjk inf'kr fd;k tkrk gA



fp= Øekd&6 % ijek.k dh d{kk,

ukfHkd d lcl lehi okyh igyh d{kk ;k d{k ;k dk'k dk K dgr g nljh d{kk dk L dgr g vkj blh rjg vxyh d{kkvk dk Øe'k% M, N l inf'kr fd;k tkrk g ¼fp= Øekd&6½A

TKJGR1

3.7 ckj&cjh ;ktuk vkj byDVkuk dk forj.k

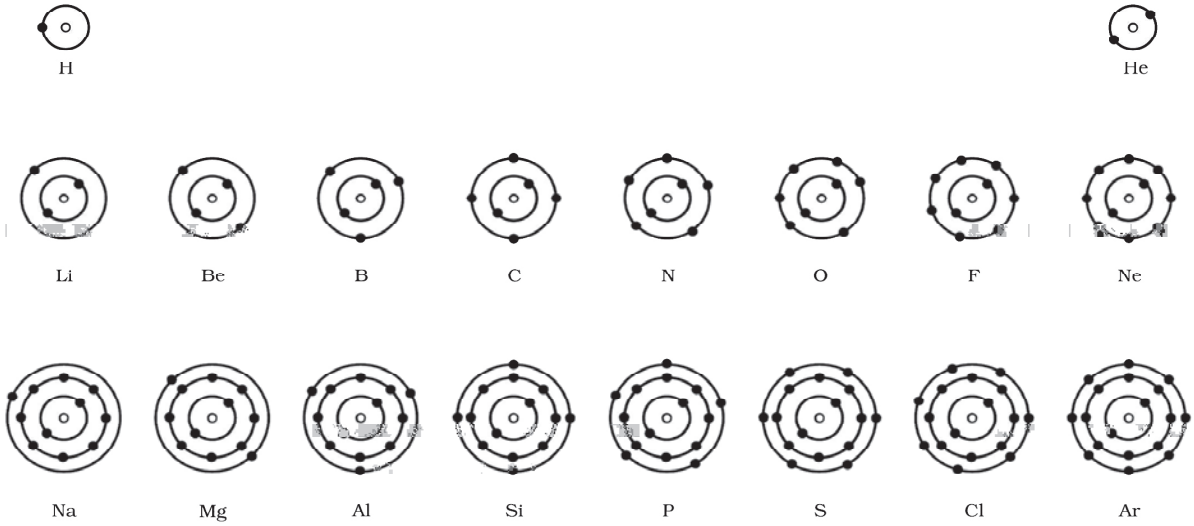
1- bl fu;e d vulkj fdlh d{kk e mifLFkr vfèkdre byDVkuk dh l[;k dk l= $2n^2$ gkrk g] tgk n d{kk dh l[;k gA K d{kk d fy, n = 1 rFkk L, M, N d{kk d fy, Øe'k% 2] 3] 4 gkrk gA igyh d{kk ;k K e byDVkuk dh vfèkdre l[;k ¾ $2\times1^2 = 2$ gkxh vkj blh rjg vU; d{kkvk d fy, byDVkuk dh l[;k dh x.kuk dh tk ldrh gA lcl ckgjh d{kk e mifLFkr byDVkuk dk l;kth byDVku dgr g vkj bl d{kk dk l;kth d{kk dgr gA

2- lcl ckgjh d{kk e byDVkuk dh vfèkdre l[;k 8 gk ldrh g ¼viokn K d{k tc ckáre d{k gk rc Hkh ble 2 gh byDVku gkr g½A

3- fdlh ijek.k dh nh x;h d{kk e byDVku rc rd LFkku ugh yr g] tc rd fd mll igy okyh Hkhrjh d{kk i.k :Ik l Hkj ugh tkrh] bll Li"V gkrk g fd d{kk, Øekulkj Hkjrh gA

4- vfre l igy d{k e d{k dh {kerk 8 l vf/kd gku ij Hkh mle ukok byDVku rc rd io'k ugh dj ldrk tc rd fd vfre d{k e 2 byDVku u Hkj tk, mnkgj.k& dfY l;e dk ijek.k Øekd 20 gA bldk byDVkfud foU;kl 2] 8] 8] 2 g u fd 2] 8] 9] 1

ckj&cjh ;ktuk d rgr iFke 18 rRok dh ijek.k ljpuk 0;oLFkk bl idkj g ¼fp= Øekd&7½A



fp= Øekd&7 % fofHkUu d{kkvk e byDVkuk dk forj.k

D;k vki blh rjg ,l ijek.kvk dh ljpuk cuk ldr g ftue 19 vkj 20 byDVku gk \ lkj.kh Øekd&1 e dN i'u okpd fpà yx g] mue lgh mÙkj fyf[k,A

lkj.kh Øekd&1¼ fofHkUu d{kkvk e byDVkuk dk forj.k vkj byDVkfud foU;kl

rRo	irhd	byDVkuk dh l[;k	d{kkvk e byDVkuk dk forj.k				byDVkfud foU;kl	l;kth byDVku
			K	L	M	N		
gkbMkt u	H	1	1				1	1
fyfFk;e	Li	3	2	1			2,1	1
dkcu	C	6	2	?			?	?
vkDlhtu	O	8	?	?			?	?
lkfM;e	Na	11	2	?	1		2,8,1	?
,yfefu;e	Al	13	2	8	?		?	?
QkLQkjl	P	15	2	8	?		?	?
Dykjhu	Cl	17	?	?	?		?	?
vkxku	Ar	18	2	8	8		?	?
ikVf'k;e	K	19	2	8	8	?	?	1
dfYl;e	Ca	20	?	?	?	2	?	?

3.8 ijek.k l[;k vkj n0;eku l[;k (Atomic number and mass number)

xkYMLVhu }kjk 1886 e duky fdj.kk dh [kkt gb] ; fdj.k èkukof'kr FkhA mud }kjk nlj voijek.kd d.k ikVku dh [kkt gbA ikVku ij èku vko'k gkrk gA ikVku dk vko'k byDVku d vko'k d cjkcj fdr foijhr gkrk gA 1932 e t-pMfod ¼J.Chadwick½ u ,d vkj voijek.kd d.k U;Vku dk [kkt fudkyk ft ldk n0;eku ikVku d cjkcj Fkk vkj ml ij dkb vko'k ugh ¼vukof'kr½ FkkA ;g d.k gkbMkt u dk NkMdj lHkh ijek.kvk d ukfHkd e ik;k tkrk gA

ijek.k d voijek.kd d.kk d vè;;u d ckn ;g fu"d"k fudyrk g fd ijek.k e byDVku] ikVku vkj U;Vku gkr gA ikVku vkj U;Vku ijek.k d ukfHkd e gkr g vkj byDVku ukfHkd d ckgj d{kk e gkr gA mnkluh ijek.k e ikVku dh l[;k] byDVku dh l[;k d cjkcj gkrh gA ijek.k e mifLFkr dy ikVku dh l[;k dk ijek.k l[;k dgr g bl Z }kjk inf'kr fd;k tkrk gA blh idkj 0;ogkfjd :i e ijek.k dk n0;eku ijek.k d ukfHkd e mifLFkr ikVku vkj U;Vku d ;kx d vkèkkj ij Kkr fd;k tkrk g ftl n0;eku l[;k dgr gA n0;eku l[;k dk ukiu dh bdkb u ¼ unified mass½ gA ukfHkd e mifLFkr voijek.kd d.k ikVku vkj U;Vku dk U;fDy;ku Hkh dgr gA

lkekU;r% byDVku dk e&] ikVku dk p+ rFkk U;Vku dk n }kjk n'kk;k tkrk gA fdlh ijek.k dk n'kku d fy, ijek.k l[;k] n0;eku l[;k vkj rRo dk irhd bl idkj fy[kk tkrk gA

n0;eku l[;k

rRo dk irhd

ijek.k l[;k

mnkgj.k d fy, lkfM;e dh ijek.k l[;k 11 vkj n0;eku l[;k 23 gA bl bl idkj fy[kr g $^{23}_{11}Na$ A fyfFk;e rFkk dfYl;e e U;Vkuk dh l[;k Øe'k% 3 rFkk 20 g] fyfFk;e vkj dfYl;e dh ijek.k l[;k vkj n0;eku l[;k dk irhdkRed :Ik e n'kkb,A

uhp nh xb lkj.kh Øekd 2 e dN rRok d ijek.kvk d ikVkuk dh l[;k vkj n0;eku l[;k nh xb gA D;k vki mud U;Vkuk dh lgh l[;k fy[k ldr g\

lkj.kh Øekd&2 % ijek.k l[;k vkj n0;eku l[;k

rRo	irhd	ikVkuk dh l[;k	n0;eku l[;k	U;Vkuk dh l[;k
gkbMkt tu	H	1	1	
fyfFk;e	Li	3	6	
dkcu	C	6	12	
vkDlhtu	O	8	16	
lkfM;e	Na	11	23	
,yfefu;e	Al	13	27	
QkLQkjl	P	15	31	
Dykjhu	Cl	17	35	
vkxku	Ar	18	40	
ikVf'k;e	K	19	39	
dfYl;e	Ca	20	40	

ge tkur g fd ijek.k dk ukfHkd ijek.k l 10^5 xuk NkVk gkrk gA ge ;g Hkh tkur g fd ukfHkd e ikVku vkj U;Vku gkr gA lkfM;e ijek.k dk vkdkj 1.86×10^{-10} ehVj gkrk gA D;k vki crk ldr g fd&

(i) bldk ukfHkd fdruk cMk gkxk\

(ii) bl vuikr dk /;ku e j[kr g, lkfM;e d ijek.k dk fp= d :i e fdl idkj n'kk,x\

D;k vki ijek.k dk fp=kRed fu:i.k dj ld\

3.9 lEkLFkkfud] ijek.k Hkkj vkj leHkkfjd (Isotopes, Atomic weight and Isobars)

dkcu rRo d ckj e ;g n[kk x;k g fd dkcu d dN ijek.kvk dh n0;eku l[;k 12 vkj dN dh 14 gA ,lk dl gkrk g\ okLro e dkcu&12 vkj dkcu&14 e U;Vkuk dh l[;k vyx&vyx gkrh gA tgk dkcu&12 e 6 U;Vku gkr g ogh dkcu&14 e 8 U;Vku gkr gA

i—fr e ,l db rRo ik, tkr g ftud ijek.kvk dh ijek.k l[;k rk leku fdr n0;eku l[;k fHkUu&fHkUu gkrh g] rRok d ,l ijek.k ,d nlj d leLFkkfud (isotope) dgykr g tl Dykjhu&35 vkj Dykjhu&37A bl rjg ge ;g dg ldr g fd Dykjhu ijek.k d nk leLFkkfud gkr gA leLFkkfudk d gekj thou e db mi;kx g tl dlj d mipkj e dkckYV d leLFkkfud] ?k?kk jkx d funku d fy, vk;kMhu d leLFkkfud vkj ijek.k HkVVh e bèku d :Ik e ;jfu;e d leLFkkfud dk mi;kx fd;k tkrk gA

Lkkif{kd ijek.k Hkkj (Relative atomic weight)

lkjek.k Hkkj jlk;u 'kkL= dh ,d eyHkr voèkkj.kk gA ijek.k Hkkj inkFk d LFky Hkkj vkj mle inkFk d fdru ijek.k g mud chp lcèk LFkkfir dju dk ,d rjhdk gA MkYVu tkur Fk fd ,d ijek.k dk rky ikuk lHko ugh Fkk] blfy, mUgku lkif{kd ijek.k Hkkj dh vkj è;ku fn;kA

pfd rc Kkr rRok d ijek.kvk e lcl gYdk ijek.k gkbMktu Fkk blfy, mUgku gkbMktu ijek.k d Hkkj dk ,d bdkb ekuk vkj mld vkèkkj ij nlj rRok d ijek.k Hkkj dh x.kuk dh blfy, bl lkif{kd ijek.k Hkkj dgr gA ;g Hkh n[kk x;k fd gkbMktu dh vi{kk vkDlhtu dh fØ;k T;knk rRok d lkFk gkrh g blfy, vkDlhTku dk ekud cuk;k x;kA vkt dy dkcu&12 d ,d ijek.k Hkkj d lki{k lHkh rRok d ijek.k Hkkj dk Kkr fd;k tkrk gA

fdlh ,d rRo d fofHkUUk leLFkkfudk dk i—fr e ik;k tkuk ;g le>u e lgk;rk djrk g fd vfèkdk'k rRok d ijek.k Hkkj i.kkd e D;k ugh gkr gA bl ,d mnkgj.k }kjk le>k tk ldrk gA idfr e Dykjhu nk leLFkkfud :ik] Dykjhu&35 rFkk Dykjhu&37 e ik;k tkrk gA idfr e ; leLFkkfud 3%1 vFkkr 75% rFkk 25% gkr gA bl fLFkfr e ge vklr ijek.k Hkkj dh x.kuk bl rjg l djr g&

$$\left(\frac{75\times 35}{100}\right)+\left(\frac{25\times 37}{100}\right)=35.5$$

bl rjg Dykjhu dk ijek.k Hkkj 35.5 u gkrk gA

lkj.kh Øekd&3 % rRok d ijek.k Hkkj

1	2	3	4	5	6	7	8	9	10
H	He	Li	Be	B	C	N	O	F	Ne
1.008	4.003	6.941	9.012	10.81	12.01	14.01	16.00	19.00	20.18
11	12	13	14	15	16	17	18	19	20
Na	Mg	Al	Si	P	S	Cl	Ar	K	Ca
22.99	24.31	26.98	28.09	30.97	32.07	35.45	39.95	39.10	40.02

;fn ge dkcu&14 ¼dkcu dk leLFkkfud½ vkj ukbVk tu&14 dk n[k rk budh n0;eku l[;k rk 14 g] fdr ijek.k l[;k Øe'k% 6 vkj 7 gA fHkUu&fHkUu ijek.k l[;k oky ,l rRo] ftudh n0;eku l[;k leku gkrh g ,d nlj d leHkkfjd (isobar) dgykr gA

i'u

1- ;fn fdlh ijek.k dh ijek.k l[;k 15 vkj n0;eku l[;k 31 g rc mle mifLFkr voijek.kd d.kk dh l[;k D;k gkxh\

2- ;fn fdlh ijek.k dh K vkj L d{kk Hkjh gb g rFkk M d{kk e doy 2 bYkDVku g rk ml ijek.k dh ijek.k l[;k D;k gkxh\

3- Ckkj&cjh ;k tuk d vulkj fuEufyf[kr ijek.kvk dk bYkDVkfud forj.k fyf[k,% $^{23}_{11}Na$, $^{12}_{6}C$, $^{35}_{17}Cl$

vc ge tku pd g fd ijek.k d dn e ,d NkVk&lk ukfHkd gkrk g] ft ldk Hkkj ij ijek.k d Hkkj dk vfèkdre Hkkx gkrk gA ukfHkd d pkjk vkj byDVku gkr gA ijek.k d voykdu d i;kl nfu;k Hkj e fd, tk jg g] vki Hkh fdrkck] bVjuV] i=&if=dkvk vkj db n';&J0; lkèkuk d ekè;e l ijek.k lcèkh viu i'uk dk gy dju dh fn'kk e i;kl djA

e[; 'kCn (Keywords)

d{k] dk'k] d{kk (orbit or shell)] ijek.k l[;k (atomic number), ijek.k Hkkj (atomic weight)] leLFkkfud (isotope), leHkkfjd (isobar)] dFkkM (cathode), ,ukM (anode), duky fdj.k (canal ray), voijek.kd (sub-atomic), U;fDy;ku (nucleon), byDVku (electron), ikVku (proton), U;Vku (neutron), lkif{kd ijek.k Hkkj (relative atomic weight), n0;eku l[;k (mass number), ukfHkd (nucleus), xf.kr vuikr dk fu;e (law of multiple proportions)

geu lh[kk

- lkjek.k dh ikjfHkd ldYiuk e ijek.k dk vfoHkkT; ekuk tkrk FkkA
- ijek.k d Hkkj vkj vkdkj dh 0;[;k dju oky MkYVu igy oKkfud Fk] mUgku xf.kr vuikr dh ckr djr g, ;g crk;k fd ijek.k jklk;fud fØ;k d vkjHk e ftru gkr g mru gh vr e Hkh gkr g ¼vFkkr ijek.k u"V ugh gkr½A
- Tk-t-Fkke lu d vulkj ijek.k e èku vko'k dk ckny jgrk g vkj _.k vkof'kr d.k bl ckny e ;gk&ogk èkl jgr gA
- lkjek.k e ukfHkd dh [kkt jnjQkM d vYQk d.kk d idh.ku i;kx }kjk gbA
- jnjQkM u vYQk d.k idh.ku i;kx l ;g fu"d"k fudkyk fd ijek.k d vnj cgr gh NkVk ukfHkd gkrk g vkj byDVku ukfHkd d pkjk vkj ?ker gA

- Ckkj d vulkj ijek.k e d{kk, gkrh g] ftue byDVku pDdj yxkr gA lkjek.k dh d{kkvk dk Øe'kk K, L, M, N..... d }kjk inf'kr fd;k tkrk gA
- lkjek.k dh lcl ckgjh d{kk e vfèkdre 8 byDVku gkr g ¼gkbMktu o ghfy;e dk NkMdj½A ijek.k dh vfre d{kk e mifLFkr byDVkuk dk l;kth byDVku dgr gA
- lkjek.k e mifLFkr dy ikVkuk dh l[;k dk ijek.k l[;k dgr gA
- lkjek.k d ukfHkd e mifLFkr ikVku vkj U;Vku d ;kx dk n0;eku l[;k dgr gA
- mnkluh ijek.k e ikVku rFkk byDVku dh l[;k cjkcj gkrh gA
- vyx&vyx rRok d ijek.k ftudh ijek.k l[;k fHkUu&fHkUu fdr n0;eku l[;k leku gk] ,d nlj d leHkkfjd dgykr gA
- ,l rRok d ijek.k] ftudh ijek.k l[;k leku fdr n0;eku l[;k fHkUu gk] ,d nlj d leLFkkfud dgykr gA
- i—fr e fdlh rRo d fdru Lor= leLFkkfud fdl vuikr ¼ifr'kr½ e ik, tkr g bl ij vklr ijek.k Hkkj dk fuèkkj.k fuHkj djrk gA

vH;kl

1- lgh fodYi pfu,&

(i) ,d rRo d leLFkkfudk e vyx gkrk g&

¼v½ byDVku ¼c½ ikVku

¼l½ U;Vku ¼n½ byDVku vkj U;Vku nkuk

(ii) uhp fn, x, ijek.koknk e l igyh ckj fdlu byDVku dk 'kkfey fd;k\

¼v½ MkYVu ¼c½ Fkkelu

¼l½ jnjQkM ¼n½ ckj

(iii) $^{39}_{19}K$ d fy, fuEufyf[kr e l dku lk dFku lR; g&

¼v½ bl ijek.k d ikl 39 byDVku gA

¼c½ bl ijek.k d ikl 39 ikVku gA

¼l½ bl ijek.k d ikl 19 byDVku gA

¼n½ bue l dkb ughA

2- lgh fodYi pudj] fjDr LFkku dh ifr dhft,&

(i) fdlh rRo d lkj ijek.k----------gkr gA ¼leku] vyx&vyx½

(ii) ,d mnkgj.k ijek.k e----------dh l[;k ikVku dh l[;k d cjkcj gkrh gA ¼byDVku] U;Vku½

(iii) $^{14}_{6}C$ vkj $^{14}_{7}N$,d nlj d---------- gA ¼leLFkkfud] leHkkfjd½

3- Fkkelu }kjk iLrkfor ijek.k] MkYVu d ijek.k l vyx dl g\

4- $^{16}_{8}O$ vkj $^{16}_{7}N$,d nlj d leHkkfjd gA bl mnkgj.k }kjk leHkkfjd dk le>kb,A

5- ckehu&79 vkj ckehu&81 i—fr e Øe'k% 50-69 ifr'kr vkj 49-31 ifr'kr ik, tkr gA ckehu dk vkl r ijek.k Hkkj D;k gkxk\

6- $^{16}_{8}O$ vkj $^{14}_{7}N$ e l;kth byDVku Kkr dhft,A

7- ckj d ijek.k ekMy dh 0;k[;k dhft,A

8- i—fr e vkDlhtu&16 d vfrfjDr vkDlhtu&17 o vkDlhtu&18 Hkh ik, tkr gA ; ijek.k ,d nlj d leLFkkfud g ;k leHkkfjd\ le>kb,A

9- MkYVu d ijek.kokn dh foopuk dhft,A bl fl)kUr dh lhek, D;k g\

10- jnjQkM dk vYQk d.k idh.ku i;kx D;k Fkk\ bl vkèkkj ij mUgku ijek.k ljpuk d lcèk e D;k fu"d"k fudky\

11- ckj&cjh ;ktuk d vulkj byDVku d forj.k d fy, iLrkfor fu;e fy[kr g, fuEufyf[kr ijek.kvk d byDVkfud foU;kl vkj U;Vuk dh l[;k fyf[k,% $^{19}_{9}F$, $^{24}_{12}Mg$, $^{28}_{14}Si$, $^{31}_{15}P$, $^{35}_{17}Cl$

vè;k;&4

xfr

(Motion)

xfr 'kCn l vki ifjfpr gA xfr d db mnkgj.k gekj nfud thou e feyr g& t l pyuk] nkMuk] okguk dk pyuk] Qy dk iM l fxjuk] if{k;k dk mMuk bR;kfn ¼fp=&1½A

fp= Øekd&1 xfr d mnkgj.k

;g rk ge tkur g fd gj iy gekj vkl&ikl fofHkUu oLr, xfr e g vkj ge Lo; Hkh lno fLFkj ugh jgrA xfr vud fØ;kvk vkj ifjoruk dk vkèkkj g vkj bld vè;;u ,o fo'y"k.k l vud cfu;knh lokyk dk tokc feyk gA mnkgj.k d fy, _r ifjoru le>u d fy, ge l; d pkjk vkj iFoh dl xfr djrh g tkuuk t:jh gA ,d LFkku l nlj LFkku rd igpu e fdlh okgu dk fdruk le; yxrk g ;g Hkh xfr dh le> n'kkrk gA

ge ik;% ;g dgr g fd dkb oLr xfr e rHkh g tc le; d lkFk mldh fLFkfr e ifjoru gkrk gA ij D;k ;g lHko g fd fdlh 0;fDr d fy, ,d oLr xfr'khy gk tcfd nlj d fy, og fLFkj gk\ t l ;fn vki Vu e cB gk rk vkidk yxxk fd vU; cB ;k=h fLFkj g vkj vki Hkh fLFkj g fdUr Vu d ckgj [kM 0;fDr d fy, Vu vkj vki nkuk xfr e gA

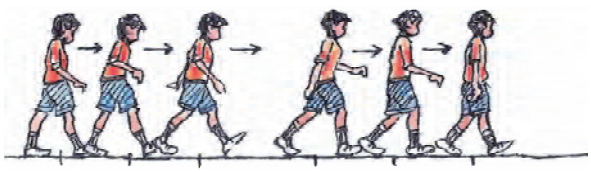
;fn vki lMd d fdukj [kM g rk vkl&ikl d iM fLFkj fn[kr g ij ;k=k djr le; pyrh cl l o xfr'khy irhr gkr gA oLr xfr e g ;k fLFkj] bl ij fuHkj djrk g fd voykdu dku o dgk l dj jgk gA bl vkèkkj ij ge dg ldr g fd dkb oLr xfr'khy rc g tc fdlh voykdu fcn d lki{k mldh fLFkfr e le; d lkFk fu;fer ifjoru gkrk gA fdlh Hkh LFkku dk voykdu fcn ekuk tk ldrk g vkj bl fun'k fcn dgr gA

nfud thou e ftu xfr;k dk ge n[kr g] mudk vè;;u vklku ugh gA tc dkb 0;fDr iny pyrk g rk mld ijk dh xfr d lkFk&lkFk mld fofHkUu vx t l gkFk] flj vkfn Hkh xfr djr gA tc dkb okgu pyrk g rk mld vyx&vyx it fHkUu&fHkUu xfr e gkr g t l& lkbfdy pykr le; vkid ijk dh xfr] iMy dh xfr] pu dh xfr] ifg;k dh xfr fHkUu&fHkUu gkrh gA

lkekU;r% oLr d vyx&vyx Hkkx] vyx&vyx fn'kk e xfr'khy gkr g vkj oLr d }kjk r; dh xb njh mld vkdkj dh ryuk e cgr T;knk gk ldrh gA bl fLFkfr e oLr dh jf[kd xfr d vè;;u d fy, ge nk ljyhdj.k ekudj vkx c<r g&

1- li.k oLr dk ifrfuf/k ,d fcn dk eku fy;k tkrk g vkj ml fcn dh ljy j[kk e gk jgh xfr dk /;ku e j[kk tkrk gA

2- ;g fcn ge ,lk pur g tgk oLr dk lEi.k n0;eku dfUnr irhr gkrk gA



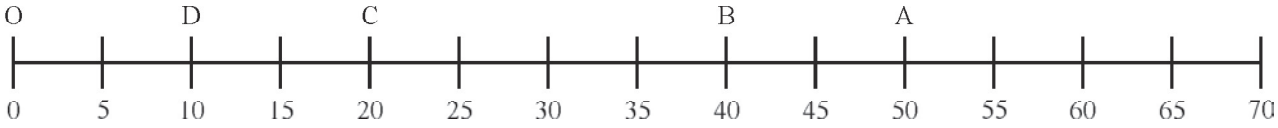
fp= Øekd&2

,d lhèkh jy dh iVjh ij Vu dh xfr] Åpkb l fxjku ij iRFkj dh xfr ljy jf[kd xfr d mnkgj.k gA D;k vki bl lph e vkj mnkgj.k tkM ldr g\

4-1 xfr dk o.ku (Description of motion)

vkb,] vc ge xfr'khy oLr d fLFkfr e gku oky ifjoru dk n[kA ,d oLr fcn O l xfr ikjHk djrh g] ftl ey fcn ekuk tk ldrk gA

igy oLr O l D, fQj D l C] fQj C l B dh vkj fQj B l A rd igprh gA O l A rd oLr }kjk r; fd, x, ekx dh yEckb] OA = 50 km



fQj ;g mlh iFk ij ykVrh g vkj B l C dh vkj l xtjr g, D rd igprh gA oLr }kjk r; fd, x, ekx dh yckb

= OA + AD

= 50 + 40 = 90 km

oLr }kjk r; dh xb ekx dh dy yckb] njh dgykrh g] tk ;gk ij 90 km gA ij oLr dh ikjfHkd vkj vfre fLFkfr e fdruk vrj g\

oLr dh ikjfHkd fLFkfr = O

oLr dh vfre fLFkfr = D

oLr dh vfre o ikjfHkd fLFkfr;k dk vrj = 10 km

;gk oLr dh vfre o ikjfHkd fLFkfr;k dk vrj 10 km gA bl vrj dk foLFkkiu dgr gA vkb,] vc foLFkkiu vkj r; dh xb njh dk FkkMk vkj foLrkj l le>r g&

fdlh oLr d }kjk r; dh xb njh dk 0;Dr dju d fy, ge doy vdh; eku dh vko';drk gkrh g] fn'kk dh vko';drk ugh gkrh gA ,lh jkf'k vfn'k jkf'k dgykrh gA jkf'k dk vdh; eku mldk ifjek.k gkrk gA

fdlh oLr d foLFkkiu dk 0;Dr dju d fy, ge ifjek.k d lkFk&lkFk mld xfr dh fn'kk dh Hkh vko';drk gkrh g] ,lh jkf'k lfn'k jkf'k dgykrh gA

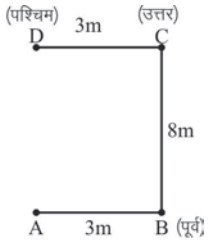
mijkDr mnkgj.k e ;fn oLr doy O l A rd njh r; dj rk

O l A rd r; dh xb njh = 50 km

O l A rd foLFkkiu = 50 km

vr% foLFkkiu o njh nkuk dk ifjek.k leku gA ;fn oLr O l A rd tk, vkj iu% O ij okil vk tk, rk oLr }kjk r; fd, x, ekx dh yckb = O A + A O = 50 km + 50 km = 100 km gkxhA fdUr foLFkkiu 'kU; g D;kfd ikjfHkd o vfre fLFkfr lkrh gk tkrh gA bl rjg foLFkkiu 'kU; Hkh gk ldrk g] pkg r; dh xb njh 'kU; uk Hkh gkA ,d vkj mnkgj.k }kjk foLFkkiu vkj njh dk le>r gA

,d 0;fDr io fn'kk e 3 eh Vj pyrk g rRi'pkr 8 eh Vj mŸkj fn'kk e pyrk gA og iu% 3 eh Vj if'pe e pyrk g ¼fp= Øekd&3½A



fp= Øekd&3

Li"V g fd ;gk r; dh xb njh AB+BC+CD=3 m + 8 m + 3 m = 14 m gA

foLFkkiu dk ifjek.k = AD = 8 m g vkj foLFkkiu A d mÙkj fn'kk e gA

4.1.1 pky ,oa vo Speed and Velocity)

fØ;kdyki&1

nk clk A o B dh xfr l lcfèkr dN vkdM lkj.kh Øekd&1 e fn, x, g&

lkj.kh Øekd&1 % cl A o B }kjk r; dh xb njh

le;	cl A d }kjk r; dh xb njh ¼fdyksehVj e½	cl B d }kjk r; dh xb njh ¼fdyksehVj e½
9.00 am	10	10
9.15 am	20	18
9.30 am	30	25
9.45 am	40	33
10.00 am	50	40
10.15 am	60	52

bu vkdMk dk voykdu djA voykdu d i'pkr crk, fd&

- D;k nkuk clk d fy, le; dk vrjky leku g\
- dku lh cl] leku le; vrjky e leku njh r; djrh g\

mDRk lkj.kh Øekd&1 d voykdu l Kkr gkrk g fd A o B nkuk d fy, le; vrjky leku gA cl A }kjk leku le; vrjky e leku njh 10 km r; dh tk jgh gA tcfd cl B }kjk leku le; vrjky e vleku njh r; dh tk jgh gA

fdlh nh xb fuf'pr njh dk r; dju e¼tl 30 fdykehVj½ cl A o cl B }kjk fy;k x;k le; vyx&vyx gA cl A, 30 fdykehVj njh 45 feuV e r; djrh g tcfd B ;gh njh 60 feuV eA ble A rt xfr l pyrh g vkj B èkheh xfr l pyrh gA

cl d xfr dh nj dk irk yxku d fy, cl }kjk bdkb le; e r; dh xb njh ukih tkrh gA bl jkf'k dk pky dgr g vkj bldk ek=d SI i)fr e ehVj@ldM (m/s) gA cl dh pky dk vU; ek=d fdykehVj@?kVk (km/h) Hkh gkrk gA

cl dh vklr pky] cl d }kjk r; dh xb dy njh vkj dy le;krjky dk vuikr gkrk gA

$$\text{vklr pky} = \frac{\text{r; dh xb dy njh}}{\text{dy le;krjky}}$$

fØ;kdyki ¼1½ e cl A vkj cl B dh pky dh x.kuk dj\

9:00 am l 9:15 am rd ¼vFkkr ¼ ?kV e½

$$\text{cl A dh vklr pky} = \frac{10\ \text{km}}{1/4\ \text{h}}$$

$$= 10 \times 4\ \text{km/h}$$

$$= 40\ \text{km/h}$$

blh idkj

$$\text{cl B dh vklr pky} = \frac{8\ \text{km}}{1/4\ \text{h}}$$

$$= 8 \times 4\ \text{km/h}$$

$$= 32\ \text{km/h}$$

lkj.kh Øekd&2

le; vrjky	cl A		cl B	
	njh (km)	vkSlr pky (km/h)	njh (km)	vkSlr pky (km/h)
9:00-9:15 am	10	40	8	32
9:15-9:30 am	10	?	7	28
9:30-9:45 am	10	?	8	?
9:45-10:00 am	10	?	7	?
10:00-10:15 am	10	?	12	48

cl A dh pky fu;r g] vr% ;g leku xfr dj jgh gA tcfd cl B dh pky cny jgh g vkj og vleku xfr dj jgh gA viu nfud thou l ,d leku xfr vkj ,d vleku xfr ¼ifjorh xfr½ d mnkgj.k <<A

vkb,] pky dk ,d mnkgj.k }kjk le>A

mnkgj.k&1 % ;fn ,d dkj 2 ?kaV e 60 fdyksehVj dh njh r; djrh g rk mldh pky fdruh gkxh\

dy njh = 60 km

le; = 2 h

$$\text{vkSlr pky} = \frac{\text{r; dh xbZ dy njh}}{\text{dy le;krjky}}$$

$$= \frac{60}{2}$$

= 30 km/h gA

bldk vFk ;g ugh g fd dkj ij le; 30 km/h dh pky l pyh gA gk ldrk g fd dN le; ;g dkj 30 km/h l vfèkd pky rFkk dN le; ;g 30 km/h l de pky l pyhA

mnkgj.k&2 % ,d oLr A l B, 20 m dh njh 10 s e r; djrh g rFkk B l A okil vkus e 6 s yrh g rk oLr dh vkSlr pky D;k gkxh\

gy % oLr }kjk r; dh xbZ dy njh = 20m + 20m = 40m

fy;k x;k dy le; = 10 s + 6 s = 16 s

$$\text{vkSlr pky} = \frac{\text{dy r; dh xbZ njh}}{\text{dy le;krjky}}$$

$$= \frac{40\text{m}}{16\text{s}} = 2.5\ \text{m/s}$$

oLr dh vkSlr pky 2.5 m/s gkxhA

4.1.2 ox (Velocity)

ge oLr dh pky d lkFk&lkFk mldh fn'kk dk Hkh 0;Dr dj ldr gA oLr }kjk ,d fuf'pr fn'kk e bdkb le; e r; dh xb njh dk ox dgr gA oLr dk ox oLr dh pky] xfr dh fn'kk ;k nkuk e ifjoru d lkFk ifjofrr gk ldrk gA

$$\text{oLr dk ox} = \frac{\text{foLFkkiu}}{\text{le;krjky}}$$

ox lfn'k jkf'k g ft ldh fn'kk foLFkkiu dh fn'kk e gkrh gA ox vkj pky dk ek=d leku gkrk gA vkSlr pky vkj vkSlr ox fdlh oLr d fn, g, vyx&vyx le;krjky e vyx&vyx xfr dk n'kkr gA ;g oLr dh {kf.kd pky ;k ox dk 0;Dr ugh djrA

mnkgj.k&3 % ,d dkj 'kgj A l nlj 'kgj B rd 40 km/h dh pky l tkrh g rFkk ogh dkj 60 km/h dh pky l okil vkrh gA dkj dh vkSlr pky rFkk ox Kkr djA

gy % ekuk fd 'kgj A l nlj 'kgj B rd dh njh = x km gA

dkj dk A l B rd tku e yxk le; $t_1 = \frac{x}{40}$ $\left(\because \text{pky} = \frac{\text{njh}}{\text{le;}}\right)$

dkj dk B l A rd tku e yxk le; $t_2 = \frac{x}{60}$ $\left(\text{vr\% le;} = \frac{\text{njh}}{\text{pky}}\right)$

$$\text{dy le; } t = t_1 + t_2 = \frac{x}{40} + \frac{x}{60}$$

$$= \frac{3x + 2x}{120} = \frac{5x}{120}$$

dkj }kjk r; dh xb dy njh $= x + x = 2x$

ijUr dkj dk foLFkkiu $= x - x = 0$

$$\text{vkSlr pky} = \frac{\text{dy r; dh xb njh}}{\text{dy le;}} = \frac{2x}{5x/120}$$

$$= \frac{2x \times 120}{5x} = \frac{240}{5} = 48 \text{ km/h}$$

$$\text{bl ;k=k e dkj dk ox} = \frac{\text{foLFkkiu}}{\text{le;krjky}} = \frac{x - x}{5x/120}$$

$$= \frac{0}{5x/120} = \frac{0 \times 120}{5x} = 0$$

4.2 xfr;k d xkQ (Graphs of motion)

vc rd geu vkl lr pky vkj ox dh ckr dh gA ij D;k ge fdlh oLr dh rkR{kf.kd pky vFkok ox irk dj ldr g\ vkb,] bl xkQ }kjk le>r g&

viok d ?kj l fo|ky; rd dh ;k=k d vkdM lkj.kh Øekd&3 e fn, x, gA

lkj.kh Øekd&3 % viok d ?kj l fo|ky; rd dh njh o le;

le; ¼feuV½	2	4	6	8	10	12
njh ¼ehVj½	12	24	36	48	60	72

viu xkQ dkxt ij x v{k ij le; vkj y v{k ij njh j[k vkj mud ieku r; djA ieku dk xkQ d Åij nk, dku ij fy[k yA vc bu vkdMk d vulkj fcUn vfdr djA bu lHkh fcUnvk dk tkMu okyh ljy j[kk Ldy ¼ieku½ dh lgk;rk l [khpA ¼fp= Ø- 4½

;g xkQ viok d ?kj l Ldy rd dh ;k=k dk xkQ gA ;kn j[k ;g cuk;k x;k xkQ vkj bl vè;k; d vkx d lkj xkQ r; dh xb njh o le; d xkQ g] u fd ;k=k d jkLr dA

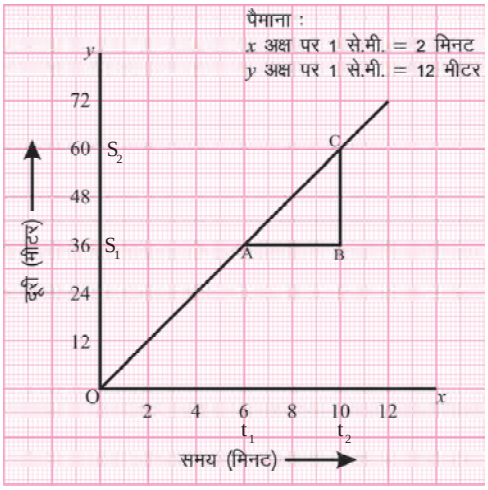
vc bl xkQ l crk,&

- viok u igy nk feuV e fdruh njh r; dh\
- viok u nlj nk feuV e fdruh njh r; dh\
- viok u 10 l 12 feuV e fdruh njh r; dh\
- D;k ; lHkh nfj;k cjkcj g\

tc dkb oLr leku le;krjky e leku njh r; djrh g rk mldh xfr ,d leku xfr dgykrh g vkj ,lh xfr d fy, njh vkj le; dk xkQ ,d ljy j[kk e gkrk gA

?kj l fo|ky; rd igpu e viok dh pky D;k Fkh\ xkQ l ;g dl Kkr gkxh] le>r g&

,lk dju d fy,] njh≤ xkQ ¼fp=&4½ e ,d fcn A yA fcn A l x v{k d lekukUrj ,d j[kk AB rFkk fcn B l y v{k d lekukrj ,d j[kk [khp] tk fcn C ij feyrh g vkj bl idkj ,d f=Hkt ABC cukrh gA vc xkQ ij j[kk AB, le;krjky $(t_2 - t_1)$ dk crkrk g tcfd j[kk BC, njh $(s_2 - s_1)$ dk crkrk gA ge xkQ l n[k ldr g fd oLr A l B fcn rd tku e $(t_2 - t_1)$ le; e $(s_2 - s_1)$ njh r; djrh gA vr% oLr dh pky fuEu idkj l 0;Dr dh tk ldrh g %



xkQ fp= Øekd&4 % ,d leku xfr dk xkQ

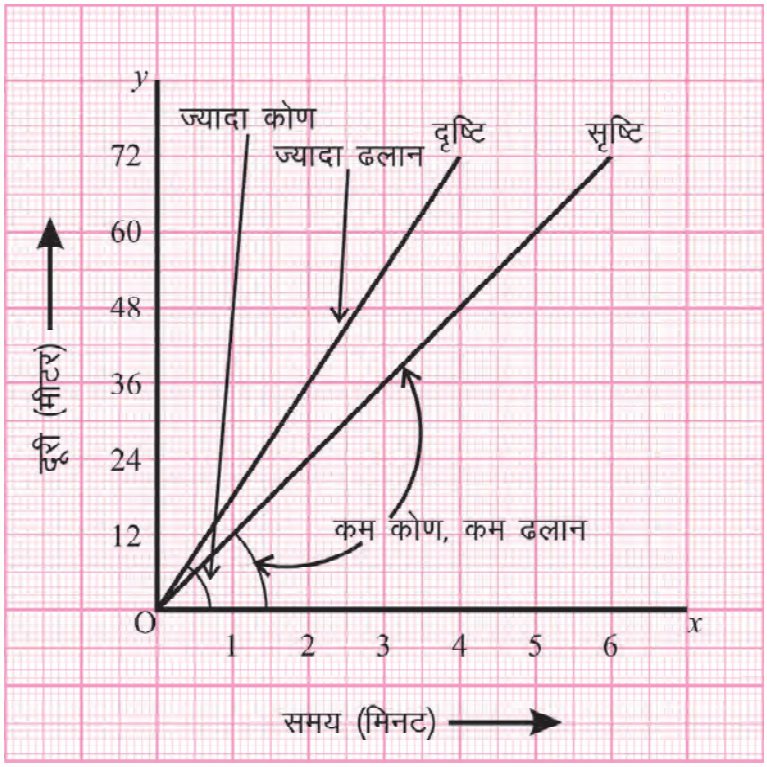
$$v = \frac{s_2 - s_1}{t_2 - t_1}$$

;fn ge fdlh {k.k oLrq dh pky D;k g] tkuuk gk rk ge ml fcn ij xkQ dh <ky ukidj ;g irk dj ldr gA

4-2-1 vyx&vyx pky okyh ,d leku xfr

nf"V vkj lf"V u ?kj l fo|ky; rd nkM yxkbA nkuk ,d leku xfr l nkM yfdu nkuk dh pky vyx&vyx FkhA nkuk dh xfr dk fp=&5 e fn[kk;k x;k gA

- D;k xkQ ,d leku xfr d g vFkok vleku xfr d g\
- xkQ dk n[kdj vd i< fcuk crk,] fd nf"V vkj lf"V e fdlh pky T;knk FkhA
- xkQ dh lgk;rk l lf"V vkj nf"V d pky dh x.kuk djA
- nf"V vkj lf"V d pky dh ryuk djd crk,] fd vkiu tk fcuk vd i< mÙkj fudkyk g og lgh g ;k ughA



xkQ fp= Øekd&5 % nf"V vkj lf"V dk xfr dk xkQ

nk ,d leku xfr d xkQ e fdlh pky T;knk g] ;g ge mudh j[kk d <yku l irk dj ldr gA <yku irk dju d fy, ge ey fcu cuk ljy j[kk dk dk.k n[kr gA

ftldk dk.k de gkxk ml ljy j[kk dh <yku ,o ml 0;fDr dh pky de gkxhA xkQ ¼fp=&5½ l n[kdj crk,] fd nf"V vkj lf"V e l fdlh xfr d xkQ dh <yku vfèkd g\ D;k mldh pky Hkh vfèkd g\

è;ku jg fd bl rjg l pkyk dh ryuk doy mu xkQk dk n[kdj gh dh tk ldrh g ftldk iekuk ,d tlk gh gA vyx&vyx ieku l cuk, x, xkQk dh ryuk doy n[kdj ugh dh tk ldrhA

4-2-2- #du dk xkQ (Graphs of halts)

eku yk fd fo|ky; d jkLrs e viok dk fdlh dkj.k l 4 feuV pyu d ckn 4 feuV #duk iMk] mld ckn og ,d leku xfr l pydj fo|ky; igp xbA mld fo|ky; igpu rd dh xfr dk xkQ ¼fp=&6½ e fn[kk;k x;k gA

tc viok igy pkj feuV d ckn #dh rk og 24 ehVj dh njh r; dj pdh FkhA vc vxy 4 feuV rd viok #dh jgh gA bl nkjku le; rk c<dj 8 feuV gk x;k ij mld }kjk r; dh xb njh vHkh Hkh 24 ehVj gh gA blfy, xkQ ij vxyk fcUn 8 feuV o 24 ehVj ij yxkA

tc dkb Hkh oLr fdlh LFkku ij igp dj #d tkrh g rk le; rk chrrk tkrk g ijUr njh ugh cnyrh gA blfy, tl fd geu vHkh n[kk fd #d g, fgLl e xkQ] le; v{k d lekukrj gk tkrk gA

vc fp=&6 dk xkQ n[kdj crk, fd bl idkj dh xfr e viok dh vkl r pky D;k Fkh\ tc viok fcuk #d Ldy igph rc mldh vkl r pky D;k Fkh\ ¼xkQ fp=&4 o lkj.kh Øekd&3 n[kdj crk,½

xkQ fp= Øekd&6 % viok d #du dk xkQ

bu nkuk vkl r pkyk e fdruk vrj g\

bl vrj dk dkj.k crk,\

i'u % vukfedk dh ;k=k d vkdM lkj.kh Øekd&4 e fn, x, gA

lkj.kh Øekd&4 % vukfedk dh ;k=k d vkdM

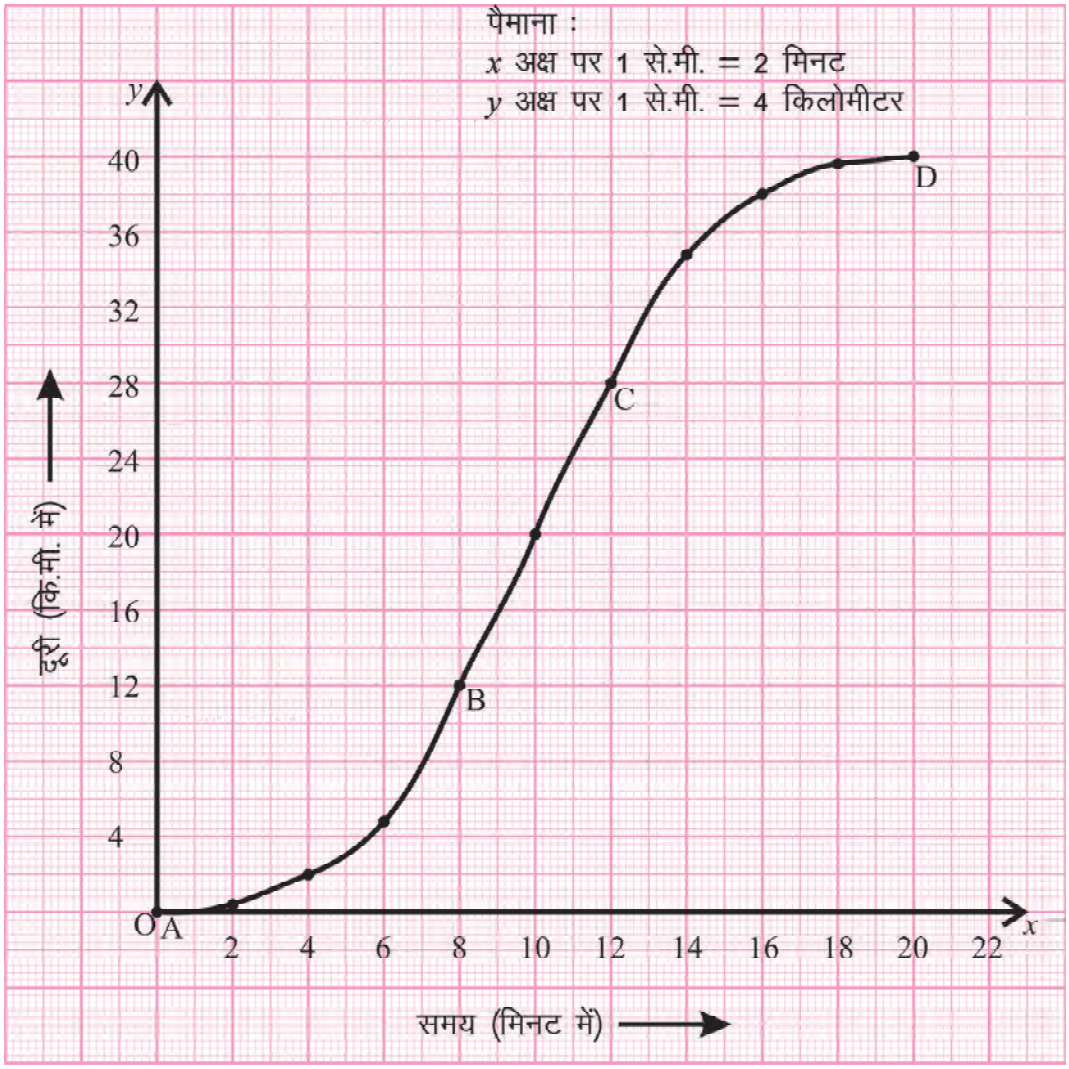
le; ¼feuV e½	2	4	6	8	10	12	14	16
r; dh xb njh ¼ehVj½	6	12	24	36	36	36	45	54

bu vkdMk d vkèkkj ij vukfedk dh xfr dk xkQ [khp vkj mldh vkl r pky Kkr djA crk, fd&

- ;k=k d fdl fgLl e mldh pky lcl vfèkd jgxh\
- D;k og jkLr e #dh\ ;fn gk rk fdru le; d fy,A

4.2.3 vleku xfr dk xkQ (Graphs for non-uniform motion)

vHkh rd geu doy ,d leku xfr;k d ckj e tkuk gA vc ge ,l xfr;k d ckj e tkux tk ,d leku ugh gA LV'ku l NVrh gb ;k LV'ku ij #drh gb cl vkiu n[kh gkxhA LV'ku l NVu ij D;k cl dh xfr ,d leku jgrh g\ **,l xfr dk ftle pky c< jgh gk ;k ?kV jgh gk] vleku xfr dgr gA**



xkQ fp= Øekd&7 % xkMh dh xfr dk xkQ

lkj.kh Øekd&5 % cl }kjk r; dh xb njh

le; ¼feuV½	r; dh xb njh ¼fdeh½
0 l 4	2 km
4 l 8	10 km
8 l 12	&&&&&&&&
12 l 16	&&&&&&&&
16 l 20	&&&&&&&&

fp= Øekd&7 e fn, x, xkQ dk n[kdj Åij nh xb lkj.kh Hkj vkj bu i'uk d mÙkj nA

- vc crk, fd D;k cl u leku le; e leku nfj;k r; dh\
- xkQ dk dku lk Hkkx cl dh cnyrh xfr dk rFkk xkQ dk dku lk Hkkx cl dh ,d leku xfr dk crkrk g\ fdl [kM e cl #dh gb FkhA

xkQ d ,d leku xfr o cnyrh xfr d [kMk dk è;ku l n[kA bue vkidk D;k dkb fo'k"k vrj fn[krk g\

xfr d xkQ dk oØ gkuk ;g fn[kkrk g fd ml [kM e xfr yxkrkj cny jgh gA xkQ d AB [kM dk è;ku l nf[k,A bl [kM e cl d LV'ku l NVu d ckn mldh pky c< jgh gA

i'u

1 pky ,o ox e vrj fy[kA

2- fdl fLFkfr e fdlh oLr d vklr pky o ox dk ifjek.k cjkcj gkxk\

3 ,d leku xfr d fy, ox le; xkQ [khpA

4-2-4 Roj.k (Acceleration)

vki jflx dkj vkj lMd ij pyu okyh dkj e lkekU;r% D;k vrj n[k ikr g\

,d e[; vrj ;g g fd jflx dkj dh pky cgr T;knk gkrh gA

nljk e[; vrj ;g g fd jflx dkj dk fid&vi T;knk gkrk gA fid&vi ;g crkrk g fd dkj dh pky fdruh rth l c< jgh gA bld fy, ,d rduhdh 'kCn ^^Roj.k** dk i;kx fd;k tkrk gA

lkj.kh Øekd&1 dh enn l cl A o B d ox dh x.kuk dj o nh xb lkj.kh Øekd&6 dk i.k djA

¼lkj.kh Øekd&1 e nh xb njh dk ehVj rFkk le; dk ld.M e cnydj ox dh x.kuk dj½

lkj.kh Øekd&6 ¼cl A o B dk ox ifjdyu½

le;	cl A dk ox ¼eh Vj@ld.M½	cl B dk ox ¼eh Vj@ld.M½
9.00	----------	----------
9.15	$\frac{(20-10)\times 1000}{(15)\times 60}=\frac{10\times 1000}{900}=11.11$	$\frac{(18-10)\times 1000}{15\times 60}=\frac{8000}{900}=8.89$
9.30	---------- = 11.11	----------
9.45	---------- = 11.11	----------
10.00	---------- = 11.11	----------
10.15	----------	$\frac{(52-40)\times 1000}{15\times 60}=\frac{12000}{900}=13.33$

lkj.kh Øekd&6 e ge ikr g fd cl A dh xfr d nkjku ox e ifjoru 'kU; rFkk leku le;&vrjky e ox fu;r gA ijr cl B dh xfr d nkjku fofHkUu le; e ox e ifjoru gk jgk gA vr% vc ge cl d ox e ifjoru dk 0;Dr dju d fy, ,d ub jkf'k d ckj e tkuuk gkxkA **cl d ox e ifjoru dh nj Roj.k dgykrh gA**

$$\text{Roj.k}=\frac{\text{ox e ifjoru}}{\text{le; vrjky}}$$

;fn ,d oLr u ox l py jgh g vkj t le; e mldk ox v gk tkrk g rk Roj.k

$$a=\frac{v-u}{t}$$

Roj.k dk ldr a l n'kkr gA bldk SI ek=d eh Vj@ldM² (m/s²) gkrk gA tc le; d lkFk oLr dk ox c<rk g rk mle mRiUu Roj.k dk èkukRed Roj.k vkj tc le; d lkFk oLr dk ox ?kVrk g rk mld Roj.k dk _.kkRed Roj.k dgr gA _.kkRed Roj.k eUnu dgykrk g] bl &a l inf'kr djr gA

tc le; d lkFk ox e ifjoru leku gkrk g rk ml ,dleku Rofjr xfr dgr g rFkk bldk Roj.k fu;r jgrk gA

fØ;kdyki&2

,d oLr }kjk 2 ldM d le; vrjky e r; dh xb njh fuEuku lkj gA mldk ox o Roj.k dh x.kuk dj o lkj.kh Øekd&7 dh ifr djA

lkj.kh Øekd&7 % oLrq dk ox o Roj.k

le; ¼lsdM e½	njh ¼eh Vj e½	ox ¼eh Vj@lsdM½	Roj.k ¼eh Vj@lsdM²½
0	0	----------	----------
2	1	$\frac{1-0}{2-0}=\frac{1}{2}=0.5$	$\frac{1.5-0.5}{4-2}=\frac{1}{2}=0.5$
4	4	$\frac{4-1}{4-2}=\frac{3}{2}=1.5$	\
6	9	----------	----------
8	16	----------	----------
10	25	----------	----------

lkj.kh Øekd&7 e vki ikr g fd iR;d le; ij Roj.k leku g ¼vFkkr leku le; vrjky e ox e ifjoru leku g½A vr% oLrq dh xfr ,d leku Rofjr xfr gkxhA

bl rkfydk dk i.k dj ,d leku Rofjr xfr dh njh≤] ox ≤] o Roj.k≤ d chp xkQ [khpA

,d leku Rofjr xfr e Roj.k le; d lkFk fu;r jgrk g vr% Roj.k≤ xkQ] le; v{k d lekukrj ljy j[kk gkrh gA ¼fp=&8½

Roj.k≤ xkQ dk 4&8 s d le;krjky d fy, le; v{k ij f?kjk {k=Qy

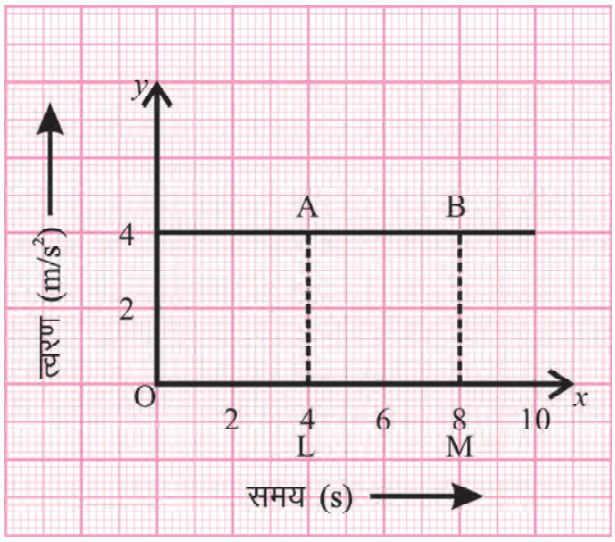
¾ vk;r ABML dk {k=Qy

¾ AL × LM

= 4 m/s² × (8 - 4)s

= 4 m/s² × 4 s

= 16 m/s



xkQ fp= Øekd&8 %
,d leku Rofjr xfr dk Roj.k le; xkQ

bl rjg Roj.k≤ xkQ dk le; v{k ij] f?kj {k=Qy l ge ox Kkr dj ldr gA

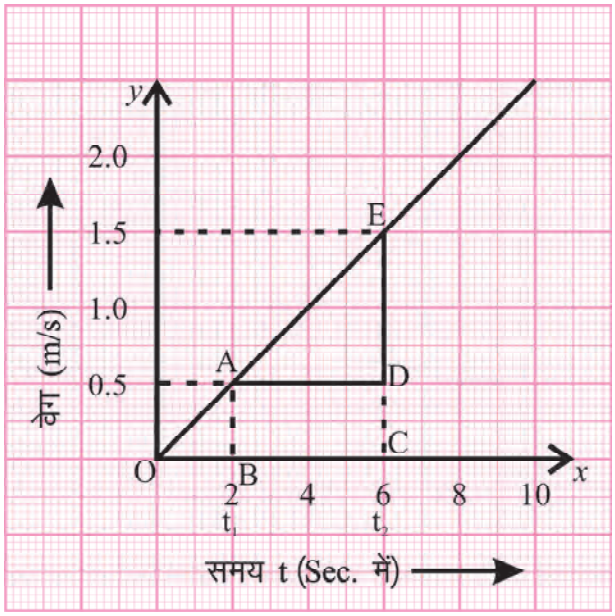
vkb,] ,d leku Rofjr xfr e ox≤ xkQ dk n[kA

xkQ l] $t_1 = 2s$ e $u = 0.5$ m/s

$t_2 = 6s$ e $v = 1.5$ m/s

$$Roj.k = \frac{v-u}{t_2-t_1} = \frac{1.5-0.5}{6-2} = \frac{1}{4} = 0.25 m/s^2$$

ge tkur g fd $ox = \frac{foLFkkiu}{le;}$ vFkkr ,d leku ox l py jgh oLr d ox ,o le; d x.kuQy l foLFkkiu ikIr fd;k tk ldrk gA fp= Øekd&9 e xkQ e n'kk, x, {k= ABCDE dk {k=Qy fn, x, le;krjky e foLFkkiu (s) dk n'kk,xkA



xkQ fp= Øekd&9 % ,d leku Rofjr xfr dk ox≤ xkQ

vFkkr s = ABCDE dk {k=Qy

= vk;r ABCD dk {k=Qy + f=Hkt ADE dk {k=Qy

$$= (AB \times BC) + \frac{1}{2} \times (AD \times DE)$$

$$s = (0.5 \times 4) + \frac{1}{2} \times (4 \times 1)$$

$$= 2 + \frac{1}{2} \times 4$$

= 2+2

= 4 m

ox≤ xkQ dk le; v{k l f?kjk {k=Qy foLFkkiu d ifjek.k dk crkrk gA

4-3 xfr d lehdj.k (Equation of motion)

tc dkb oLr ,d leku Rofjr xfr l xfr djrh g rk ,d fuf'pr le; vrjky (t) e oLr d ox (v)] Roj.k (a) rFkk r; dh xb njh (s) e lcèk LFkkfir djuk lHko gA bl xfr d lehdj.k d uke l tkuk tkrk gA

$$v = u + at \ldots\ldots\ldots\ldots (1)$$

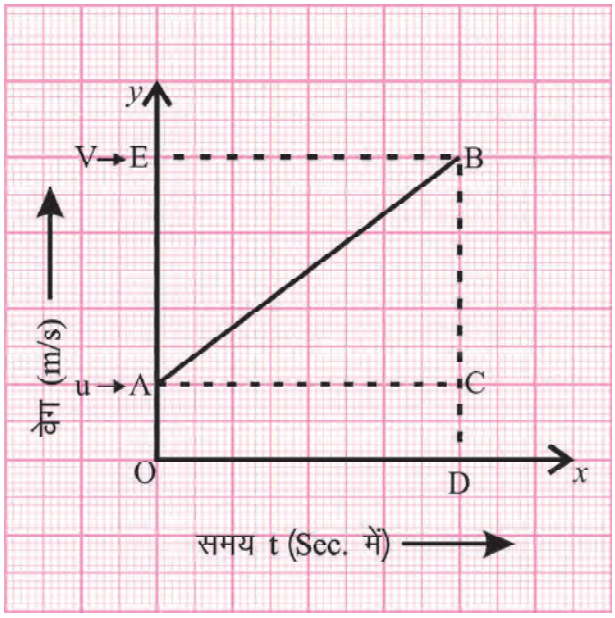
$$s = ut + \frac{1}{2}at^2 \ldots\ldots\ldots (2)$$

$$v^2 = u^2 + 2as \ldots\ldots\ldots (3)$$

,d leku Rofjr xfr e ox le; lcèk

fp=&9 e geu leku Rofjr xfr dk ox≤ xkQ n[kkA ,l gh ,d vkj xkQ fp= Øekd&10 e fn[kk;k x;k gA

xkQ e ;g irk py jgk g fd oLr dk ikjfHkd ox u g tk t le; e c<dj v gk x;k gA fcUn A ij oLr dk ikjfHkd ox u g vkj fcUn B ij oLr dk vfre ox v g ¼xkQ fp= Øekd&10 l½A



xkQ fp= Øekd&10

$$BC = v - u \qquad \ldots\ldots\ldots (i)$$

ge tkur g fd Roj.k] $a = \frac{BC}{AC} = \frac{BC}{OD}$

$$a = \frac{v-u}{t}$$

$$at = v - u \qquad \ldots\ldots\ldots (ii)$$

$v = u + at$;g xfr dk iFke lehdj.k gA

,d leku Rofjr xfr e fLFkfr le; lcèk

(a) ,d leku Rofjr xfr e ox le; xkQ dk le; v{k l f?kjk {k=Qy fudkyr g tk fd foLFkkiu d ifjek.k] s d cjkcj gkrk gA

xkQ l] s = vkdfr OABD dk {k=Qy

s = vk;r OACD dk {k=Qy + f=Hkt ABC dk {k=Qy

$= (OA \times OD) + \frac{1}{2}(AC \times BC)$

$= ut + \frac{1}{2}(OD \times BC)$ leh- (i) o fp= Øekd&10 l

$= ut + \frac{1}{2}t(v-u)$

$$= ut + \frac{1}{2}(v-u)t$$

$$= ut + \frac{1}{2}at.t \qquad \text{lehdj.k (ii) l}$$

$$s = ut + \frac{1}{2}at^2$$;g xfr dk f}rh; lehdj.k gA

ge ,d vkj rjhd l s Kkr dj ldr gA

(b) ¼·.· OABD,d leyEc prHkt gA½ vr%

s = leyc prHkt OABD dk {k=Qy

$s = \frac{1}{2} \times$ ¼ prHkt dh lekukrj Hkt kvk dk ;kxQy½ × Åpkb

$s = \frac{1}{2}(OA + BD) \times OD$ fp= Øekd&10 l

$s = \frac{1}{2}$ ¼u + v½ × t lehdj.k (ii) l t dk eku j[ku ij

$s = \frac{1}{2}$ ¼v + u½ $\times \left(\frac{v-u}{a}\right)$

$s = \frac{v^2-u^2}{2a}$

$v^2 - u^2 = 2as$;g xfr dk rrh; lehdj.k gA

bl idkj xfr d rhuk lehdj.k fuEufyf[kr g&

$v = u + at$

$s = ut + \frac{1}{2}at^2$

$v^2 - u^2 = 2as$

mnkgj.k&4 % ,d fiM 4 ehVj@ldM d ox l xfr'khy gA ;fn mldk Roj.k 2 m/s² gk rk 5 s i'pkr mldk ox rFkk mld }kjk r; dh xb njh Kkr djA

gy % fn;k g &

fiM dk ox u = 4 m/s

Roj.k $a = 2\ m/s^2$

vfre ox $v = ?$ rFkk r; dh xb njh $s = ?$

le; $t = 5\ s$

xfr d igy lehdj.k l] $v = u + at$

$= 4 + 2\times5$

$= 4 + 10$

$= 14\ m/s$

$s = ut + \frac{1}{2}at^2$

$= 4\times5+\frac{1}{2}\times2\times(5)^2$

$= 20+\frac{1}{2}\times2\times25$

$= 20 + 25$

$= 45\ m$

vr% 5s le; i'pkr mldk ox 14 m/s rFkk r; dh njh 45 m gkxhA

mnkgj.k&5 % ,d dkj $4\ m/s^2$ dh ,d leku Roj.k l xfreku g] rk xfr ikjHk dju d 10 s ckn og fdruh njh r; djxh\

gy % Roj.k $a = 4\ m/s^2$

ikjfHkd ox $u = 0$

le; $t = 10\ s$

njh $s = ?$

ge tkur g] fd $s = ut + 1/2\ at^2$

$s = (0\times5) + \frac{1}{2}\times(4)\times(10)^2$

$s = 0 + \frac{1}{2}\times4\times100$

$s = 200\ m$

vr% dkj }kjk r; dh xb njh 200 m gkxhA

mnkgj.k&6 % ,d xkMh 36 km/h dh ,d leku pky l py jgh gA tc mle cd yxk;k tkrk g rk उसमें 0.5 m/s² dk enu mRiUu gk tkrk gA xkMh u #du d igy fdruh njh r; dh gkxh\

gy % fn;k g]

xkMh dk ikjfHkd ox $u = 36\ km/h$

$$u = \frac{36 \times 1000}{60 \times 60}\ m/s$$

$$u = 10\ m/s$$

enu $a = -0.5\ m/s^2$ ¼;gk _.kRed fpUg enu dk n'kkrk gA½

vfre ox $v = 0$

pyh xbZ njh $s = ?$

$$v^2 = u^2 + 2as$$

$$(0)^2 = (10)^2 + 2 \times (-0.5) \times s$$

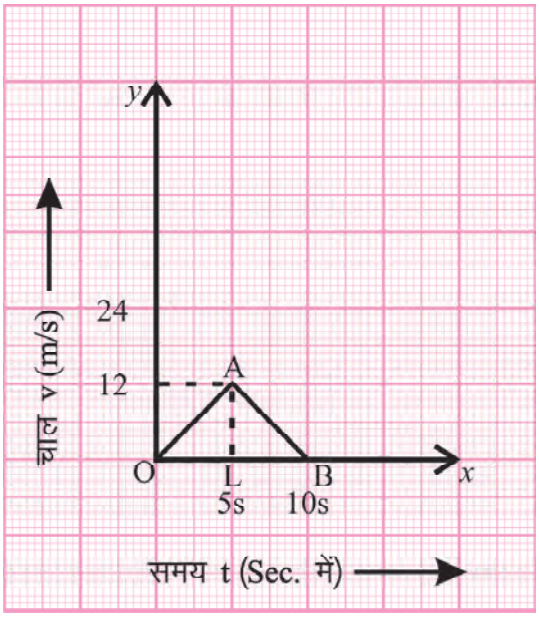
$$0 = 100 - 1s$$

$$1s = 100$$

$$s = 100\ m$$

bl rjg xkMh }kjk r; dh xbZ njh = 100 m gkxhA

mnkgj.k&7 % fdlh fuf'pr fn'kk e py jg d.k dh pky≤ xkQ uhp fp= e inf'kr g&



xkQ fp= Øekd&11 % pky≤ xkQ

0 l 10 s e pyh xb njh rFkk d.k dh vkl r pky Kkr djA

gy % (i) s = 0 l 10s e pyh xb njh

¾ pky≤ xkQ e pky≤ v{k l f?kjk {k=Qy

= ΔOAB dk {k=Qy

= $\frac{1}{2}$ vkèkkj × Åpkb = $\frac{1}{2}$ OB × AL

= $\frac{1}{2}$ × 10 × 12

= 60 m

(ii) 0 l 10s e d.k dh vkl r pky = $\frac{\text{r; dh xb njh}}{\text{dy le;}}$

= $\frac{60}{(10-0)} = \frac{60}{10}$ = 6 m/s

i'u

1- ,d leku enu e ox le; xkQ [kpA

2- dkb dkj ,d leku :i l Rofjr gkdj 18 km/h l viuk ox 36 km/h, 5s e dj yrh g rk ml dk Roj.k rFkk ml d }kjk r; dh xb njh Kkr djA

4.4 oÝkh; xfr (Circular motion)

ge tkur g fd tc fdlh oLr dh xfr Rofjr gkrh g rk ml d ox e ifjoru gkrk gA ;g ox e ifjoru fdl&fdl rjg l gk ldrk g\ ox ifjoru dh rhu fLFkfr;k lHko g&

¼1½ ox d ifjek.k e ifjoru gk ij xfr dh fn'kk fu;r gkA

¼2½ ox dk ifjek.k fu;r fdr fn'kk e ifjoru gkA

¼3½ ox d ifjek.k vkj oLr d xfr dh fn'kk] nkuk e ifjoru gkA

vc D;k vki ,d ,lh oÙkh; xfr dk mnkgj.k lkp ldr g ftle ,d leku xfr e oLr d ox dk ifjek.k fu;r gk ijr ml dh xfr dh fn'kk e fujrj ifjoru gk jgk gk\

uhp dN mnkgj.k fn, x, gA crk,] ox dh fn'kk vkj ifjek.k e D;k ifjoru gk jgk g\

(i) èkkod dk oÙkh; ekx ij nkMuk (ii) i[k dk ?keuk (iii) ?kMh dh lb;k dk ?keuk

oÙkh; xfr d vuHko] vki oÝkh; >y] gokb >y e Hkh djr gA oÝkh; xfr d ,l vU; mnkgj.k nfud thou e <<A

geu lh[kk

- xfr le; d lkFk oLr dh fLFkfr e ifjoru gA bldh 0;k[;k r; dh xb njh ;k foLFkkiu d :i e dh tkrh gA
- oLr }kjk r; fd, x, ekx dh yckb njh dgykrh gA ;g ,d vfn'k jkf'k gA SI i)fr e bldk ek=d ehVj (m) gA
- oLr dh fdUgh nk fLFkfr;k dk vrj mldk foLFkkiu dgykrk gA ;g ,d lfn'k jkf'k gA SI i)fr e bldk ek=d ehVj (m) gA
- foLFkkiu r; fd, x, ekx ij fuHkj ugh g tcfd njh r; fd, x, ekx ij fuHkj gA
- ifr bdkb le; e r; dh xb njh pky dgykrh gA bldk SI ek=d ehVj@ldM (m/s)gA
- foLFkkiu d ifjoru dh nj ox dgykrh gA bl bdkb le; e oLr }kjk ,d fuf'pr fn'kk e r; dh xb njh d uke l tkuk tkrk gA bldk ek=d ehVj@ldM (m/s) gA
- tc dkb oLr leku le; e leku njh r; djrh g rk mldh xfr ,d leku xfr dgykrh gA
- ,d leku xfr e ox le; xkQ le; v{k d lekukrj ljyj[kk gkrh gA
- fdlh oLr d ox ifjoru dh nj Roj.k dgykrh gA ;g ,d lfn'k jkf'k gA bldk SI i)fr e ek=d ehVj@ldM^2 (m/s^2) gkrk gA
- ,d leku Rofjr xfr e Roj.k≤ xkQ le; v{k d lekUkkrj ljy j[kk gkrh gA
- ,d leku Rofjr xfr e ox≤ xkQ dk le; v{k l >dko Roj.k dgykrk gA
- tc dkb oLr oÙkh; iFk ij ,d leku pky l pyrh g rk mldh xfr ,d leku oÙkh; xfr dgykrh gA

e[; 'kCn (Keywords)

njh (distance), foLFkkiu (displacement), pky (speed), ox (velocity), Roj.k (acceleration) enu (retardation or deaccelearation), ,d leku oÙkh; xfr (uniform circular motion)

vH;kl

1- lgh fodYi pudj fy[k &

(i) ;fn fdlh fi.M }kjk pyh xb njh $s = at + \frac{1}{2}bt^2$ g rk fi.M dk Roj.k gkxk&

¼v½ a ¼c½ b ¼l½ 2 b ¼n½ a + b

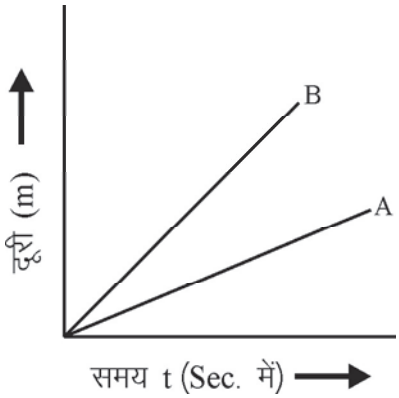
(ii) ox le; xkQ dk le; v{k l f?kjk {k=Qy ftl Hkkfrd jkf'k dk 0;Dr djrk g] mldk ek=d g &

¼v½ m ¼c½ m/s ¼l½ m/s² ¼n½ bue l dkb ugh

(iii) uhp oLr A o B dk fLFkfr le; xkQ fn;k gA crk, fdl oLr dk ox vfèkd g\

¼v½ A ¼c½ B

¼l½ A vkj B ¼n½ bue l dkb ugh



(iv) crk, fd fuEu l l dku lk mnkgj.k ,d leku oÙkh; xfr dk g&

¼v½ iFoh dh l; d pkjk vkj xfr

¼c½ f[kykuk Vu dh j[kh; ekx ij xfr

¼l½ ?kMh d ldM dkV dh xfr

¼n½ oÙkh; ekx ij jflx dkj dh xfr

2- fjDr LFkku dh ifr dj&

(i) ,d fiM fu;r ox l py jgk g mldk Roj.k ---------- gkxkA

(ii) oLr d ox dh fn'kk ---------- l fuèkkfjr gkrh gA

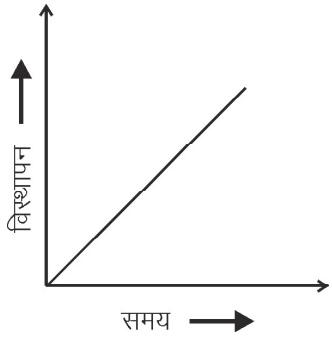
(iii) ,d oLr dh pky 72km/h g mldh pky ---------- m/s gkxhA

(iv) ,d 0;fDr 2m f=T;k d oÙkkdkj ekx dk ,d pDdj 2 ldM e yxkrk g rk 8 ldM ckn mldk foLFkkiu ---------- gkxkA

3- ,d leku oÙkh; xfr fdl dgr g\ bld nk mnkgj.k nA

4- ,d oLr l; d pkjk vkj fu;r ox l py jgh gA mldh xfr ,d leku xfr g ;k vleku\

5- ,d oLr dk foLFkkiu& le; xkQ uhp fn;k gA mld ox d ckj e vki D;k ifj.kke fudkyx\



6- ,d oLr dk fLFkfr le; xkQ le; v{k d lekukrj ljy j[kk gA mldh xfr d ckj e vki D;k dgx\

7- ,d leku xfr rFkk vleku xfr dk ifjHkkf"kr djr g, iR;d d nk&nk mnkgj.k nA

8- xfr d rhuk lehdj.k fy[kdj mle i;Dr ldrk d vFk crk,A

9- ,d ,FkyhV oÝkh; iFk ft ldh f=T;k 7 m g dk ,d pDdj 44 s e yxkrk gA 1 feuV d ckn og fdruh njh r; djxkA (60m)

10- xkQh; fofèk l xfr dk f}rh; lehdj.k $s = ut + 1/2\ at^2$ 0;RiUu djA

11- uhjt xkMh l Ldy 20 km/h dh vkl r pky l tkrk gA mlh jkLr l ykVu d le; ogk HkhM de gku l mldh vkl r pky 30 km/h gA ijh ;k=k d nkjku uhjt dh xkMh dh vkl r pky D;k g\

(24km/h)

12- ,d 20m Åph ehukj l ,d xn dk fxjk;k tkrk gA ;fn mldk ox 10 m/s^2 d ,d leku Roj.k l c< jgk g rk og tehu ij fdl ox l Vdjk;xh \ ml tehu l Vdjku efdruk le; yxxk\

(20 m/s)

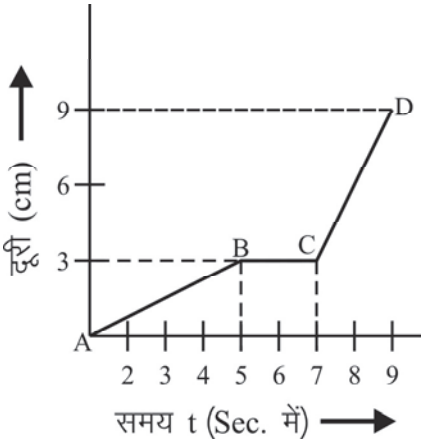
13- ,d dkj lhèk lMd ij ,d leku Rofjr xfr l xfr dj jgh gA fofHkUu le;k ij dkj dk ox fuEufyf[kr g rk mldk ox le; xkQ [khpdj mldk Roj.k o 30 ldM e pyh njh Kkr djA

t le; (s)	0	10	20	30	40	50
v pky (m/s)	5	10	15	20	25	30

(375 m)

14- lyXu fp= e fdlh oLr d fofHkUu le;k ij fLFkfr≤ xkQ [khp g, gA oLr dh pky Kkr djA

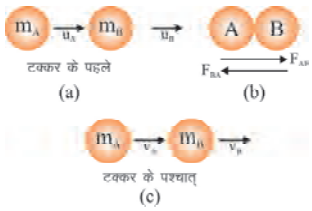
(i) A l B (ii) B l C (iii) C l D



vè;k;&5

cy ,o xfr d fu;e

(Force and Laws of Motion)



nfud thou e ge viu vkl ikl dh oLrvk dk n[k rk dN oLr, fLFkj voLFkk e yxrh g vkj dN xfr'khyA fdl h fLFkj oLr dk xfr e dl ykr g\ lkbfdy pyku d fy, iMy pyuk iMrk g] iMy pyuk cUn dj nu ij ml dh xfr èkheh gk tkrh gA lkbfdy dk xfr e j[ku d fy, vkidk fQj l iMy pyuk iMrk gA bl h idkj xn dk xfr nu d fy, ge ml èkdy ldr gA xn dk èkdyu ij D;k ok ge'kk d fy, xfr'khy gk tkrh g ;k FkkMh nj e #d tkrh g\ xn d #du dk D;k dkj.k g\

xn dk xfr nu d fy, ge ml èkdyuk iMrk g vkj fQj og èkhj&èkhj #d tkrh gA xfr'khy xn dl :drh g\ D;k og viu&vki gh :d tkrh g vFkok dkb dkjd g tk ml jkd jgk g\ io e geu i<k fd fdl h oLr dh fLFkj voLFkk vFkok xfr voLFkk e ifjoru yku d fy, cká dkjd dh vko';drk gkrh g ftl ge cy dgr gA

fØ;kdyki&1

bl fØ;kdyki e ge fpduh ydMh dk ,d xkykdkj xVdk ¼;k cky½ ydMh d nk iVV ¼1 eh- vkj 30 leh- yEckb½ lykfLVd V] jr] ry dh t:jr gA

- NkV ydMh d iVV dk 45° dk.k ij >dk dj ,d urlery cuk, ¼fp=&1½A
- yc iVV dk urlery d fupy Hkkx l lVk dj j[kA
- xVd dk urlery d Åijh Hkkx ij j[kdj ljdk,A
- xVd }kjk yc iVV ij r; dh xb njh ekiA
- vc yc iVV dk gVkdj ml d LFkku ij jr l Hkjh V j[kA
- iuh xVd dk urlery d Åijh Hkkx l ljdk, vkj jr l Hkjh V ij xVd }kjk r; dh xb njh ekiA
- mDr fØ;k dk ,d fpduh lykfLVd dh V vkj fQj fdl h ,l h lrg tk ry yxku l vkj T;knk fpduh gk tk, ij djA
- iR;d fØ;k e xVd }kjk bu leryk ij r; dh xb njh ekiA

¼fp=&1½

bl fØ;kdyki d vkèkkj ij fuEu i'uk d mÙkj nu dk i;kl dj&

1- D;k xVd u lHkh lrgk ij leku njh r; dh\

2- xVd }kjk r; dh xb nfj;k dk fHkUu&fHkUu lrgk d vulkj Øe e tek,A

3- fdl fLFkfr e xVd u lcl T;knk njh r; dh vkj D;k\

io d{kkvk e ge ^^?k"k.k** cy d ckj e i< pd g tk oLr dh xfr dk jkdrk gA ?k"k.k cy dk eku lrgk dh idfr d vulkj cnyrk jgrk gA ftu lrgk ij ?k"k.k cy de gkrk g mu ij oLr vfèkd njh r; djrh gA

bld vkèkkj ij crk, fd mDr fØ;kdyki e fdl lrg ij ?k"k.k cy dk eku lcl de Fkk\

tl k fd geu n[kk] ftu lrgk ij ?k"k.k cy dk eku lcl de gkrk g] ml ij oLr vfèkd le; rd xfr dh voLFkk e jgrh gA

lkp] ;fn lrg ij ?k"k.k cy dk eku 'kU; gk rk D;k oLr dHkh :dxh\

xyhfy;k dk dguk Fkk fd fdlh ckÁ vojkèkd cy dh vuifLFkfr e {kfrt ry ij xfr djrh gb oLr fu;r ox l yxkrkj xfr djrh jgxh vkj blh rjg ;fn dkb oLr fojke e g rk tc rd ml ij dkb ckÁ cy dk; ugh djxk rc rd og mlh voLFkk e jgxhA vr% ge dgr g fd oLr viuh fLFkfr ¼xfr ;k fojke½ e rc rd cuh jgrh g tc rd fd dkb ckÁ cy mldh fLFkfr e ifjoru mRiUu u djA bl tMRo dgr gA tMRo d db mnkgj.k ge viu nfud thou e n[k ldr g] tl pyr okgu e ,dk,d cd yxku ij ml e cBk 0;fDr vkx dh vkj >d tkrk g vkj okgu e iMh oLr,¡ vkx fd vkj ljdrh gA vkiu Hkh ,lk egll fd;k gkxkA ,lh ifjfLFkfr;k d dN vkj mnkgj.k nA D;k vki crk ldr g fd ,lk D;k gkrk g\ vkil e ppk djA

pyr okgu e cBk 0;fDr okgu d lkFk xfr'khy voLFkk e gkrk gA okgu d :du ij mld 'kjhj dk fupyk Hkkx tk lhV d lkFk g] tYnh fLFkj voLFkk e vk tkrk g ijr tMRo d dkj.k Åij dk Hkkx xfr'khy gh cuk jgrk gA vr% okgu e cBk 0;fDr vkx dh vkj >d tkrk gA vki ;g Hkh crk ldr g okgu d ,dk,d pyu ij 'kjhj ihN dh vkj D;k >d tkrk g\ vkil e ppk djd mÙkj dkih e fy[kA

5-1 tMRo rFkk n0;eku (Inertia and mass)

vHkh rd fn, x, lHkh mnkgj.kk l Kkr gkrk g fd iR;d oLr viuh voLFkk e ifjoru dk fojkèk djrh g pkg og fojkekoLFkk e gk ;k xfr'khyA og bl fLFkfr dk ugh cnyuk pkgrh vkj viuh ey voLFkk cuk, j[kuk pkgrh gA oLrvk dh ;g idfr gh tMRo gA bll db vkj loky mHkjr gA tl ;g lkpk tk ldrk g fd D;k lHkh oLrvk e tMRo gkrk g\ ;fn gk rk bldk eku fdl ij fuHkj g vkj ;g Hkh fd D;k lHkh oLrvk dk tMRo leku gkrk g\ vkb,] bl tkuu d fy, ,d fØ;kdyki djr gA

fØ;kdyki&2

- lykfLVd dh nk ckry ^d* vkj ^[k* yA
- ckry ^[k* e ikuh HkjA
- nkuk ckry dk gkFk l ekj dj fxjk,A
- fdl ckry dk fxjkuk T;knk vklku Fkk\

vki ik,x fd [kkyh ckry dk Hkjh ckry d vi{kk gkFk l ekjdj fxjkuk vklku gA

blh rjg iLrdk l Hkj ckDl dk èkDdk nu dh vi{kk [kkyh ckDl dk èkDdk nuk vklku gkrk gA

,l db vkj mnkgj.k ge lkp ldr g tl lkbfdy ij vdyk 0;fDr gk rk lkbfdy dk cd yxkdj 'kh?krk l jkdk tk ldrk gA ijr tc vkid lkFk vkidk fe= Hkh lkbfdy ij cBk gkrk g rk lkbfdy dk cd yxkdj jkduk dfBu gk tkrk gA

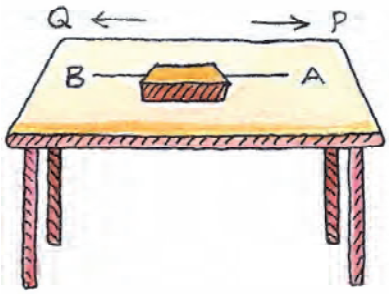
D;k vki budk dkj.k le>k ldr g\ vkil e ppk djA

Hkjh gb ckry dh voLFkk cnyu d fy, [kkyh ckry dh vi{kk T;knk cy dh vko';drk gkrh gA blh idkj tc ,d 0;fDr lkbfdy pykrk g rk pyrh lkbfdy dk jkdu e de cy yxrk g] tcfd nk 0;fDr;k d cB gku ij cd yxku e T;knk cy yxrk gA bldk vFk g Hkkjh oLrvk e T;knk tMRo gkrk gA tMRo og idfr g ftld dkj.k oLr yxkrkj viuh fojke ;k xfr dh voLFkk e cu jgu dk i;kl djrh gA n0;eku oLr d voLFkk ifjoru e fojkèk dk ekid g vFkkr n0;eku oLr d tMRoh; iofÙk dk eki gA n0;eku ftruk vfèkd gkxk oLr dk tMRo Hkh mruk gh vfèkd gkxkA SI i)fr e n0;eku dk ek=d fdykxke (kg) gkrk gA

5.2 lrfyr vkj vlrfyr cy (Balanced and unbalanced force)

fØ;kdyki&3

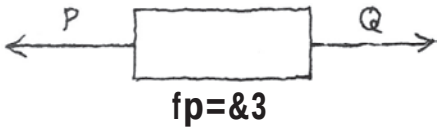
,d ydMh dk xVdk yA bl xVd d nk foijhr Qydk ij gd ;k dhy yxk,A nkuk gdk e leku yEckb d èkkx A vkj B yxk,] tl fp=&2 e fn[kk;k x;k gA vc bl xVd dk et ij j[kA vc ;fn doy èkkx A dk ¼P cy l½ [khp rk xVdk nkfguh vkj f[kldrk g vkj doy èkkx B dk ¼Q cy l½ [khp rk xVdk ck;h vkj f[kldrk gA ;fn èkkx A o B ij leku cy yxkdj [khp rk xVdk viu LFkku l ugh f[kldrk gA ;g leku cy vkil e ,d nlj dk lrfyr dj yr g ftl oLr dh fLFkfr e cnyko ugh yk ikr gA bl mnkgj.k e fn, lrfyr cy dk fp=&3 }kjk n'kk;k tk ldrk g ¼tgk P = Q g½A



¼fp=&2½

;fn nkuk cy cjkcj ugh rk xVd ij yxk gvk uV cy gkxk

= P – Q tgk P > Q



fp=&3

uV cy fdlh oLr ij yx jg lHkh cyk dk ifj.kkeh cy gA uV cy dk le>u d fy, ge lcl igy oLr ij yx jg lHkh cyk ,o mudh fn'kkvk dk tkuuk gkxkA uV cy ikIr dju d fy, mu cyk dk tkMk tkrk g tk ,d fn'kk e g vkj mu cyk dk ?kVk;k tkrk g tk foijhr fn'kk e gA xVd ij yxk gvk uV cy] P vkj Q dk lfn'k ;kx gA blfy,] lrfyr cy dh voLFkk e xVd ij yxk gvk uV cy = P – Q

;fn (∵ P = Q)

vr% uV cy = 0

;fn èkkx A ij de o èkkx B ij T;knk cy yxkdj [kpk tk, rk xVdk ck;h vkj f[kld tkrk gA nkuk cy lrfyr ugh g vFkkr yxu okyk cy vlrfyr cy gA vr% oLr dh xfr vfèkd ifjek.k oky cy dh fn'kk vFkkr B dh vkj g ¼fp= Øekd&3 l½A

oLr ij dk; dju okyk cy ¾ P – Q

TZTFQP

5-3 xfr dk iFke fu;e (First law of motion)

U;Vu u cy o xfr d lcèk dk le> dj xfr d fu;e iLrr fd,A U;Vu d vuIkj ^iR;d oLr viuh fLFkj voLFkk ;k leku xfr dh voLFkk e rc rd cuh jgrh g tc rd fd ml ij dkb cká vlrfyr cy dk;jr u gkA** bl xfr dk iFke fu;e dgr gA

tlk fd geu i<k g] tMRo oLr dh og iofÙk g ftld dkj.k oLr mldh fLFkfr e gku oky ifjoru dk fojkèk djrh gA vr% xfr d iFke fu;e dk tMRo dk fu;e Hkh dgr gA

D;k vki xfr d iFke fu;e d vuIkj fuEu mnkgj.kk dk le>k ldr g\

- dcy dk NMh l ihVu ij èky d d.k >M tkr gA
- iM dk fgyku ij mle yx Qy uhp fxjr gA

vkil e ppk djd bldk dkj.k le>k,A D;k vki ,l dN vkj mnkgj.k lkp ldr gA

tc ge pyrh gb jyxkMh e ,d gh LFkku ij [kM gkdj mNyr g rc mlh txg ij nkckjk vk tkr g] ,lk D;k gkrk g\

5-4 jf[kd lox (Linear momentum)

xfr dk iFke fu;e ge ;g crkrk g fd tc dkb vlrfyr cká cy fdlh oLr ij dk; djrk g rk ml oLr d ox e ifjoru gkrk gA ;g ox e ifjoru oLr ij yxk, x, cy ij fuHkj gkrk g ij ox d ifjoru dk ge dl irk dj] ge vkx bl ij ppk djxA

;fn ,d rt xfr l Qdh Vcy Vful dh xn vkj ,d fØdV dh xn vki l vkdj Vdjk, rk vkidk fdldh pkV vfèkd yxxh\ ,d leku ox l xfr'khy lkbfdy ;k Vd nhokj l Vdjk, rk Vd d

Vdjku l nhokj dk vfèkd gkfu gkxhA ,l dN vkj mnkgj.k lkp o mu ij ppk djA bl ij vkj fopkj dju d fy, fØ;kdyki&4 djA

fØ;kdyki&4

- ,d cMh lyV yA
- ml xhyh feVVh ;k jr l Hkj nA
- fØdV dh xn vkj lykfLVd dh xn dk ,d leku Åpkb l lyV ij fxjk,A D;k gkrk g\ D;k nkuk xnk dk iHkko jr ij leku gkrk g\
- ;fn fØdV dh xn dk fHkUu&fHkUu Åpkb;k l lyV ij fxjk;k tk, rk D;k iHkko gkxk\ dc xn vfèkd èkl rh g\

bl fØ;kdyki l irk pyrk g fd oLr d }kjk mRiUu iHkko oLr d n0;eku ij fuHkj gA vfèkd n0;eku okyh fØdV dh xn dk iHkko vfèkd gA nljh vkj l ge n[kr g fd vfèkd Åpkb l Qdh xb xn vfèkd ox l jr ij fxjxh o jr vfèkd èklxhA e[;r% ;g iHkko oLr d ox o n0;eku ij fuHkj gA ble l dkb Hkh jkf'k leku ifjfLFkfr e c<kb tk, rk iHkko T;knk gkxkA

fdlh oLr d n0;eku o ox dk x.kuQy lox dgykrk gA fdlh oLr dk lox p mld n0;eku m vkj ox v d x.kuQy l ifjHkkf"kr gkrk g vFkkr p = mv

lox ,d lfn'k jkf'k g ftldh ifjek.k o fn'kk nkuk gkrh gA lox dh fn'kk ogh gkxh tk ox dh fn'kk gkrh gA bldk SI ek=d fdxk eh@ld.M (kg.m/s) gA

lox e ifjoru o cy (Force and the change in momentum)

,d ,lh fLFkfr d ckj e lkp ftll [kjkc cVjh okyh dkj dk lhèkh lMd ij xfr dju d fy, èkDdk fn;k tkrk gA 'k:vkr e dkj pky ugh gkrh g yfdu dN le; rd yxkrkj èkDdk nu l dkj dh xfr c<rh tkrh g vkj xfr rt gku d ckn gh dkj dk pky dju dk i;kl djr gA ge dg ldr g fd yxkrkj cy yxku l dkj dk lox Hkh èkhj&èkhj c<rk tkrk gA bll Li"V g fd dkj d lox e ifjoru doy cy d ifjek.k l ugh gkrk g cfYd ml le; ij Hkh fuHkj djrk g ftru le; rd ml ij cy yxrk gA oLr d lox e ifjoru yku e cy dk eku vkj cy d dk; dju dk le; egRoi.k gA

5-5 xfr dk f}rh; fu;e (Second law of motion)

xfr d f}rh; fu;e d vulkj ^^fdlh oLr d lox ifjoru dh nj yxk, x, vlrfyr cy d lekuikrh gkrh gA**

;fn F uV vlrfyr cy gk tk oLr ij yx jgk g] p lox gk rk] xfr d f}rh; fu;e d vulkj&

$$F \alpha \frac{p_2 - p_1}{t_2 - t_1}$$

U13BSC

tgk t_1 le; ij oLr dk ikjfEHkd lox p_1 g rFkk
t_2 le; ij oLr dk lox p_2 gA

$F \alpha \frac{\Delta p}{\Delta t}$ tgk $\Delta p = p_2 - p_1$ ¼lox e ifjoru½

$\Delta t = t_2 - t_1$ ¼le; e ifjoru½

;gk lekuikr fpà dk gVkus d fy, K, ,d lekuikfrd fLFkjkd] yxk;k tkrk gA

$$F = K \frac{\Delta p}{\Delta t}$$

K = 1 yus ij $F = \frac{\Delta p}{\Delta t}$

$$F = \frac{\Delta p}{\Delta t}$$

$$F = \frac{m\Delta v}{\Delta t} \qquad [p = mv]$$

$$F = m \frac{\Delta v}{\Delta t} \qquad \left[\because a = \frac{\Delta v}{\Delta t}\right]$$

$$F = ma$$

;gh xfr d f}rh; fu;e dk xf.krh; :i gA

;fn m = 1 fdyksxke (1 kg)

a = 1 eh/Vj@lsd.M^2 (1m/s^2)

rks] F = 1 fdxk × 1eh/Vj@l^2 (kg.m/s^2)

F = 1 U;wVu (N)

1 U;wVu cy og cy g ftls 1 fdxk dh oLr ij yxkus ij og 1 eh/Vj@lsd.M^2 d Roj.k ls xfr djrk gA U;wVu] cy dk SI ek=d gA bl N ls n'kkr gA

mnkgj.k&1 % 3 fdyksxke n0;eku okyh oLr ij fØ;k'khy fu;r cy 25 lsd.M e mlds ox dk 2 eh/Vj@lsd.M ls c<kdj 3-5 eh/Vj@lsd.M dj nrk g rk yxk;k x;k cy dk ifjek.k Kkr djA

gy % oLr dk n0;eku m = 3 kg

oLr dk ikjfHkd ox u = 2 ms^{-1}

oLr dk vfre ox v = 3.5 ms^{-1}

cy yxus dk le; t = 25 s

Kkr djuk g F = ?

ge tkur g fd $F = \frac{p_2 - p_1}{t} = \frac{mv - mu}{t}$

$F = \frac{m(v-u)}{t}$

$F = \frac{3(3.5-2)}{25}$

$F = \frac{3\times1.5}{25} = \frac{3\times15}{250} = \frac{45}{250}$

$F = 0.18N$

yxk, x, cy dk ifjek.k 0-18 U;Vu gkxkA

mnkgj.k&2 % 5 fdyksxke dh ,d Vkyh ij cy yxku l mle 10 ms^{-2} dk Roj.k mRiUu gkrk gA vkjkfir cy dh x.kuk djA

gy % Vkyh dk n0;eku m = 5 kg

Vkyh e mRiUu Roj.k a = 10 ms^{-2}

Vkyh ij yxk cy F = ?

F = ma

F = 5 × 10

F = 50 N

Vkyh ij yxk cy 50 U;Vu gA

mnkgj.k&3 % ,d ych et ij lhèkh j[kk e tk jgh 30 xke n0;eku dh xn d ox dk le; d lkFk xkQ fn;k x;k gA xn dk fojkekoLFkk e yku d fy, fdruk ?k"k.k cy yxkuk gkxkA

gy % xn dk ikjfHkd ox u = 15 cm/s = 0.15 ms^{-1}

xn dk vfre ox v = 0

le; t = 5 s

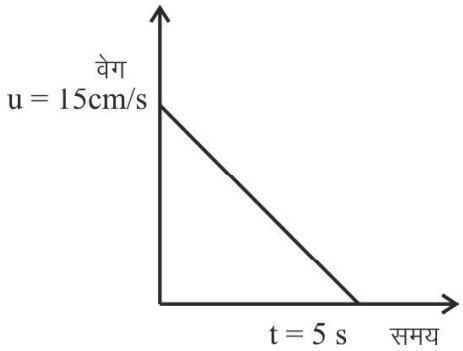
xn dk n0;eku m = 30 gm = 0.03 kg

xn ij yxk ?k"k.k cy F = ?

$F = m\frac{(v-u)}{t} = \frac{0.03(0-0.15)}{5}$

$F = \frac{0.03(-0.15)}{5} = -0.0009N$

$F = -9 \times 10^{-4}$ N



fp=&4

;gk _.kkRed fpUg ;g crkrk g fd xn dh ikjfEHkd xfr d foijhr fn'kk e ?k"k.k cy yx jgk gA

mnkgj.k&4 % 5 fdxk dh ,d oLr ij 10 U;Vu dk cy 5 sec rd yxk;k tkrk g] bl cy l fdruk Roj.k mRiUu gkxkA oLr d ox e ifjoru dh Hkh x.kuk djA

gy % ge Kkr g fd oLr dk n0;eku $m = 5\,kg$

oLr ij yxk cy $F = 10\,N$

le; $t = 5\,s$

ge Kkr djuk g Roj.k $a = ?$

vkj ox e ifjoru $v-u = ?$

pfd $F = ma$

vFkkr $10 = 5 \times a$

$a = 2 m/s^2$

$\because a = \frac{v-u}{t}$

$2 = \frac{v-u}{5}$

$v-u = 2 \times 5\,m/s$

ox e ifjoru ¾ $v-u = 10\,m/s$

ppk dj

1- fØdV f[kykMh rth l vkrh xn dk dp djr le; xn idMu d lkFk viu gkFk ihN D;k y tkrk g\

2- dN Åpkb l iDd Q'k dh vi{kk dPp Q'k ij ;k Hkl d <j ij dnu ij pkV de yxrh g] D;k\

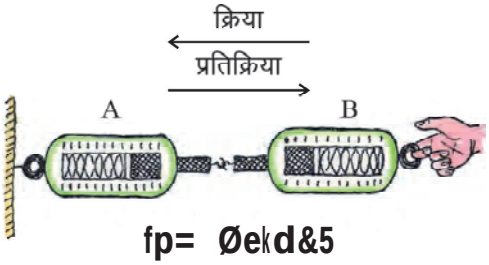
3- ;fn uV vlrfyr cy 'kU; gk tk, rk D;k lox Hkh 'kU; gkxk\ le>k,A

5-6 Xkfr dk rrh; fu;e (Third law of motion)

xfr dk rrh; fu;e le>u d fy, vkb, ,d fØ;kdyki djA

fØ;kdyki&5

- ,d fLix cyl A y rFkk mldk fLFkj fljk nhokj ij dhy l yVdk nA
- fLix d eDr flj dk [khp vkj yxk, x, cy dk eku ukV dfj,A



fp= Øekd&5

- ,d vkj fLix cyl B dk A l tkMA t l k fd fp=&5 e fn[kk;k x;k gA
- vc A vkj B dk ,d lkFk [khp vkj eku ukV dfj,A
- vki n[kr g fd nkuk fLix ryk, ,d gh eku n'kkrh gA D;k\

mi;Dr mnkgj.k e fLix cyl B fLix cyl A ij cy yxkrk g vkj nljk fLix cyl A, fLix cyl B ij leku cy foijhr fn'kk e yxkrk gA nkuk leku cy nk vyx&vyx oLrvk ij dk; djr gA tc ,d oLr nljh oLr ij cy yxkrh g rk nljh oLr Hkh igyh oLr ij foijhr fn'kk e leku cy yxkrh gA oLrvk ij yx jg bu cyk d tkMk dk fØ;k&ifrfØ;k dgk tkrk gA

Xkfr d rhlj fu;e d vulkj ^iR;d fØ;k dh lno cjkcj ,o foijhr fn'kk e ifrfØ;k gkrh gA** fØ;k vkj ifrfØ;k cy lno nk vyx&vyx oLrvk ij dk; djr gA blhfy, cy lno leku vkj foijhr fn'kk e gku ij Hkh uV cy 'kU; ugh gkrkA

tc vki pyr g rk D;k gkrk g\ pyuk 'k: dju d fy, cy dh vko';drk gkrh g ft l l Roj.k mRiUu gkrk gA Roj.k mRiUu dju d fy, ft l fn'kk e ge vkx c<uk gkrk g mld foijhr fn'kk e ge lMd ij viu ijk l cy yxkr gA lMd Hkh gekj ijk ij mruk gh ifrfØ;k cy foijhr fn'kk e yxkrh g ft l l ge vkx c<r gA

è;ku n fd ;|fi fØ;k vkj ifrfØ;k cy eku e ge'kk leku gkr g fQj Hkh ;g cy ,d leku ifjek.k d Roj.k mRiUu ugh djr D;kfd nkuk oLrvk dk n0;eku ,d lk ugh gkrkA gekj èkdyu l iFoh ihN dh vkj pyuk 'k: ugh djrh fdr ge vkx dh vkj t:j Roj.k l xfr fey tkrh gA

;fn A oLr B oLr ij F_1 cy yxk, vkj B oLr A oLr ij F_2 cy yxk, rk xfr d rrh; fu;e d vulkj $F_1 = -F_2$

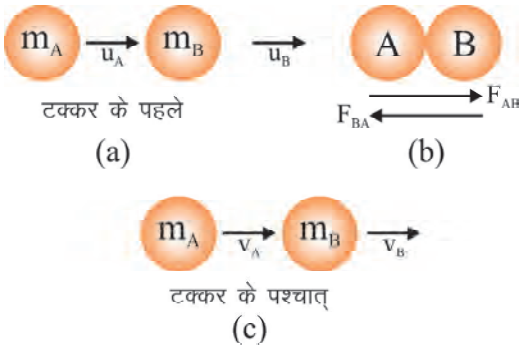
;gk _.kkRed fpà ;g n'kkrk g fd cy F_2 dh fn'kk F_1 d foijhr gA

xfr dk iFke ,o f}rh; fu;e ,d gh oLr ij ykx gkrk g tcfd rrh; fu;e nk ijLij fØ;k dj jgh oLrvk ij ykx gkrk gA fØ;k ifrfØ;k o cy n'kkrh g tk ,d gh le; ij nk vyx&vyx oLrvk ij dk; djrh gA

rrh; fu;e d dN vkj mnkgj.k lkpA

5.7 lOkx lj{k.k dk fu;e (The law of conservation of momentum)

ekuk fd vkid ikl nk xn A vkj B g ftudk n0;eku Øe'k% m_A vkj m_B g ;g ,d gh ljy j[kk e Øe'k% u_A vkj u_B ox l xfr dj jgh g rFkk mu ij dkb vlrfyr cy ugh yx jgk gA t le; i'pkr nkuk xn vkil e Vdjkrh g tgk A, B xn ij F_{AB} cy rFkk B, A xn ij F_{BA} cy yxkrh gA bll A vkj B d ox Øe'k% V_A vkj V_B gk tkr gA



xnk }kjk ijLij yxk;k x;k cy xfr d rrh; fu;e d vulkj leku ,o foijhr fn'kk e g vrk

$F_{AB} = -F_{BA}$

bu cyk d dkj.k xn d ox e ifjoru gkrk g ft l l xn dk lox ifjofrr gk tkrk gA

vr% xfr d f}rh; fu;e d vulkj %

cy ¾ lox e ifjoru dh nj

$$F_{AB} = \frac{m_B(v_B - u_B)}{t}$$

$$F_{BA} = \frac{m_A(v_A - u_A)}{t}$$

Xkfr d rrh; fu;e l

$F_{AB} = -F_{BA}$

$$\frac{m_B(v_B - u_B)}{t} = \frac{-m_A(v_A - u_A)}{t}$$

$m_B(v_B - u_B) = -m_A(v_A - u_A)$

$m_B v_B - m_B u_B = -m_A v_A + m_A u_A$

$m_A v_A + m_B v_B = m_A u_A + m_B u_B$

Vdjku d ckn lox = Vdjku d igy lox

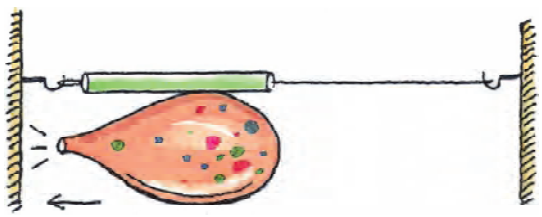
bl leh dj.k l geu ik;k fd tc xnk ij dkb cká cy ugh yxrk g rk mudk dy lox Vdjku d ckn Hkh leku jgrk gA nkuk xnk dk dy lox ugh cnyrk g tcfd xnk dk viuk&viuk lox cny tkrk gA bl gh lox lj{k.k dk fu;e dgr gA

bl fu;e d vulkj ^^cká vlrfyr cy dh vuifLFkfr e nk oLrvk dk dy lox ljf{kr jgrk gA**

vkb,] bl gr fØ;kdyki n[kA

fØ;kdyki&6

- ,d cM vkdkj dk xCckjk y rFkk ble ijh rjg l gok Hkjdj bld e[k dk èkkx l ckèk yA
- bl xCckj dh lrg ij Vi dh enn l ,d LVk yxk,A
- LVk d chp l ,d yck o eghu èkkxk vkjikj fudkyA
- vc bl èkkx d nkuk fljk dk nhokj ij yxk,A ¼fp= Øekd&7½
- vc xCckj d eg e yx èkkx dk [kky nA
- t l gh èkkxk [kkyr g] xCckj e Hkjh gok ckgj vku yxrh gA
- xCckj o LVk dh xfr dk voykdu dfj,A



fp= Øekd&7

vki le> x, gkx fd ;gk xfr dk rrh; fu;e ykx gk jgk gA ij D;k vki crk ldr g fd o oLr,¡ dku lh g ftu ij ;g fu;e ykx gk jgk g\

bl fl)kUr ij dk; dju oky mnkgj.kk dk <f<,A

mnkgj.k&5 % 40 fdxk vkj 20 fdxk n0;eku dh nk xkykdkj oLr,¡ 10 m/s rFkk 50 m/s d ox l py jgh gA budh fn'kk ,d nlj dh vkj gA dN le; lk'pkr o Vdjkdj vkil e fpid tkrh gA bl tMh gb oLr dk ox fdruk gkxk\

gy % fn;k x;k g fd

igy xkykdkj oLr dk n0;eku $m_1 = 40\,kg$

nlj xkykdkj oLr dk n0;eku $m_2 = 20\,kg$

igy xkykdkj oLr dk ox $u_1 = 10\,m/s$

nlj xkykdkj oLr dk ox $u_2 = 50\,m/s$

Vdjku d ckn fpid tkM dk ox $v = ?$

lox lj{k.k fu;ekulkj $(m_1 + m_2)\,v = m_1u_1 + m_2u_2$

$$(40 + 20)\,v = 40 \times 10 + 20 \times (-50)$$

$$60v = 400 - 1000$$

[∵ oLr,¡ ,d nlj dh vkj xfreku g blfy, $u_2 = -50\,m/s$]

$$v = -\frac{600}{60}$$

$$v = -10\,m/s$$

Vdjku d ckn tMh gb oLr dk ox 10 ms^{-1} gkxk vkj ;g 20 kg. n0;eku okyh oLr dh fn'kk e xfr'khy gkxhA

mnkgj.k&6 % 2 fdxk dh ,d cUnd l 20 gm dh xkyh 100 ms^{-1} d {kfrt ox l NkMh tkrh gA cnd d ihN gVu dk ox Kkr djA

gy % cnd dk n0;eku $m_1 = 2\,kg$

cnd dk ikjfEHkd ox $u_1 = 0$

xkyh dk n0;eku $m_2 = 20\ gm = 0.02\ kg$

xkyh dk ikjfEHkd ox $u_2 = 0$

cnd dk vfre ox $v_1 = ?$

xkyh dk vfre ox $v_2 = 100\,m/s$

lox lj{k.k fu;e l

$$m_1v_1 + m_2v_2 = m_1u_1 + m_2u_2$$

$$2 \times v_1 + 0.02 \times 100 = 20 \times 0 + 0.020 \times 0$$

$$2v_1 + 2 = 0 \quad ;k \quad 2v_1 = -2$$

$$v_1 = -1\,m/s$$

vr% cnd 1 m/s ox l ihN dh vkj gVxhA

ppk dj

1- ;fn fØ;k lno ifrfØ;k d cjkcj g rk Li"V dj fd cy xkMh dk dl [khp ikrk g\

2- jkdV dh xfr fdl fl)kr ij vkèkkfjr g\

3- ,d vfXu'keu depkjh dk rho xfr l T;knk ek=k e ikuh Qdu okyh jcj dh ikbi l rdyhQ D;k gkrh g\ Li"V djA

i'u

1- 1 kg vkj 2 kg n0;eku dh nk oLr, ,d gh j[kk d vufn'k ,d gh fn'kk e Øe'k% 2 ms^{-1} vkj 1 ms^{-1} dh ox l xfr dj jgh gA nkuk oLr, Vdjkrh gA Vdjku d ckn iFke oLr dk ox 1-5 ms^{-1} gk tkrk g rk nljh oLr dk ox Kkr djA

geu lh[kk

- Cky og ckÁ dkjd g tk fdlh oLr dh fLFkj voLFkk vFkok xfrt voLFkk e ifjoru djrk g ;k ifjoru dju dk i;kl djrk gA
- Xkfr d iFke fu;e d vulkj ^^oLr viuh fLFkj voLFkk vFkok xfrt voLFkk e rc rd cuh jgrh g tc rd fd ml ij dkb ckÁ vlrfyr cy dk; u djA**
- fdlh oLr dh og iofÙk ft ld dkj.k oLr viuh fLFkj voLFkk ;k xfr voLFkk e ifjoru dk fojks/k djrh g] tMRo dgykrh gA fdlh oLr d tMRo dh eki mld n0;eku ij fuHkj gA
- fdlh oLr d n0;eku vkj ox dk x.kuQYk lox dgykrk gA lox dh fn'kk ogh gkrh g tk oLr d ox dh fn'kk gkrh gA lox dk ek=d kgms^{-1} gkrk gA
- lox e ifjoru dju e yxk le; ;fn de gk rk cy T;knk gkxkA ,l e xfreku oLr dk jkdu e pkV yxu dh lHkkouk c< tkrh gA
- xfr d f}rh; fu;e d vulkj fdlh oLr d lox ifjoru dh nj ml oLr ij vkjksfir vlrfyr cy d lekuikrh rFkk cy dh fn'kk e gkrh gA
- cy dk SI ek=d U;Vu ;k kgms^{-2} gA
- xfr d rrh; fu;e d vulkj iR;d fd;k d foijhr o cjkcj ifrfØ;k gkrh gA fØ;k vkj ifrfØ;k nkuk fHkUu&fHkUu oLrvk ij dk; djrh gA
- ;fn fdlh oLr ij ckÁ cy u yx jgk gk rk oLr dk lox ljf{kr jgrk gA

e[; 'kCn (Key Words)

lrfyr cy (balanced force)] vlrfyr cy (unbalanced force)] tMRo (inertia), jf[kd lox (linear momentum), jf[kd lox lj{k.k d fu;e (laws of conservation of linear momentum)

vH;kl

1- lgh fodYi pfu,&

(i) fdlh oLr d tMRo dk dkj.k gA

¼v½ doy n0;eku ¼c½ doy ox

¼l½ n0;eku vkj ox nkuk ¼n½ dkb Hkh ughA

(ii) ,d yMdk ,d Vu d fMCc e lcl Åij dh lhV ij cBk gA tc Vu ,d LV'ku ij #drh g] mlh le; yMdk viu l Bhd uhp viu Hkkb d [ky gkFk ij vke fxjkrk gA vke fxjxk&

¼v½ Bhd mld Hkkb d gkFk eA

¼c½ mld Hkkb d gkFk l dN nj Vu pyu fd foijhr fn'kk eA

¼l½ mld Hkkb d gkFk e dN nj Vu pyu dh fn'kk eA

¼n½ bue l dkb Hkh ughA

(iii) jkdV uknu dk fl)kUr vkèkkfjr g&

¼v½ xfr d iFke fu;e ¼c½ xfr d f}rh; fu;e

¼l½ n0;eku lj{k.k d fu;e ij ¼n½ lox lj{k.k d fu;e ij

(iv) ,d xkyk 500 N cy yxku ij 0-06 ld.M e #d tkrk gA xky dk lox gkxk&

¼v½ 500 N ¼c½ 500 kgm/s ¼l½ 30 kgm/s ¼n½ 30 N

2- fjDr LFkku dh ifr dj&

(i) lox lj{k.k dk fu;e ---------- dh vuifLFkfr e ykx gkrk gA

(ii) ,d dekuhnkj ryk d nkuk fljk dk 20&20 fdykxke Hkkj d cy l [khpk tkrk g rk ryk dk ikB;kd ---------- gkxkA

(iii) xfr dk iFke fu;e ---------- d fu;e l tkuk tkrk gA

(iv) fdlh oLr d n0;eku dk fLFkj j[kr g, Roj.k dk nxuk dj n rk cy ---------- gk tk,xkA

(v) cy ---------- jkf'k gA

ppk djd fy[k

1- rhu Bkl tk Øe'kh ,yfefu;e] LVhy rFkk ydMh d cu g ,o budk vkdkj rFkk vk;ru leku gA crkvk ble l fdl Bkl dk tMRo T;knk gkxk vkj D;k\

2- dkp d cru iDd Q'k ij fxju l VV tkr g ij jr ij fxju l ughA ,lk D;k\

3- xfr d f}rh; fu;e dk xf.krh; l= fy[kdj mle i;Dr ldrk dk vFk fyf[k,A

4- cnd pyku ij 0;fDr dk ihN dh vkj èkDdk D;k yxrk g\

5- cl dh Nr ij j[k lkeku dk jLlh l D;k ckèkk tkrk g\

6- fl} dj ;fn nk oLrvk d lox leku g rk gYdh oLr dk ox Hkkjh oLr d ox l vfèkd gkxkA

7- xfr d rhlj fu;e d vulkj tc ge fdlh oLr ij cy yxkr g rk oLr mruk gh cy foijhr fn'kk e yxkrh gA ;fn og oLr ,d dkj gk tk ,d lMd d fdukj [kMh g] lHkor% gekj }kjk cy yxku ij Hkh dkj xfr'khy ugh gk ik,xhA ,d fo|kFkh bl lgh lkfcr dju d fy, dgrk g fd nkuk cy foijhr o cjkcj g tk ,d nlj dk fujLr dj nr gA bl rd ij viu fopkj n vkj crk, fd dkj foijhr fn'kk e xfr'khy D;k ugh gk ikrh\

8- 50 fdxk n0;eku dh ,d oLr dk ox leku Roj.k l pyr g, 6 ldM e 4 ehVj@ldM l 7 ehVj@ldM gk tkrk gA oLr d igy vkj ckn e loxk o ml ij vkjkfir cy dh x.kuk djA

9- ,d QVcky vkj Vful cky leku ox l xfr'khy gA nkuk ,d nlj l vkeu&lkeu Vdjkr g rFkk dN le; ckn nkuk #d tkr gA vxj Vdjku dk le; vrjky 1 ld.M g rk&

(i) dku l cky ij cy dk lcl vfèkd iHkko iMxkA

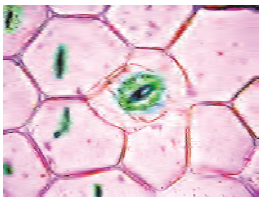
(ii) fdl cky d lox e lcl vfèkd ifjoru gkxkA

(iii) fdl cky dk Roj.k lcl vfèkd gkxkA

10- fl) dhft, fd nk oLrvk dk dy lox mud ijLij Vdjku l io ,o Vdjku d i'pkr leku jgrk gA

vè;k;&6

thou dh ekfyd bdkbZ % dkf'kdk



(Fundamental Unit of Life : Cell)

geu fiNyh d{kk e fofHkUu idkj d ,ddkf'kdh; vkj cgdkf'kdh; thok e dkf'kdkvk dh vkdfr o vkdkj e fofoèkrk dk voykdu fd;k gA geu ;g Hkh tkuk Fkk fd jkcV gd u 1665 e dkd dh iryh dkV dh ftu dkf'kdkvk dk voykdu fd;k ml ^ly* uke fn;kA vkb,] ge fofHkUu fØ;kdykik d ekè;e l dkf'kdkvk dh 0;oLFkk o dk;k dk le>u dk i;kl djA

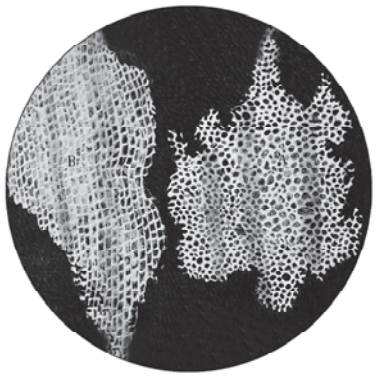
6-1 rjg&rjg dh dkf'kdkvk dk voykdu

bu fØ;kdykik e vkidk CyM] LykbM] doj fLyi] ekfpl dh rhyh] fj;k dh iÙkh] vkbLØhe dh pEep] yky L;kgh] l{en'kh dh t:jr gkxhA

fØ;kdyki&1

ekfpl dh rhyh dh dkV e dkf'kdkvk dk voykdu

ekfpl dh rhyh dh dkV n[ku d fy, ekfpl dh ,d rhyh ydj ,d ?kVk ikuh e fHkxk dj j[kA vc CyM l bldh iryh dkV ydj ,d LykbM ij ikuh dh cn e j[k] doj fLyi l <d vkj l{en'kh d fuEu vkoèku e gh bldk voykdu djA tlk fn[kkb n jgk g mldk fp= cuk,A



fp= Øekd &1 % dkd dh dkV

viu cuk, x, fp= dk feyku iLrd e fn, x, fp= Øekd&1 l djA ;g ogh fp= g ftl jkcV gd u 1665 e dkd dh iryh dkV dk l{en'kh l n[kdj cuk;k FkkA

fØ;kdyki&2

iÙkh dh dkf'kdkvk dk voykdu

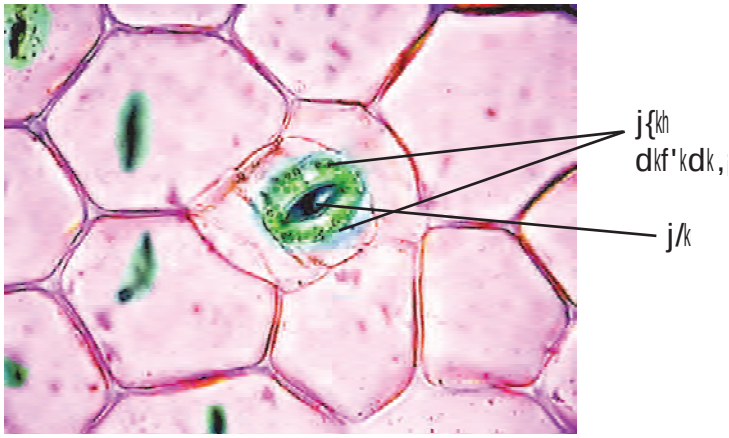
fun'k % fØ;kdyki 2 o 4 dk ,d lkFk fd;k tk ldrk gA

fj;k dh iÙkh dh fupyh lrg l ,d ijr fudkydj LykbM e j[kA bl ij nk cn ikuh MkyA doj fLyi Mkydj mldk voykdu l{en'kh d fuEu vkoèku l dj ,o fp= cuku dk i;kl djA

fp=&2 l viu fp= dk feyku dj vkj fuEufyf[kr lokyk d tokc <<&

- D;k lkjh dkf'kdk, ,d leku g\
- dkf'kdk e dku&dku l Hkkx fn[kkb n jg g\

;g fØ;kdyki vki ftehdn vFkok tkl ku ¼xMgy½ ;k vU; fdlh ekly iÙkh l Hkh dj ldr gA bld fy, iÙkh dh fupyh lrg dh ijr fudkydj yky L;kgh@vkyrk@ lÝfuu d gYd ?kky l vfHkjftr dj LykbM cukuh gkxhA

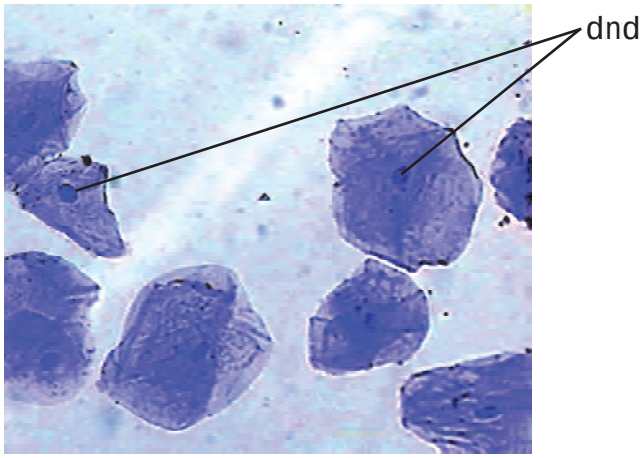


fp= Øekd&2 % fj;k dh iÙkh dh fupyh lrg e dkf'kdkvk dh 0;oLFkk

fØ;kdyki&3

xky dh dkf'kdkvk dk voykdu

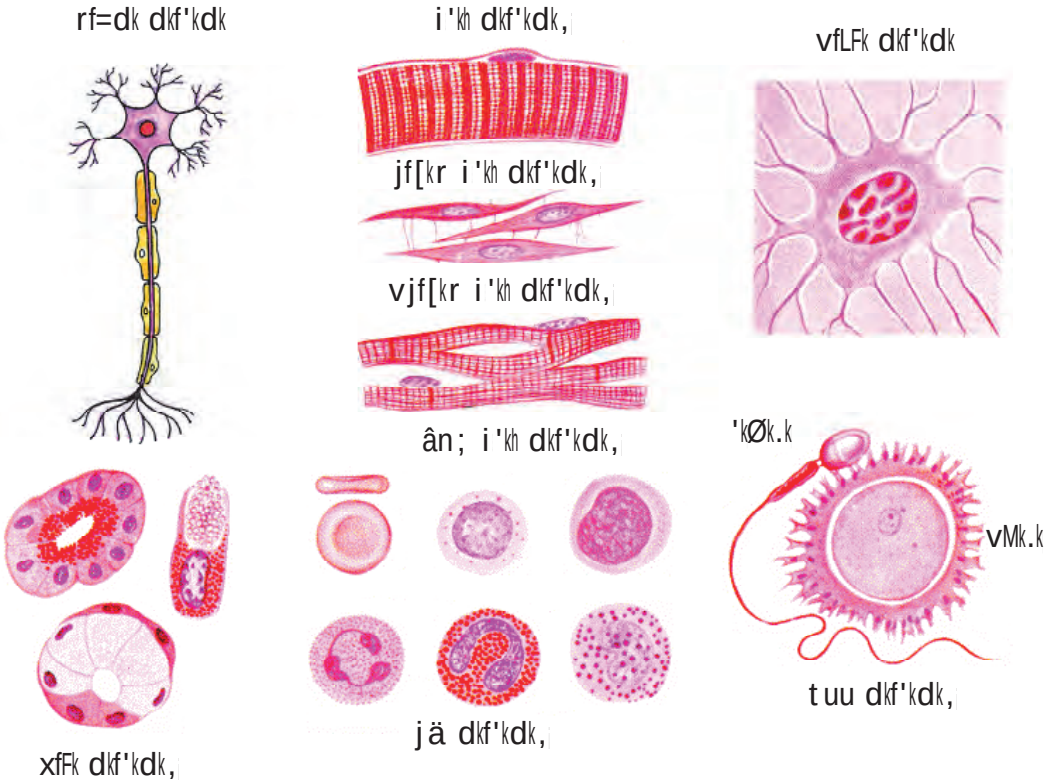
;g fØ;kdyki f'k{kd dh mifLFkfr e gh djA xky dh vnj dh lrg dk vkbLØhe d pEep l [kjpdj LykbM ij Qyk,A è;ku jg fd xky dk dBkjrk l u [kjpA LykbM ij ikuh dh ,d cn MkyA bld ckn nk cn yky L;kgh@ vkyrk@lÝfuu d ru ?kky dh Mky vkj doj fLyi yxk,A fQj l{en'kh d fuEu vkoèku l n[k rFkk fp= cuk,A



fp= Øekd&3 % xky dh dkf'kdk, ¼uhyh L;kgh l jx fd;k gvk½

- xky dh dkf'kdkvk ,o iÙkh dh dkf'kdkvk e D;k&D;k lekurk, g\
- xky dh dkf'kdkvk ,o iÙkh dh dkf'kdkvk e dkb ,d fHkUurk fy[kA

dkf'kdk, n[ku d fy, ge vDlj l{en'kh dh enn yuh iMrh gA exj uhc] lrjk tl Qyk e jl Hkjk ,d NkVk Hkkx] eNyh vkj exh d vfu"kfpr vM bR;kfn dkf'kdk, g ftUg ge fcuk l{en'kh l Hkh n[k ldr gA ;gk rjg&rjg dh dkf'kdkvk d fp= fn, x, g budk Hkh voykdu djA



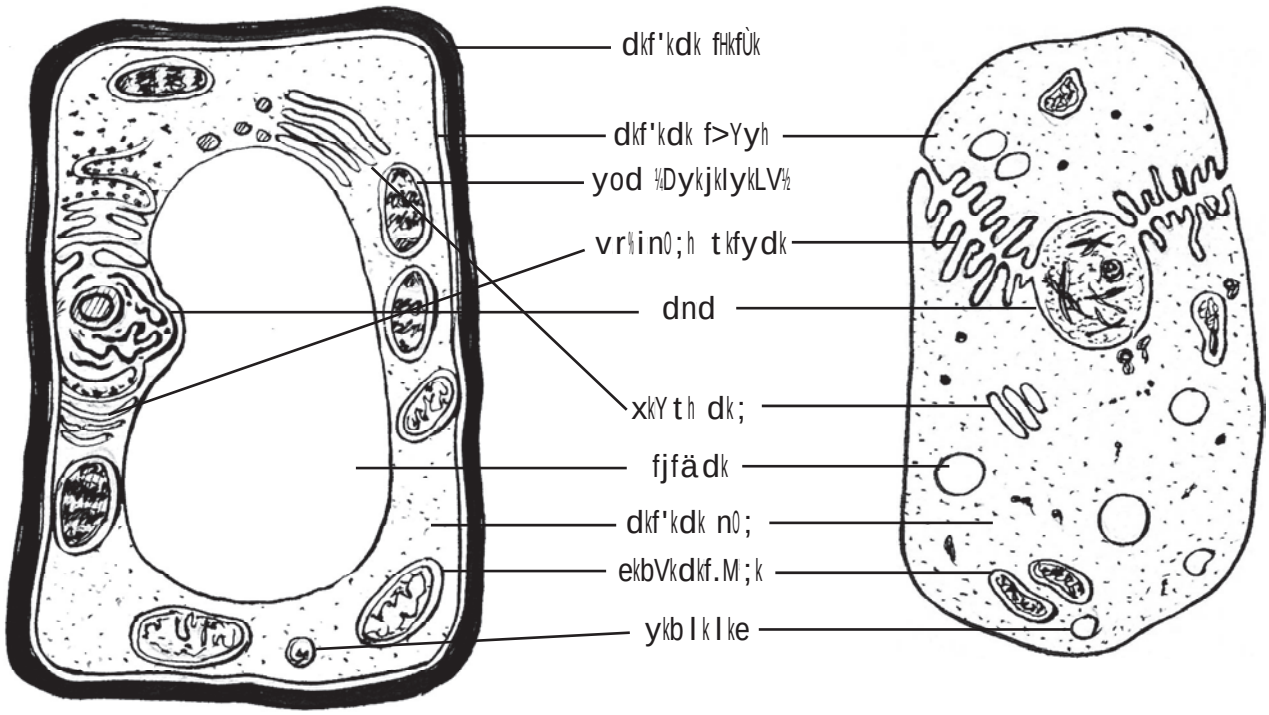
fp= Øekd&4 % fofHkUu idkj dh dkf'kdk,

- bu dkf'kdkvk e vkidk fdl&fdl idkj d vrj fn[kkb fn,\

;g vk'p; dh ckr g fd bru vrj d ckotn pkg ,ddkf'kdh; tho gk ;k cgdkf'kdh;] bue lkjh ey tfod&fØ;k, ¼ik"k.k] 'olu] ituu] mRlt u vkfn½ dkf'kdk e pyrh jgrh gA cgdkf'kdh; thok e vyx&vyx dkf'kdk, ;k dkf'kdkvk d leg vkilh leUo; l tfod fØ;kvk dk liUu djr gA

6-2 dkf'kdkvk dk vè;;u&ik:fid dkf'kdk (The typical cell)

oKkfudk u dkf'kdk dh dN cfu;knh lekurkvk dk è;ku e j[kdj dkf'kdk dk ekMy cuk;k ftl ge ik:fid dkf'kdk dgr gA ikni vkj tr dkf'kdk d ik:fid ukekfdr fp= bl idkj gA



¼v½ ik:fid ikni dkf'kdk **¼c½ ik:fid tr dkf'kdk**

fp= Øekd&5

- vkidk nkuk dkf'kdkvk e D;k&D;k lekurk, fn[kkb n jgh g\
- ikni dkf'kdk e ik; tku oky dkb ,d dkf'kdkx dk <f<, tk fd tr dkf'kdk e fn[kkb ugh n jgk gA

fofHkUu lkrk l ikIr tkudkjh d vkèkkj ij ik:fid fp=k dk cuk;k tkrk gA mue vc rd dh tkudkjh d vulkj e[; vxk dk bl idkj n'kk;k tkrk g fd ge dkf'kdk dh ljpuk dk vkHkkl feyA vktdy db oKkfud rk ,ddkf'kdh; tho dk gh ik:fid dkf'kdk ekudj vè;;u djr gA bll mUg dkf'kdk d thor fØ;k'khy :i dk Hkh vkHkkl feyrk gA pkg ge viu 'kjhj d vnj dh lHkh dkf'kdkvk dk vè;;u djuk gk ;k vU; fdlh tho dk] fdlh u fdlh ik:fid fp= dh vko';drk gkrh gh gA

D;k vki tkur g

egt nk lk lky e geu ,l l{en'kh dk fuek.k fd;k g ftll ge fdlh dkf'kdk dk nl xuk l ydj 5 yk[k xuk cMk djd n[k ldr gA vfHkjtu rduhd Hkh bruh fodflr gk xb g fd dkf'kdkvk dh dk; i.kkyh dh foLrr tkudkjh ge fey jgh gA dkf'kdkvk dh ljpuk ,o dk; cgr tfVy g rFkk mudh tkudkjh vHkh Hkh vèkjh g vkj mu ij 'kkèk tkjh gA

ol ;g vko';d ugh fd ,d ik:fid ikni ;k tr dkf'kdk e fn[kkb xb lHkh jpuk, ,d lkFk lHkh dkf'kdkvk e ikb tk,A dkf'kdk e mud dk;k d vkèkkj ij dkf'kdkxk dh mifLFkfr o l[;k e fofoèkrk n[ku dk feyrh gA dkf'kdkxk dh l[;k dk Hkh ik:fid dkf'kdk e n'kk;k ugh tkrk gA tl fdlh ikni dkf'kdk e ;fn lk DykjklykLV gk rk ik:fid dkf'kdk e dN ,d DykjklykLV dk gh n'kk;k tkrk gA dN dkf'kdkx t:j leLr dkf'kdkvk e ik, tkr g] ij lHkh ughA ik:fid ikni dkf'kdk e lno DykjklykLV fn[kkb nx ijr okLro e lHkh ikni dkf'kdkvk e DykjklykLV mifLFkr gk t:jh ugh gA blh idkj ik:fid dkf'kdk e fofHkUu dkf'kdkx d vkdkj d vuikr dk è;ku ugh j[kk x;k gA ;fn ge ,d dkf'kdk dk ieku d vkèkkj ij ik:fid fp= cuk,x rk mle dkf'kdk ,o mld dkf'kdkxk e lcèk dN bl idkj dk gkxkA ;fn dkf'kdk dk 0;kl 30 ehVj dk gk rk yxHkx 6 ehVj dk dnd] yxHkx 1 ehVj dk ekbVkdkf.M;k vkj jkbcklke tl NkV&NkV vx yxHkx 1 leh- d gkxA ; vuikr vyx&vyx dkf'kdkvk e fHkUu&fHkUu gkr gA vr% ik:fid dkf'kdk dk fp= ,d 0;oLFkk dk fu:i.k ek= gA

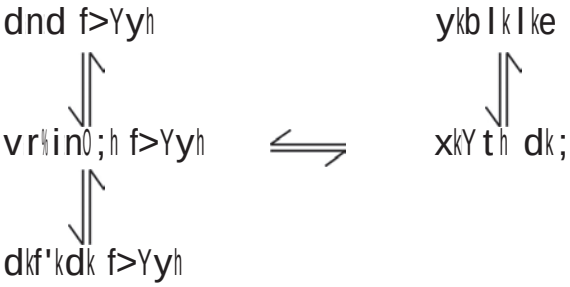
6-3 dkf'kdk dk lxBu (Organization of cells)

dkf'kdk dk viuk ,d <kpk gkrk g tk vDlj cnyrk jgrk gA ge vkt rd ;g tku ik, g fd dkf'kdk d db vx dkf'kdk f>Yyh l gh cu gA ge mudk vè;;u vr%f>Yyh r= d vrxr djxA dN vx ,l g tk dkf'kdk e fdlh vU; tho d io'k dju vkj dkf'kdk d lkFk mldh lgthfork l cuA ,l vxk dk ge vr%lgthfork d vrxr vè;;u djxA

- dkf'kdk d vxk e fdl idkj d lcèk g\ lkpdj fy[kA

6-4 vr%f>Yyh r= vkj dkf'kdkx (Endomembrane system and cell parts)

bld vrxr db Hkkx tl vr%in0;h tkfydk] xkYth dk;] ykblklke] dkf'kdk f>Yyh] dnd f>Yyh bR;kfn vkr gA ; dkf'kdkx ,d f>Yyhc) vkoj.k l f?kj jgr g ftldh xgk ;k vUnj dk LFkku ckÁ dkf'kdk n0; l vyx gkrk gA ; dkf'kdkx ,d nlj l fofHkUu rjg l lcèk cuk, jgr g] fp= Øekd&6 e ,lk ,d lcèk n'kk;k x;k gA blh e bul gkdj xtju oky inkFkk d vkokxeu dh 0;oLFkk dk Hkh n'kk;k x;k gA rhjk dh fn'kk n'kkrh g fd inkFkk d vkokxeu dh ifØ;k nkuk fn'kkvk e pyrh gA



fp= Øekd&6 % vr%f>Yyh r= d fofHkUu dkf'kdkxk e vUrlcèk

- dkf'kdk e dkf'kdk f>Yyh rd inkFkk d vkokxeu d fdUgh rhu ekxk dk fy[kA

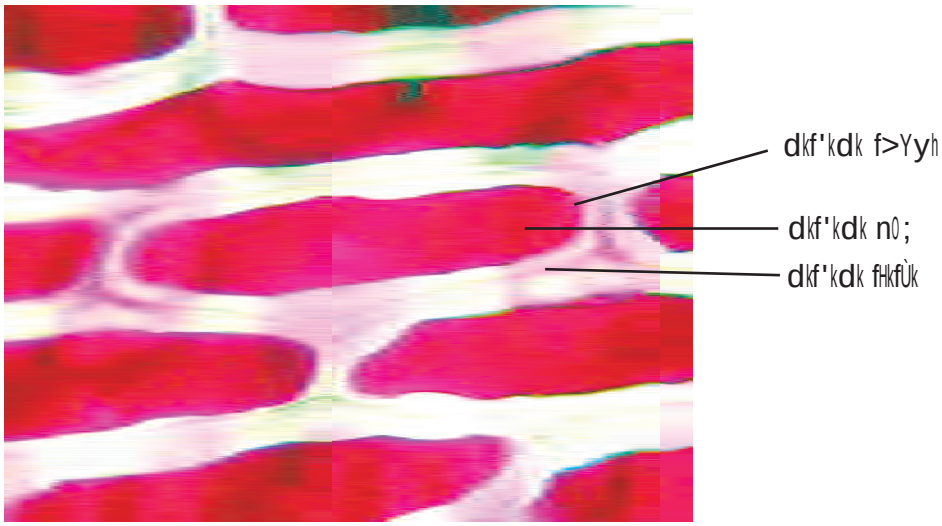
vkb,] ge bl r= d fofHkUu dkf'kdkxk dh ljpuk dk vkj xgjkb l tkuu dk i;kl djr gA

6-4-1 dkf'kdk f>Yyh (Cell membrane)

fØ;kdyki&4

dkf'kdk f>Yyh dk voykdu

'kDdj dk lkn ?kky cuk, ¼;kuh 2 pEep 'kDdj vkèk di ikuh e ?kky y½ bl ?kky dh 2 cn fj;k dh iÙkh dh fupyh lrg dh ijr ij MkyA bld fy, vki ub LykbM Hkh cuk ldr g ;k fØ;kdyki&2 e cuh LykbM dk mi;kx Hkh dj ldr gA bl LykbM dk 5 feuV d fy, j[k nA fQj bl l{en'kh l n[kA



fp= Øekd&7 ¼ fj;k dh dkf'kdk e dkf'kdk n0; dpu

D;k xykch jx dkf'kdk d ,d fgLl e fleV x;k g\ dkf'kdk d xykch jx oky fgLl dh ckgjh lhek gh dkf'kdk f>Yyh g] ik:fid dkf'kdk e Hkh bl n[ku dk i;kl djA ;g cká vkoj.k ;kuh dkf'kdk fHkfÙk l nj gk xb gA bl voLFkk dk dkf'kdk n0; dpu dgr gA

- dkf'kdk n0; ldfpr dl gvk gkxk\

bldk ,d dkj.k dkf'kdk e l ikuh fudy tkuk gA exj D;k ;gk ikuh dh lknrk l tMh gb dkb ifØ;k py jgh g\ lkfp,] fd vxj dkf'kdk d ckgj ikuh dh lknrk de gk ¼phuh d lkn ?kky e dkf'kdk n0; l de ikuh g½ rk T;knk lknrk l de lknrk dh rjQ ikuh dk cgko gkxkA ,l gh tc lknrk d vrj d dkj.k n0;k dk cgko fdlh f>Yyh d ekè;e l gkrk g rk ml ijklj.k dgk tkrk gA dkf'kdk

f>Yyh dkf'kdk n0;k d vkokxeu e egRoi.k Hkfedk fuHkkrh gA dkf'kdk f>Yyh dh jpuk byDVku l{en'kh l gh n[kh tk ldrh gA ;g e[; :i l olk ,o ikVhu dh cuh gkrh g rFkk ;g yphy LoHkko dh gkrh gA dkf'kdk f>Yyh dkf'kdk dk vkdkj vkj ml dh lhek dk fuèkkj.k djrh g rFkk lj{kk dk dk; djrh gA dkf'kdk f>Yyh l dkf'kdk d vnj vkj ckgj d okrkoj.k e inkFkk dk p;fur :i l vkokxeu gkrk gA blfy, bl p;ukRed ikjxE; f>Yyh dgr gA

- dkf'kdk f>Yyh p;ukRed f>Yyh ugh gkrh] rk bldk dkf'kdk ij D;k iHkko iMrk\

D;k vki tkur g

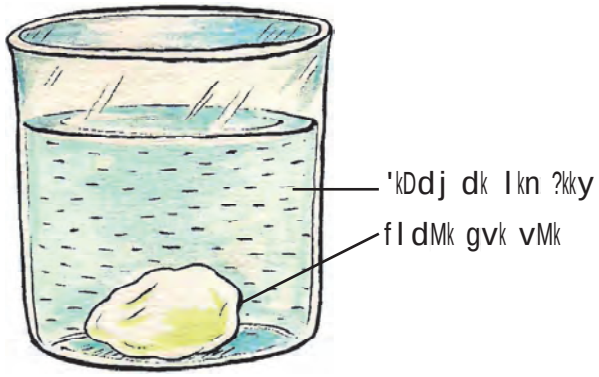
iR;d dkf'kdk f>Yyh ij ,l igpku fpgu gkr g ftudh enn l dkf'kdk, ,d&nlj dk igpkurh gA bldk lthok d thou e cgr egRo gA tl fd trvk e 'k:vkrh ifjoèku d le; ub&ub dkf'kdk, curh g vkj ,d txg l nljh txg LFkkukrfjr gkrh gA ml le; dkf'kdk f>Yyh d igpku fpgu d vkèkkj ij gh dkf'kdk, ,d nlj dk igpku yrh gA bl rjg l bud chp tMko curk g vkj ;gh tMko Årdk rFkk vxk d cuu e egRoi.k Hkfedk fuHkkrk gA bld vykok lthо d 'kjhj e ;fn dkb ckgjh dkf'kdk vk tk, rk 'kjhj dh dkf'kdk, ml vU; ¼fotkrh;½ dkf'kdk d :i e igpku ikrh gA

geu fØ;kdyki&4 e ikni dkf'kdk e dkf'kdk n0; dpu dk vè;;u fd;k gA blh fØ;kdyki e geu ikni dkf'kdk e dkf'kdk f>Yyh vkj dkf'kdk fHkfÙk dk n[ku dk Hkh i;kl fd;kA pfy,] vM d i;kx l ge tr dkf'kdk dh f>Yyh dk Hkh voykdu djA

fØ;kdyki&5
vM dh f>Yyh dk voykdu

bl fØ;kdyki d fy, ge vMk] fljdk] 'kDdj dk lkn ?kkyk] chdj] ikuh dh t:jr iMxhA

vM dk fljd e 4&5 fnuk rd j[kA le;≤ ij ml ?kekr jgA ftl vM d Åij dk dop tk dfY'k;e dkckuV dk cuk gkrk g og ?kydj gV tk,A bld ckn vM d Åij iryh f>Yyh fn[ku yxxhA ;gh dkf'kdk f>Yyh gA 'kDdj dk lkn ?kkyk chdj e yA bl vM dk chdj e j[k nA yxHkx 10 feuV d ckn bldk voykdu djA



fp= Øekd&8 % 'kDdj d lkn ?kkyk e j[kk gvk dop jfgr vMk

- nf[k, bl vM e D;k ifjoru gvk\ ifjoru dk D;k dkj.k gk ldrk g\

6.4.2 dkf'kdk fHkfÙk (Cell wall)

tlk fd vki tku pd g] dkf'kdk fHkfÙk ikni dkf'kdkvk dh ,d vuBh fo'k"krk gA tgk tr dkf'kdkvk e ckgjh ijr doy dkf'kdk f>Yyh gkrh g ogh ikèkk dh dkf'kdkvk e dkf'kdk f>Yyh d ckgj e[;r% lyykt l cuh ,d etcr ijr ikb tkrh g ftl dkf'kdk fHkfÙk dgr gA tr vkj ikni dkf'kdkvk e ;g ,d ie[k vrj ekuk tkrk gA

;g dBkj vFkok yphyh] fNne; ijr gkrh g tk dkf'kdk dk ,d fuf'pr vkdkj o lj{kk inku djrh gA thfor dkf'kdkvk l gh bl ijr dk fuek.k gkrk gA ekfpl dh rhyh ;k jkcV gd d dkd d voykdu e tk ljpuk fn[kkb nh] og fHkfÙk gh g tk dkf'kdk d er gk tku ij Hkh fn[krh jgrh gA

- dkf'kdk f>Yyh vkj dkf'kdk fHkfÙk e D;k vrj g\
- ikni dkf'kdkvk e dkf'kdk fHkfÙk dh D;k Hkfedk gkxh\

6.4.3 dkf'kdk n0; (Cytoplasm)

dkf'kdk f>Yyh l dkf'kdk n0; dh ckgjh lhek r; gkrh gA fdlh Hkh dkf'kdk e bl n0; e gh dkf'kdk d vU; vx ik, tkr g] tl& ekbVkdkf.M;k] yod] vr%in0;h tkfydk] dnd vkfnA vFkkr dkf'kdk n0; ,d vkèkkj n0; g] ftle lfpr inkFk] lkoh inkFk o vif'k"V inkFk vkfn ik, tkr gA dkf'kdk n0; e vkerkj ij ikuh dh ek=k vfèkd gkrh gA

6.4.4. dnd (Nucleus)

jkcV ckmu u lu 1831 e dkf'kdk d eè; e ftl ljpuk dk n[kk ml U;fDy;l ¼dnd½ uke fn;kA ;g dkf'kdk dk ,d egRoi.k vx gA

- fp= Øekd&5 v vkj c d vkèkkj ij crk, fd D;k lHkh dkf'kdkvk e dnd eè; e fLFkr gkrk g\
- jkcV gd u ikni vkj tr dkf'kdk e l fdl idkj dh dkf'kdk dk vè;;u fd;k gkxk\

D;k vki tkur g

Lruèkkfj;k dh yky jDr dkf'kdkvk ,o ikèkk d ¶yk,e Ård dh ,d idkj dh dkf'kdkvk e dnd ugh gkrA vly e bue 'k:vkr e rk dnd gkr g] exj tYnh gh u"V gk tkr g ftll inkFkk d logu d fy, T;knk l T;knk LFkku miyC;èk gk ldA

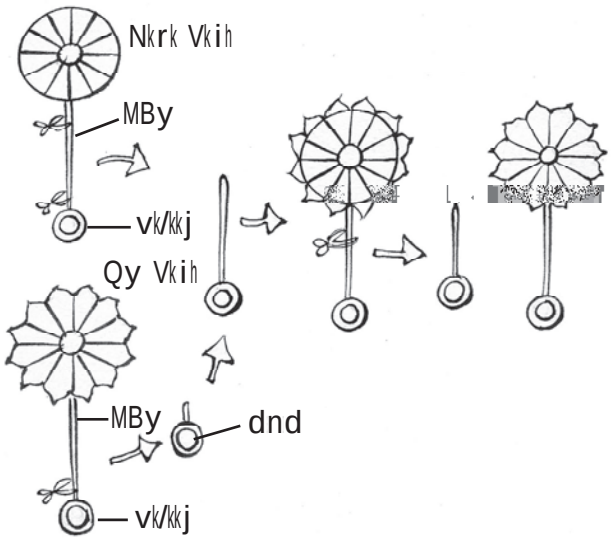
dnd e èkkx tlh jpuk gkrh g ftUg ØkefVu dgr gA ;g e[; :i l vkuokf'kd inkFk d cu gkr gA tl gh dkf'kdk] foHkktu d fy, r;kj gkrh g ; ØkefVu NMk dk :i y yr g] rc bUg x.kl= ¼Økeklke½ dgr gA ekrk&firk l vxyh lrfr e vkuokf'kd x.k bUgh ljpukvk l tkr gA

dnd] dkf'kdk d lHkh dk;k dk lpkyu ,o fu;=.k djrk g vkj thok d x.kk dk fuèkkj.k Hkh djrk gA dnd vkj dkf'kdkn0; d chp ,d f>Yyh gkrh g] ftl dnd f>Yyh dgr gA ;g f>Yyh dkf'kdk f>Yyh tlh gkrh gA tho txr e oxhdj.k dk ,d e[; vkèkkj dnd f>Yyh dh mifLFkfr gA ;fn dnd f>Yyh mifLFkr gk rk ;dfj;kV ox dh dkf'kdk, gkxh vU;Fkk ikdfj;kV ox dhA

D;k vki tkur g

,flVkcyfj;k dk i;kx

dnd gh x.kk dk fuèkkj.k djrk g bldk Li"V iek.k loiFke teu tho oKkfud tkfde gejfyx u 1934 e ,d lenh 'koky ,flVkcyfj;k ij i;kx dj crk;kA



;g lenh 'koky ,ddkf'kdh; tho gA bld rhu Hkkx gkr g& vkèkkj] MBy] VkihA vyx&vyx tkfr;k e Vkih vyx&vyx vkdkj dh gkrh g] fdlh e mYV Nkr d leku rk fdlh e Qy d lekuA Vkih dkVu ij fQj l Vkih mx tkrh gA

gejfyx u Qy tlh Vkih oky 'koky dk doy vkèkkj fy;k vkj fQj bl ij ,d Nkrk tlh Vkih oky 'koky dk MBy jki fn;kA bll tk Vkih mxh og Nkr vkj Qy dk feyk tyk :i Fkh bldk eryc ;g gvk fd vkèkkj e mifLFkr dN inkFk vkj MBy e ektn dN inkFk feydj bldk :i r; dj jg FkA gejfyx u bl Vkih dk Hkh dkV fn;k vc dh ckj tk Vkih mxh og Qyuek Fkh eryc vc bldk :i ijh rjg vkèkkj ij fuHkj Fkk] vFkkr vkèkkj l fudyk dkb inkFk Vkih dk :i r; djrk gA

gejfyx ;g n[k gh pd Fk fd bl 'koky dk dnd vkèkkj e gkrk gA db i;kxk d vkèkkj ij tho oKkfud bl fu"d"k ij igp fd dnd e ml tho dh gj idkj dh dkf'kdk cuku dh tkudkjh gkrh gA

- dnd dk dkf'kdk dk fu;=.k d{k D;k dgk tkrk g\

6.4.5 vr%in0;h tkfydk (Endoplasmic reticulum)

fp= Øekd&5 ¼v½ ,o ¼c½ dk n[kA mle f>Yyh ;Dr ufydkvk ,o Fkyk dk ,d cgr cMk tky gA byDVku l{en'kh l n[ku ij ;g dgh [kjnjh rFkk dgh fpduh fn[kkb nrh gA fp= e Hkh [kjnjh vkj fpduh vr%in0;h tkfydk fn[kkb n jgh gA [kjnjh vr%in0;h tkfydk ij jkbckske uked dkf'kdkx gkr

g tk e[; :i l ikVhu l'y"k.k dk dk; djr gA fpduh vr%in0;h tkfydk e[;r% olk cuku e enn djrh gA ;gk l cu dN ikVhu vkj olk l f>fYy;k dk cuuk] ejEer vkfn dk; gkr jgr gA

- fdl dkf'kdkx d ekè;e l fdlh inkFk dk dnd f>Yyh l dkf'kdk f>Yyh rd igpk;k tk ldrk g\ ¼fp= Øekd&6 dh enn y½

6.4.6 xkYth dk; (Golgi body)

xkYth dk; dk o.ku 1898 e dfeyk xkYth u fd;k FkkA ;g db lkjh f>fYy;k l feydj cuk gkrk gA ; f>fYy;k Fkyhuek jpuk, cukrh g vkj bud vkl&ikl dN no Hkjh Fkfy;k gkrh gA jkbcklke ij cu ikVhu o vU; inkFk xkYth dk; e igpk, tkr gA xkYth dk; dk dk; inkFkk d vkokxeu l igy idftx djuk gA ikVhu rFkk vU; inkFk Fkyhuek ljpukvk l vU; vxk rd igpk, tkr gA

dkf'kdk e xkYth dk; dh l[;k vyx&vyx gkrh gA inkFkk dk lkfor dju okyh dkf'kdkvk e budh l[;k T;knk gkrh gA

6.4.7 ykblklke (Lysosome)

dkf'kdkvk e dN ,l inkFk ik, tkr g tk ijh dkf'kdk d yxHkx lkj inkFkk dk u"V dju dh {kerk j[kr gA i'u ;g g fd fQj ; inkFk ml dkf'kdk dk u"V D;k ugh djr\ ;g igyh rc ly>h tc ykblklke dh [kkt gbA ;g Li"V gvk fd ,l lkj fouk'kdkjh inkFk ykblklke uked Fkfy;k e Hkj gkr g vkj lkèkkj.k ifjfLFkfr e dkf'kdk d 'k"k inkFkk d lid e ugh vkrA vc vki le> gh x, gkx fd tl gh dkf'kdk e gkfudkjd inkFk cur g ykblklke ml ik;% u"V dj nr gA dHkh&dHkh fof'k"V ifjfLFkfr;k e ykblklke QV tkr g vkj mue Hkj ,tkbe ijh dkf'kdk dk ipk Mkyr gA blfy, ykblklke dk llkbMy cx ;k vkRe?kkrh >kyk Hkh dgr gA

- dkb dkf'kdk i.k :i l jkx xLr gk x;h gk rk ykblklke dh D;k Hkfedk gkxh\

6.4.8 fjfDrdk, (Vacuoles)

- fp= Øekd 5 ¼v½ e ikni dkf'kdk dk dku&lk vx cgr cMk lk fn[k jgk g\

dkf'kdk n0; e rjy inkFk l Hkjh dN xkykdkj Fkyhuek jpuk, ikb tkrh g ftUg fjfDrdk, dgr gA tr dkf'kdkvk e ; jpuk, NkVh&NkVh gkrh gA fjfDrdkvk e dN inkFkk dk lxg.k gkrk gA

6.5 vr%f>Yyh r= dh dk; i.kkyh (Function of the endomembrane system)

vkb,] ,d mnkgj.k dh lgk;rk l bl r= dh dk;i.kkyh dk le>u dk i;kl djr gA ikVhu l'y"k.k dh ifØ;k d le; jkbcklke vr%in0;h tkfydk l tM tkr g rFkk bue cuu oky ikVhu

vr%in0;h tkfydk dh xgk e io'k dj tkr gA ;gk l NkVh&NkVh Fkfy;k e ikVhu xkY th dk; rd igpk, tkr gA xkY th dk; budh idftx dk dke djrk gA ;kuh T;knk l T;knk ikVhu dk Fkfy;k e Hkjk tkrk gA ;gk l ; inkFk dkf'kdk d vU; Hkkxk t l dkf'kdk f>Yyh] dnd f>Yyh bR;kfn rd Hkt tkr gA ; inkFk db dk; ;kuh f>Yyh dh ejEEr e] f>Yyh d cuu bR;kfn e dke vkr g ;k ckgj lkfor dj fn, tkr gA

mi;Dr mnkgj.k l ge ;g le> ldr g fd dkf'kdk e liUu gku oky ,d dk; d fy, fofHkUu dkf'kdkxk dh egRoi.k Hkfedk gkrh gA vkb,] dN vkj dkf'kdkxk dk vè;;u djA

6-6 vr%lgthfork l cu vx (Parts formed by endosymbiosis)

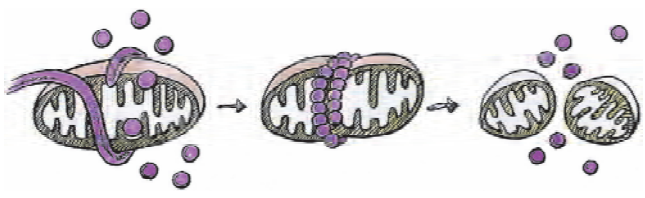
oKkfudk u ik;k fd dkf'kdkvk e dN ,l tho io'k dj x, ftud dkf'kdk no nkgjh f>Yyh l f?kj Fk vkj mue vkuokf'kd inkFk mifLFkr FkA le; d lkFk ; dkf'kdk d dk;k d vfHkUu fgLl cu x,A ekbVkdkf.M;k ,o Dykjklykl V ,l gh dkf'kdkx gA etcku (host) dkf'kdk dk ekbVkdkf.M;k d t l thok l Åtk vkj Dykjklykl V t l thok l ik"k.k feyu yxkA bu thok dk etcku dkf'kdk l jgu d fy, ljf{kr LFkku ikIr gvkA

6-6-1 ekbVkdkf.M;k (Mitochondria)

vyx&vyx dkf'kdkvk e fofHkUu vkdfr;k d ekbVkdkf.M;k gkr gA t l xky] NMuek] 'kkf[kr vkfnA ; dnd l djhc 6&10 xuk NkV gkr gA ,d dkf'kdk e yxHkx 100 l 1000 ekbVkdkf.M;k gk ldr gA ;fn ,d Lruèkkjh d yhoj ¼;dr½ dh ,d dkf'kdk dk mnkgj.k y vkj mle mifLFkr lkj ekbVkdkf.M;k dk feyk n rk og ml dkf'kdk dk 15 l 20 ifr'kr Hkkx ?kj yxkA

dkf'kdk dh 'olu fØ;k e ekbVkdkf.M;k dh egRoi.k Hkfedk gkrh gA ; dkf'kdk dh tfod fØ;kvk dk Åtk lkr cu jgr gA vkuokf'kd inkFkk d gku l ekbVkdkf.M;k foHkkftr gkrk g vkj vkuokf'kd x.k ,d ih<h l nljh ih<h rd igpr gA

D;k vki tkur g



ekbVkdkf.M;k ,o vr%in0;h tkfydk e xR;kRed lcèk gA bl lcèk d ckj e ge rc tku ik, tc vr%in0;h tkfydk }kjk ekbVkdkf.M;k dk foHkkftr dju d fy, mÙkftr djr n[kk x;kA vr%in0;h tkfydk dh ufydk d Qn l ekbVkdkf.M;k nk Hkkxk e foHkkftr gkr n[k x, gA iR;d Hkkx Lor= ekbVkdkf.M;k d :i e dk; dju e l{ke jgkA

- fdlh Hkh dkf'kdk e ekbVkdkf.M;k dk T;knk l[;k e gkuk D;k t:jh g\

6-6-2 yod (Plastid)

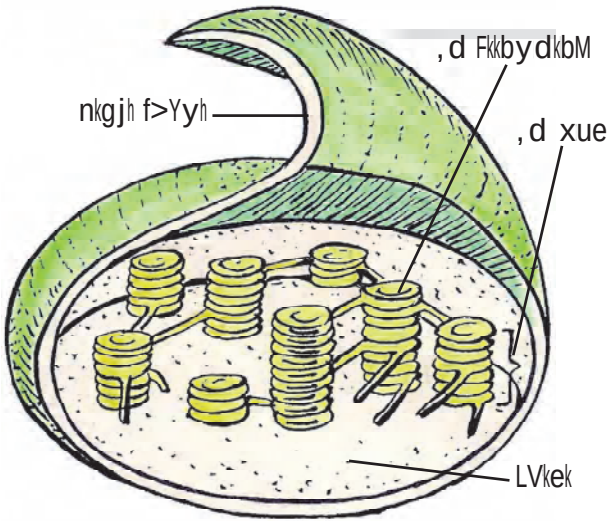
;g dkf'kdkx ikni dkf'kdkvk e gh ik;k tkrk gA lkekU;r% tr dkf'kdkvk e bldk vHkko gkrk gA o.kd dh mifLFkfr d vkèkkj ij yod nk idkj d gkr gA

1- jxghu yod& ble o.kd ugh ik;k tkrkA ;g LVkp d :i e Hkktu lfpr djrk gA bl ge eDd d cht] vky] eyh vkfn e n[k ldr gA

2- jxhu yod& ble o.kd ik, tkr gA ; db jxk d gkr gA cht] i"i ,o Qyk d jx budh mifLFkfr l fn[kkb nr gA gj jx d yod DykjklykLV dgykr gA ; fMLduek] vMkdkj] yl d vkdkj d] lh<huek] flrkjuek] dMykdkj] tkyuek bR;kfn vkdkj d gkr gA

D;k vki tkur g

DykjklykLV dk 0;kl fdlh ekbVkdkf.M;k l yxHkx nxuk gkrk gA DykjklykLV nkgjh f>Yyh l f?kj gkr gA nkuk f>Yyh d vykok ,d vkj f>Yyh ik;h tkrh g ftll Fkyh tlh ljpuk lxfBr gkrh g ftl FkkbydkbM dgr gA FkkbydkbM flDdk d pVVk dh Hkkfr <j d :i e feyr g] ftUg xuk dgr gA f>fYy;k d chp Hkj inkFk dk LVkek dgr gA



DykjklykLV dh rhu vk;keh ljpuk

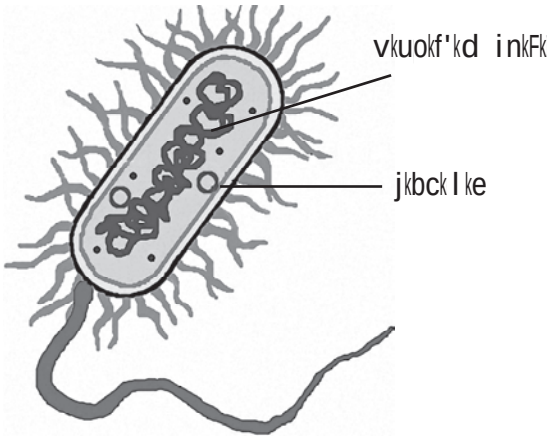
ikni dkf'kdkvk e DykjklykLV dh mifLFkfr l idk'k l'y"k.k dh fØ;k liUu gkrh gA

- DykjklykLV dk dkf'kdk dk jlkb?kj Hkh dgr gA lkfp, D;k\
- vxj ekbVkdkf.M;k ugh gkrk rk dkf'kdk dh dk;i.kkyh e D;k vrj iMrk\
- vr%lgthfork d vrxr dkf'kdk e io'k dju oky thok d fof'k"V x.k D;k Fk\

geu vHkh rd ;dfj;kfVd dkf'kdkvk dk vè;;u fd;k gA vkb,] ge dN ikdfj;kfVd dkf'kdkvk dh fo'k"krkvk dk Hkh vè;;u djA

6.7 ikdfj;kfVd dkf'kdkvk dh fo'k"krk,&

; dkf'kdk, Hkh dkf'kdk f>Yyh ,o dkf'kdk fHkfÙk l f?kjh jgrh gA ijr bue dN dkf'kdkx ugh ik, tkr gA tl ekbVkdkf.M;k] vr%in0;h tkfydk] xkYth dk; vkfnA bul lcfèkr dk; dkf'kdk n0; e gh liUu gkr gA dN dk; dkf'kdk f>Yyh dh vn:uh lrg ij Hkh liUu gkr gA bue NkV vkdkj oky jkbcklke ik, tkr gA bld vykok idk'k l'y"k.k dju e l{ke cDVhfj;k e DykjkfQy Hkh gkrk gA ikdfj;kfVd dkf'kdkvk e vkuokf'kd inkFk vDlj oÙkkdkj jpuk d :i e gkrk gA cDVhfj;k] lk;ukcDVhfj;k nkuk ikdfj;kfVd dkf'kdk, gA



¼v½ cDVhfj;k

¼c½ lk;ukcDVhfj;k

fp= Øekd&9 % ikdfj;kfVd tho

- vè;k;&1 l lgk;rk ydj ikdfj;kfVd dkf'kdkvk dh vU; ie[k fo'k"krkvk dk fy[kA
- ;dfj;kfVd vkj ikdfj;kfVd dkf'kdkvk e dkb nk vrj fy[kA

dkf'kdk e db tfod ifØ;k, liUu gkrh g] tl 'olu] ik"k.k] vif'k"V inkFkk dk fu"dklu vkfnA bu lkjh ifØ;kvk dk dju e dkf'kdk d lHkh vx ,d&nlj ij fuHkj jgr gA Bhd ol gh tl fd gekj 'kjhj dk pyku e fofHkUu vxr= feydj dke djr gA blfy, dkf'kdk dk lthok dh fØ;kRed bdkb dgr gA

6.8 dkf'kdk fl)kr (Cell theory)

cgr le; rd ykxk dh ;g èkkj.kk Fkh fd thok dk fuek.k feêh] gok vkj ikuh l Lor% tuu d :i e gkrk gA db lkyk rd db oKkfudk d 'kkèk d QyLo:i bl ckr dk [kMu gvkA exj loky Fkk fd ok dkulh bdkb g ftl l thocur g vkj mudh

'kkjhfjd ljpuk dk fuek.k gkrk gA vkt l yxHkx 200 lky igy thou dh bl bdkb dh [kkt dh fn'kk e db i;kl fd, tk jg FkA mue l dN oKkfud tl efFk;kl tdc 'yhMu vkj fFk;kMkj 'oku rFkk #MkYQ fojpko dh ckr mYy[kuh; gA

'yhMu vkj 'oku e l ,d ouLifr oKkfud Fk vkj ,d tr oKkfudA nkuk u dkf'kdkvk dk xgu vè;;u fd;k vkj ik;k fd dkf'kdk gh og bdkb g ftll thо dk 'kjhj lxfBr gkrk gA

:MkYQ fojpko u yxHkx 1855 d vklikl n[kk fd dkf'kdk, foHkkftr gkrh g vkj ub dkf'kdk, cukrh gA 'yhMu] 'oku rFkk fojpko d voykduk d vkèkkj ij ifrikfnr tho&foKku dk egRoi.k fl)kr dkf'kdk fl)kr cuk tk bl idkj g&

1- lHkh l tho dkf'kdkvk] dkf'kdkvk d leg vkj vr%dkf'kdh; inkFkk l cur gA

2- dkf'kdk thok dh ljpukRed vkj fØ;kRed bdkb gA

3- lHkh dkf'kdk, igy l mifLFkr dkf'kdkvk l ink gkrh gA

è;ku nu dh ckr ;g g fd dkf'kdk d ukedj.k l ydj dkf'kdk fl)kr d ifriknu d chp 200 o"kk dk vrj jgkA

- dkf'kdk fl)kr] dkf'kdk d ckj e gekjh le> dk dl Li"V djrk g viu 'kCnk e fy[kA
- D;k foKku d fdlh Hkh fl)kr dk fdlh 0;fDr fo'k"k ;k nk 0;fDr;k dh nu ekuk tk ldrk g\ D;k ;k D;k ugh\

6.9 dkf'kdk, vDlj NkVh gkrh g] cMh ugh] D;k\

dkf'kdkvk dk vkdkj vDlj bruk NkVk gkrk g fd fcuk fdlh vkoèkd midj.k dh enn l bUg n[k ikuk lHko ugh gA

- D;k vkiu dHkh lkpk g] fd dkf'kdkvk dk vkdkj bruk NkVk D;k gkrk g\
- vxj dkf'kdk, cMh gkrh rk D;k gkrk\
- vkdkj NkVk gku l dkf'kdkvk dk D;k&D;k ykHk gkr g\

geu i<k g fd dkf'kdkvk e fofHkUu inkFkk tl ik"kd inkFk] mRlth inkFk] fofHkUu xlk vkfn dk vkokxeu gkrk gA ;g vkokxeu dkf'kdk f>Yyh d lrgh {k= l gkrk gA fofHkUu inkFkk dk vkokxeu] de njh] de le; e gkrk g rk Åtk Hkh de [kp gkrh gA ;g rHkh lHko g tc dkf'kdk dk vkdkj NkVk gkA vkb,] bl xf.krh; :i e le>u dk i;kl djA

;fn dkf'kdk xky gk rk dkf'kdk dk 0;kl c<ku l mld lrgh {k=Qy e oxkRed x.kd of) gkrh g rFkk vk;ru e ?kukRed x.kd of) gkrh gA

lkj.kh Øekd&1 % xky dkf'kdk dh lrgh {k=Qy ,o vk;ru d vuikr dk lcèk

v/k0;kl feyhehVj	0.5	1.0	1.5	3.0	3.5
lrgh {k=Qy	3.14	12.6	28.2	113.4	153.8
vk;ru	0.5	4.1	14.0	112.5	179.0
lrgh {k=Qy ,o vk;ru dk vuikr&	6:1	3:1	2:1	1:1	0.8:1

mi;Dr lkj.kh d vkèkkj ij fuEufyf[kr lokyk d mÙkj n&

- ;fn dkf'kdk dk 0;kl c< jgk g rk dkf'kdk d vk;ru ,o lrgh {k=Qy e D;k ifjoru gk jgk g\
- D;k lrgh {k=Qy ,o vk;ru d vuikr dk dkf'kdk d 0;kl l dkb lcèk g\

;fn dkf'kdk dk lrgh {k=Qy vfèkd gkxk rk ckgjh okrkoj.k e mifLFkr inkFkk d dkf'kdk l lid dh ek=k Hkh c< tk,xhA

dkf'kdk dk vk;ru c< tku ij tfod fØ;kvk dk liUu dju d fy, vfèkd ek=k e ik"kd inkFkk dh vko';drk gkxhA geu i<k Hkh g fd vkdkj e of) gku l vk;ru dh ryuk e lrgh {k=Qy e de of) gkrh gA ,lh fLFkfr e dkf'kdk e inkFkk d vrxg.k dh ekx lrg }kjk ijh ugh gk ik,xh o tfod fØ;kvk dh xfr èkheh gk tk,xhA

bl idkj dk lcèk fofHkUu vkdfr dh dkf'kdkvk e Hkh n[kk tk ldrk gA

vkiu dN cMh dkf'kdkvk t l if{k;k d vM dk ;kd okyk Hkkx] eNyh d vM dh dkf'kdkvk dk n[kk gkxkA ; dkf'kdk, viuh ifjiDo voLFkk dk ikIr dj pdh gkrh gA bl voLFkk e budh tfod fØ;k, Hkh èkheh iM tkrh gA vc vki le> x, gkx fd vkdkj e cMh gku d ckotn ; dkf'kdk, fdl idkj thfor jg tkrh gA

6.10 D;k dkf'kdk, piVh gh gkrh g\ (Are cells flat)

lkekU;r% tc ge dkf'kdk dk l{en'kh l n[kr g rk bldh ljpuk piVh ;k f}vk;keh irhr gkrh gA okLro e dkf'kdk dh yckb] pkMkb rFkk ekVkb gkrh g vFkkr ;g f=vk;keh gkrh gA bldh yckb vkj pkMkb ge vklkuh l n[k ldr g ij ekVkb ughA blfy, ge ,lk irhr gkrk g fd dkf'kdk piVh gkrh gA dN ,l mnkgj.k g ftl ge dkf'kdk dh ekVkb dk vè;;u dj ldr g] tl vM ,o lrj dh dkf'kdk l Hkh ge dkf'kdk dh yckb] pkMkb ,o ekVkb dk vkHkkl ikIr dj ldr gA

e[; 'kCn (Keywords)

ikdfj;kV (prokaryote), ;dfj;kV (eukaryote)] dkf'kdk fl)kr (cell theory)] dnd (nucleus), ekbVkdkf.M;k (mitochondria)] DykjkIykLV (chloroplast)] ykbIkIke (lysosome)

geu Ih[kk

- dkf'kdk Ithok dh IjpukRed ,o fØ;kRed bdkb gA
- dkf'kdk dh [kkt IoiFke jkcV gd u dhA
- dkf'kdk d pkjk vkj ,d yphyh p;ukRed ikjxE; f>Yyh gkrh gA
- ikèkk dh dkf'kdk f>Yyh d pkjk vkj Iyykt I cuh gb dkf'kdk fHkfÙk gkrh gA
- ;dfj;kfVd dkf'kdk e dnd nkgjh f>Yyh ;Dr gkrk gA
- ykbIkIke nkgjh f>Yyh;Dr dkf'kdkx g] ftIe db idkj d inkFkk d ikpu gr ,tkbe ik, tkr gA
- xkYth dk; e inkFkk d idftx d dk; Iikfnr gkr gA
- ekbVkdkf.M;k dkf'kdk dk Åtk ?kj gA
- yod ,I dkf'kdkx g] tk doy ikni dkf'kdkvk e gkr gA ; nk idkj d gkr g& jxhu o jxghuA
- DykjkfQy ;Dr jxhu yod dk DykjkIykLV dgr gA budh mifLFkfr e ikèk idk'k I'y"k.k djr gA
- ikdfj;kfVd dkf'kdkvk e f>Yyh ;Dr dkf'kdkx vuifLFkr gkr gA
- dkf'kdk, piVh ugh gkrh] ; f=vk;keh gkrh gA
- dkf'kdk d dnd] ekbVkdkf.M;k ,o yod e vkuokf'kd inkFk ik, tkr gA

vH;kl

1- lgh fodYi pu&

(i) ^^ly** 'kCn nu oky oKkfud dk uke g&
¼v½ jkcV gd ¼c½ jkcV ckmu
¼l½ Y;ou gkd ¼n½ ¶yfex

(ii) dkf'kdk fl)kr iLrkfor fd;k&
¼v½ 'yhMu] 'oku rFkk fojpko ¼c½ okVlu rFkk fØd
¼l½ Mkfou rFkk oyl ¼n½ eMy rFkk ekxu

(iii) ,dy f>Yyh fuEufyf[kr e ikb tkrh g&
¼v½ ekbVkdkf.M;k ¼c½ Dykjkl ykLV
¼l½ ykblklke ¼n½ bue l dkb ugh

(iv) fuEufyf[kr l fdl ,d dh dkf'kdk fHkfÙk lY;ykt dh ugh cuh gkrh g&
¼v½ cDVhfj;k ¼c½ gkbfMyk
¼l½ vke dk o{k ¼n½ dDVl

(v) ikdfj;kfVd dkf'kdk e fn[ku okyk ,d ek= dkf'kdkx g&
¼v½ ekbVkdkf.M;k ¼c½ jkbcklke
¼l½ yod ¼n½ ykblklke

2- ik:fid ikni dkf'kdk dk fp= cukdj fuEufyf[kr vxk dk ukekfdr dj&
¼v½ dkf'kdk fHkfÙk ¼c½ dnd
¼l½ Dykjkl ykLV ¼n½ fjfDrdk

3- dkf'kdk f>Yyh vkj dkf'kdk fHkfÙk e ,d vrj fy[kA

4- ik:fid tr dkf'kdk dk ukekfdr fp= cuk,A

5- ikdfj;kfVd dkf'kdk,] ;dfj;kfVd dkf'kdkvk l fdl idkj fHkUu gkrh g\

6- dkf'kdk fl)kr thok dh ljpuk d ckj e gekjh le> dk Li"V djrk g] dl\ le>k,A

7- ekbVkdkf.M;k rFkk gfjr yod e nk lekurk, rFkk ,d vlekurk fy[kA

8- ikèk d mu Hkkxk d uke fy[k ftue jxhu yod] gfjr yod ,o jxghu yod ik, tkr gA

9- vrkf>Yyh r= dh fØ;kfofèk dk le>k,A

10- dkf'kdk, ik;k NkVh gkrh g] D;k\

11- Hkktu idku dh ifØ;k d nkjku ge ik;% lfCt;k e ued Mkyr gA ued Mkyu d ckn lfCt;k l ikuh ckgj fudyrk g] ,lk D;k gkrk g] le>k,A

12- D;k gkxk tc\

(i) dkf'kdk e dnd u gk rkA

(ii) dkf'kdk dh lykTek f>Yyh QV tk,A

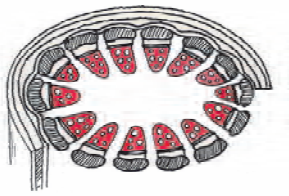
(iii) fj;k dh iÙkh dk ikuh e mckydj 'kDdj d foy;u e Mkyk tk,A

(iv) dkf'kdk l xkYth dk; dk fudky fn;k tk,A

vè;k;&7

cgdkf'kdh; ljpuk % Åtd

(Multicelluar Structure : Tissue)



geu fiNy vè;k; e dkf'kdk vkj mld dk;k d fo"k; e foLrr vè;;u fd;kA geu ;g le>u dk i;kl fd;k fd lHkh ltho pkgs o tr gk ;k ikèk dkf'kdkvk d cu gkr gA jkcV gd u dkd dh ftl eghu ijr dk l{en'kh e n[kk Fkk og okLro e cgr lkjh dkf'kdkvk dk leg gh FkkA gd u viu voykduk e dkf'kdkvk d leg d ,d lnL; dk ^ly* uke fn;k FkkA ikèkk ,o trvk d fofHkUu Hkkxk tl& iÙkh dh lrg] xky dh vkUrfjd lrg] eNyh@pt dh eklif'k;k vkfn dk l{en'kh ln[k rk ge Hkh dkf'kdkvk d leg fn[kkb nxA

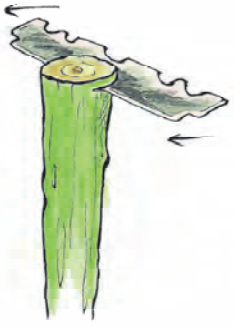
vkb,] ge fØ;kdyki d }kjk ;g tkuu dk i;kl dj fd dkf'kdkvk d leg D;k&D;k dk; djr gA

fØ;kdyki&1

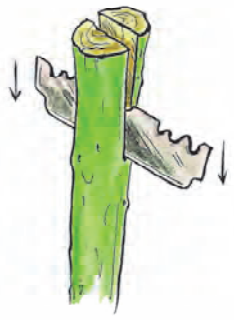
ge bl fØ;kdyki dk dju d fy, dkey ru okyk ikèkk ¼ftehdn@duk@ lnkcgkj@euhlykV@ inhuk½] ,d dkp dk fxykl] yky L;kgh] dVj ;k CyM o g.Myl dh vko';drk gkxhA

pu x, ikèk dh nk 'kk[kk, yA ,d 'kk[kk dk og fljk tk ru l tMk Fkk ml CyM ;k dVj dh lgk;rk l lery dj yA bl fgLl dk gMyl l voykdu djA vkiu tk dN Hkh n[kk mldk fp= cuk,A dVj ;k CyM dh lgk;rk l blh 'kk[kk d ru dh [kMh dkV dk Hkh voykdu djA viu voykduk d fy, vki uhp cu fp=k dh enn y ldr gA

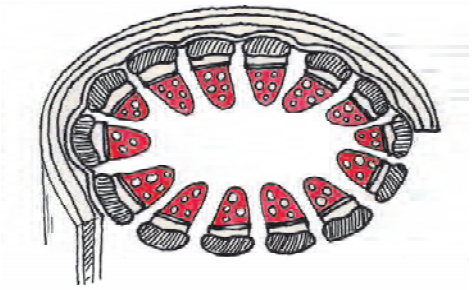
vkidh enn d fy,&



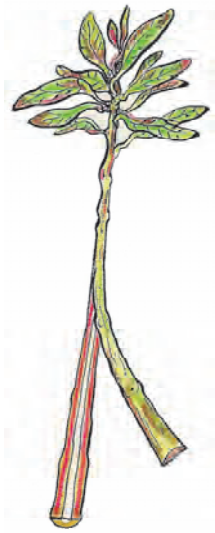
vkMh dkV



[kMh dkV



¼v½ vkMh dkV&f}cht i=h ikèk dk ruk



¼c½ [kMh dkV& f}cht i=h ikèk dk ruk

fp= Øekd&1

vc dkp d ,d fxykl dk rhu pkFkkb ikuh l Hkj yA ble yky L;kgh dh bruh ek=k feyk n fd ikuh xgj yky jx dk gk tk,A fxykl e nljh 'kk[kk dk [kMh dj yxHkx nk ?kV d fy, l; d idk'k e j[k nA nk ?kV ckn bl 'kk[kk d ru dh vkMh o [kMh dkV dk voykdu djA bld fy, vki fp= 1 ¼v½ o ¼c½ dh enn yA

- nkuk voykduk dh ryuk dju ij vkidk D;k e[; vrj fn[kkb fn;k\
- vkidk D;k yxrk g fd nljh 'kk[kk dk dN gh Hkkx yky xykch D;k gvk\
- D;k ge dg ldr g fd tk Hkkx yky@xykch gvk doy ml h Hkkx dh ikuh d logu e Hkfedk jgh g\

fp= Øekd&2 % yky L;kgh oky ikuh e Mch gb lnkcgkj dh 'kk[kk

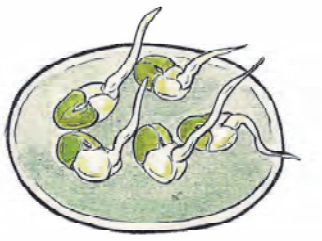
vkiu ;g Hkh] voykdu fd;k gkxk fd jxhu Hkkxk dh dkf'kdkvk dh 0;oLFkk vU; Hkkxk dh 0;oLFkk l fHkUu gA ; dkf'kdk, ikèkk e ikuh dk logu dj jgh gA

fØ;kdyki&2

bl fØ;kdyki dk dju d fy, ge puk@ex d yxHkx 30 cht] 4 dVkfj;k] ikuh] lrh diMk o CyM dh vko';drk gkxhA

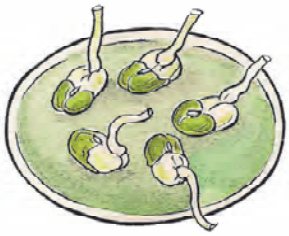
pu@ex d djhc 30 cht ,d dVkjh e yA bu chtk dk vdfjr dju d fy, ¼djhc 6&7 ?kV rd½ ikuh e fHkxk nA bld ckn bu chtk dk ikuh l fudky dj ,d lkQ lrh diM e ckèk dj j[k nA cht l[k uk bld fy, chp&chp e diM dk ikuh l xhyk djr jgA yxHkx 2&3 fnuk e cht vdfjr gk tk,xA

¼**fun'k&** chtk d vdj.k dh r;kjh f'k{kd o fo|kFkh io e gh dj yA½



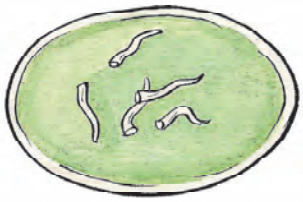
¼**v**½

dVkjh ¼v½ e ex d 5 vdfjr cht



¼**c**½

dVkjh ¼c½ e ex d 5 vdfjr cht ftud eykdj d flj dV g,



¼**l**½

dVkjh ¼l½ e eykdjk d 5 dV g, flj

fp= Øekd&3

bue l yxHkx 10 vdfjr chtk dk puko dj yA vc 5&5 vdfjr chtk dk nk vyx&vyx dVkfj;k ¼v] c½ e j[kA bUg vHkh Hkh ikuh l xhyk j[kA bu nkuk dVkfj;k d chtk d eykdjk dh yckb Ldy l eki dj nh xb lkj.kh e HkjA ;fn eykdj lhèk u gkdj VM&eM ;k eM g, g rk vki èkkx dk mi;kx dj eykdj dk eki ldr gA ;g iFke fnu dh eki gA vc dVkjh ¼c½ d chtk d eykdjk d vfre flj dk yxHkx -05 leh- dkV nA dV g, fljk dk ,d vU; dVkjh ¼l½ e xhyk djd lHkkydj j[k nA budk i;kx ge fØ;kdyki 3 e djxA ;g è;ku jg fd ge dVkjh ¼v½ d chtk dk ;Fkkor j[kuk gA

lkj.kh Øekd&1

eykdjk dh yckb	dVkjh ¼v½ d cht					dVkjh ¼c½ d cht				
iFke fnu										
ikpok fnu										

vc ge le;≤ ij nkuk dVkfj;k ¼v o c½ d chtk dk voykdu djr jgxA ;g Hkh è;ku j[kuk g fd cht l[ku u ik,A iuh ikpo fnu nkuk dVkfj;k ¼v o c½ d chtk d eykdjk dh yckb eki y vkj Åij nh xb lkj.kh e HkjA ;g ikpo fnu dh eki gA

- ikp fnuk d ckn fdl dVkjh d chtk d eykdjk dh yckb vfèkd g vkj D;k\
- ftu chtk d eykdjk d flj dkV fn, x, Fk D;k mudh yckb e of) gb\

fØ;kdyki&3

bl fØ;kdyki d fy, ge dVkjh ¼l½ d rkt dV g, eykdjk dk i;kx djxA chtk d eykdjk d vfre flj dk ydj bldh LykbM r;kj djA dV g, ,d eykdj dk ydj LykbM e j[k vkj ,d cn ikuh dh MkyA vc bl yky L;kgh@vkyrk@lÝfuu l vfHkjftr djA bl ij fXyljhu dh ,d cn Mkydj bl doj fLyi l <d nA ;g è;ku j[k fd gok d cycy doj fLyi d vUnj u jgA vc bl LykbM dk tyrh gb ekecÙkh dh yk ij gYd l xe djA bl gYd l nck, rkfd og piVk gk tk,A l{en'kh l LykbM dk voykdu djA voykdu d fy, fp= 4 dh enn yA vkiu tk n[kk mldk fp= viuh dkih e cuk,A

fun'k% bl fØ;kdyki d fy, ge eykdjk d rkt dV flj gh pkfg, gkxA vr% vki fØ;kdyki 2 d ckn cp g, flj ;k vU; vdfjr chtk d eykdjk d fljk dk i;kx dj ldr gA

fp= Øekd&4 % eykdj d vfre flj e dkf'kdkvk dh 0;oLFkk

- v vkj c dVkjh e l fdld chtk e eykdjk dh of) tkjh jgh\
- eykdjk d flj D;k dk; djr g\ fopkj dj fy[kA

vkiu n[kk dVkjh c d chtk d eykdjk dh yckb ml flj l ugh c<h tgk l mud vfre fljk dk dkV fn;k x;k Fkk] D;kfd ikèkk e of) dju okyh dkf'kdkvk dk leg mlh vfre flj e FkkA tcfd v dVkjh d chtk d eykdjk dh yckb e of) gb D;kfd of) dju okyh dkf'kdk, ;Fkkor FkhA

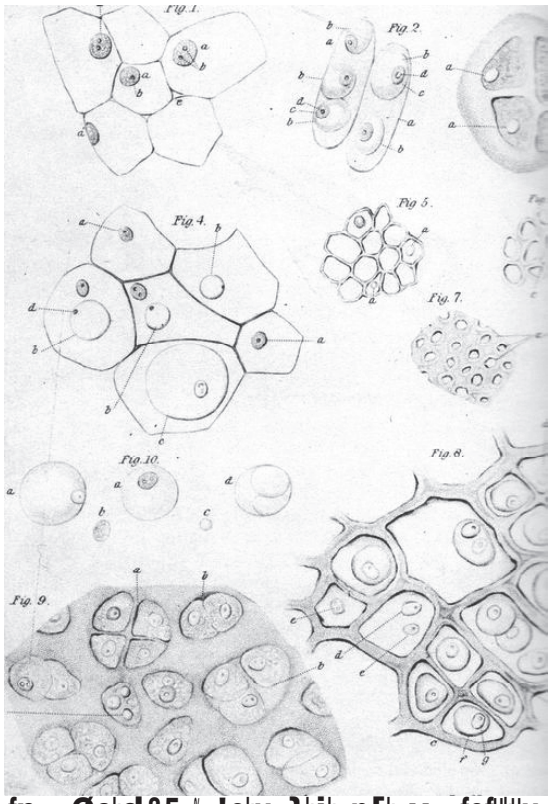
fØ;kdyki 1] 2 o 3 e geu n[kk fd ikèk e ikuh d logu d fy, dN dkf'kdk, ftEenkj gkrh g rk of) d fy, nljhA geu ;g Hkh n[kk fd budh 0;oLFkk vU; dkf'kdkvk l fHkUu gkrh gA vr% ge dg ldr g fd l thok e dkf'kdk, ,d idkj dh 0;oLFkk e leg cukr g, ,d ;k ,d l vfèkd dk;k dk liUu djrh gA dkf'kdkvk dh ,lh 0;oLFkk o leg dk Ård d uke l tkuk tkrk gA

7-1 ge Årdk d ckj e dl irk pyk\

1799 e ekjh ÝUdkbl tfo;j fcNV u eu";k d 'kjhj e jkx xflr {k=k dh vkrfjd ljpuk l lcfèkr voykduk d nkjku vkil e xFkh gb ljpukvk d fy, ^fV';** ;kuh Ård dk uke fn;kA bUgku viuh iLrd e bud ckj e foLrr fooj.k Hkh fn;kA vkidk ;g tkudj vk'p; gkxk fd fcNV u Årdk d vè;;u e l{en'kh dk mi;kx ugh fd;k FkkA mudk vè;;u e[; :i l tr Årdk ij vkèkkfjr FkkA mUgku igy rk Årdk dk e[; :i l 3 Hkkxk e ckVk FkkA

1- o Ård tk j'k d leku Fk mUg Qkbcl dgkA
2- o Ård tk rjy] ikuh d tl Fk mUg fljl dgkA
3- dN Ård fpifpi Fk ml E;dl dgkA

mUgku bud vkj mileg cuk, ftue 21 vU; Årdk dk fooj.k feyrk gA vkt d le; e i;kx e vku oky lkj tr Årdk dk ukedj.k ,o fooj.k fcNV d fooj.k l dkQh feyrk tyrk gA



fp= Øekd&5 % 'oku }kjk n[k x, fofHkUu idkj d Årdk d fp=

,lk ugh g fd fcNV gh Årdk dk vè;;u dju oky igy oKkfud FkA bul yxHkx ,d 'krkCnh io oKkfudk u ikèkk o tr Årdk dk n[kk vkj mudk fooj.k vyx&vyx 'kCnkoyh e mudh lrg dh cukoV] ljpuk o dk;k d vkèkkj ij fd;k FkkA bue l ,d oKkfud ugfe;k xho ¼1641&1712½ FkA bUgku e[; :i l nk fu"d"k ifrikfnr fd,A bud vulkj iR;d ikèk e nk idkj d tfod Hkkx gkr gA igyk fiFkh ¼eTtk½ nljk oMh ¼dk"Bh;½A xho gh o oKkfud Fk ftUgku loiFke iryh f>Yyh okyh ue] Lith o no l Hkjh dkf'kdkvk dk ijUdkbek dgkA 'yhMu o 'oku ¼1838½ u Hkh bl fn'kk e vè;;u fd, tk fd xho d vè;;u l feyr&tyr FkA bUgku i{kh d i[k dh vkMh dkV e olh gh dkf'kdkvk dk n[kk tlh xho u ikèkk dh dkf'kdkvk e n[kk FkkA 'yhMu o 'oku u viu vè;;u e ;g Hkh ik;k fd f'k'k HkM d iV dh vkrfjd lrg d Ård ijUdkbek l ijh rjg feyr gA

Årdk d ckj e vè;;u dju oky ,d vU; oKkfud uxyh FkA ; ouLifr 'kkL=h Fk ftUgku QkefVo ,o LVcy Årdk dh ldYiuk nhA bUgku QkefVo Årdk dk rth l of) dju oky Ård ;k ejhLVefVd uke fn;kA bUgku lkoèkkuhiod voykdu fd;k vkj ik;k fd ikèkk dh tMk o ru d 'kh"k Hkkx ,o trvk e jDr o Ropk e bl idkj d Ård ik, tkr gA bld lkFk gh uxyh u ikèkk e ufydk d tl Årdk dk tk fd ikuh] [kfut o Hkktu dk logu djr g bUg Øe'k tkbye vkj ¶yk,e uke fn;kA Årdk d bl leghdj.k e mUgku Hkktu o ikuh d logu dh fn'kk dk vkèkkj ekukA

uxyh dh rjg 'yhMu vkj 'oku u Hkh rth l of) djr g, Årdk dk n[kk vkj ik;k fd bu Årdk dh dkf'kdk, NkVh] dnd cM o Li"V FkA dkf'kdkn0; dh ek=k cgr de FkhA tl&tl dkf'kdk, ifjiDo gkrh xb ; dkf'kdk, vkdkj e cMh] dnd NkVk] i;kIr dkf'kdk n0; vkj budh dkf'kdk f>Yyh rFkk dkf'kdk fHkfÙk ekVh gkrh xbA

bl idkj geu n[kk dh dl vyx&vyx le; e oKkfudk u Årdk e dkf'kdkvk dh 0;oLFkk dk n[kkA Årdk dh ljpuk ,o dk;k dk l{erk l voykdu fd;kA lHkh u Årdk dk foLrkj l le>u d fy, mud 0;oLFkk o dk;k dk vkèkkj cuk;kA lkFk gh lHkh oKkfudk u Årdk dk ikèkk o trvk nkuk e vè;;u fd;kA mUgku ikèkk o trvk nkuk d Årdk e lekurk o vlekurk dk tkuu dk i;kl fd;kA gekj 'kjhj e dN Ård ,l g tk ikèkk d Årdk l lekurk j[kr g] ; lekurk bruh vfèkd gkrh g fd vuHkoh oKkfud Hkh bue vrj dju e dfBukb egll djr gA lkekU;r% tr Ård ifjiDo ikni dkf'kdkvk dh ryuk e vfèkd dkey gkr gA ikèkk ,o tr nkuk d Årdk e dkf'kdkvk dh 0;oLFkk vkj mud dk;k e lekurk d vkèkkj ij gh 'yhMu o 'oku u dkf'kdk fl)kr dk ifriknu fd;k FkkA

- dkf'kdk fl)kr d e[; fcn D;k g\

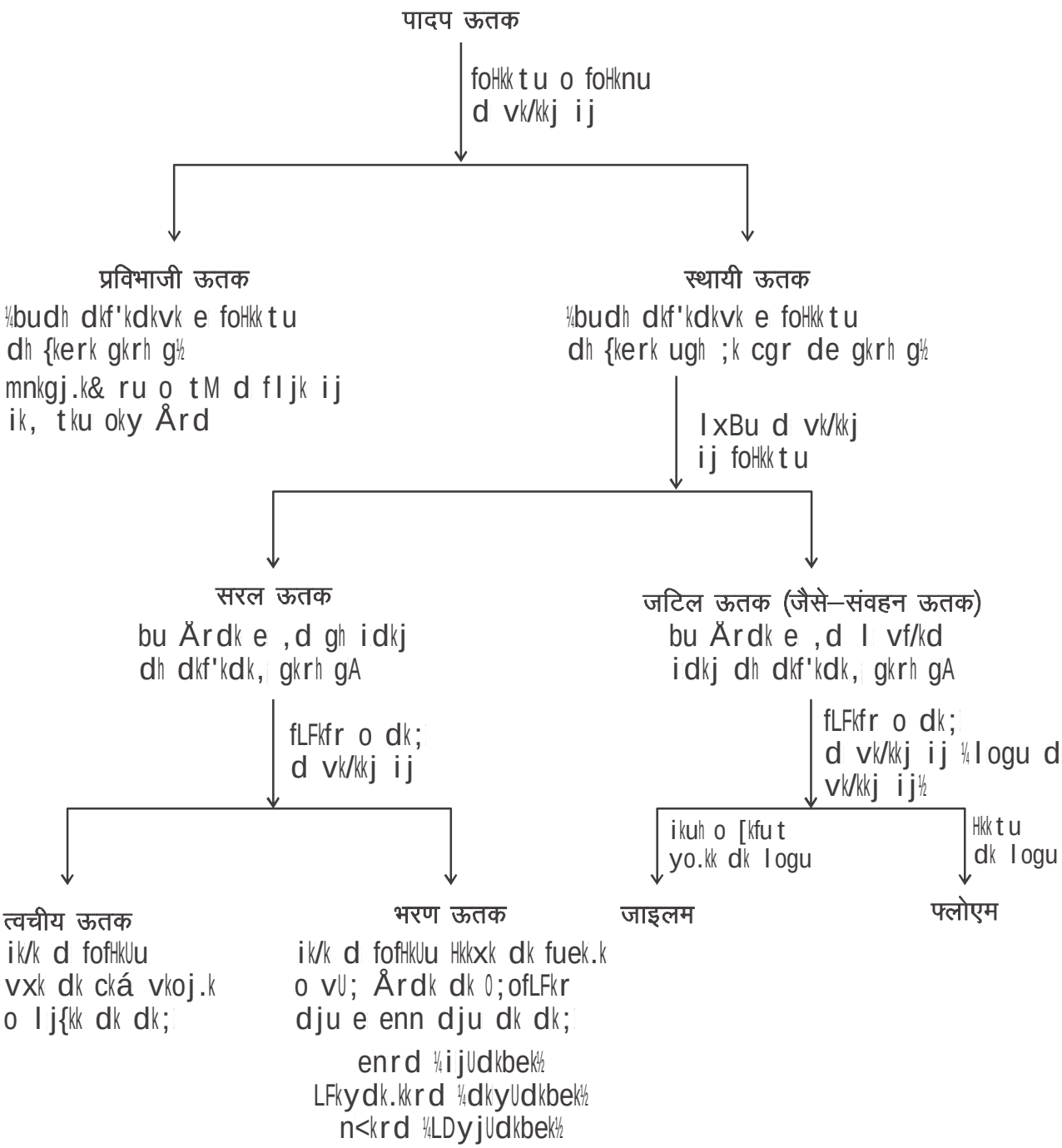
ge Hkh ;fn ikèkk o trvk d Årdk dk xgjkb l voykdu dj rk ik,x fd ikèkk e logu dk dk; dju oky vkj lgkjk nu oky vfèkdk'k Ård er gkr g tcfd trvk e ik;% ; Ård thfor gkr gA vkerkj ij ikèkk d Årdk e foHkkftr gku oky vkj foHkkftr ugh gku oky {k=k e ge vkIkuh l vrj dj ldr gA mnkgj.k d fy, foHkkftr {k=k dh dkf'kdk, NkVh o iryh fHkfÙk okyh gkrh g tcfd vfoHkkftr {k=k dh dkf'kdk, cMh o ekVh fHkfÙk okyh gkrh gA trvk d Årdk e bl rjg dk vrj dj ikuk ef'dy gA

7.2 Årdk dk leghdj.k (Grouping of tissues)

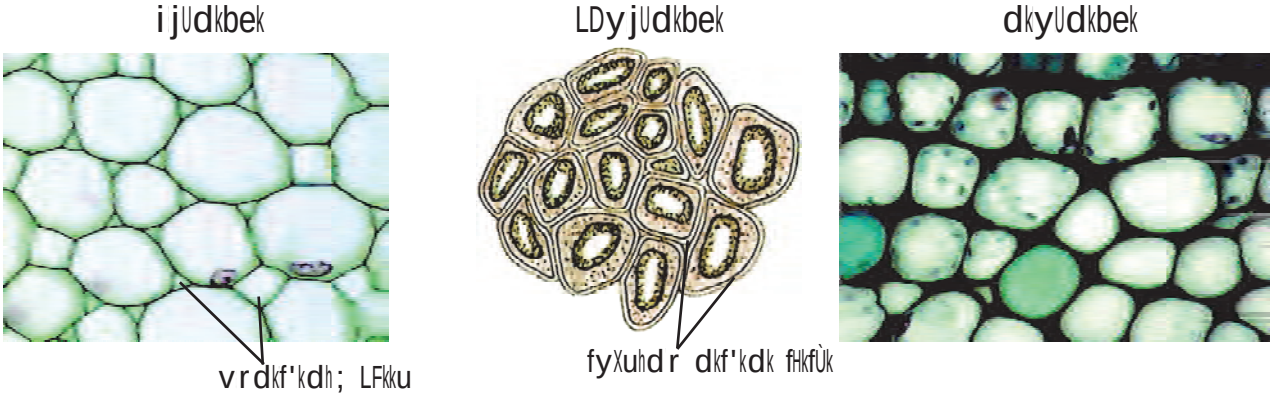
geu i<k fd le;≤ ij oKkfudk u ikni o tr Årdk dk vè;;u fd;kA bud foLrr vè;;u d fy, oKkfudk u leghdj.k dh ifØ;k dh lgk;rk yhA ble mUgku Årdk d dk;k] fLFkfr] lxBu] 0;oLFkk o foHkktu {kerk vkfn x.kk dk vkèkkj cuk;kA vè;;u dh lfoèkk dh nf"V l ge ikni o tr Årdk dk ,d lkFk leghdr u djd vyx&vyx leghdr dj jg gA

7.2.1 ikni Ård dk legdj.k

ikni Ård d legdj.k dk ,d mnkgj.k fuEu idkj dk gk ldrk g&



fp= Øekd&6 ikni Ård dk legdj.k

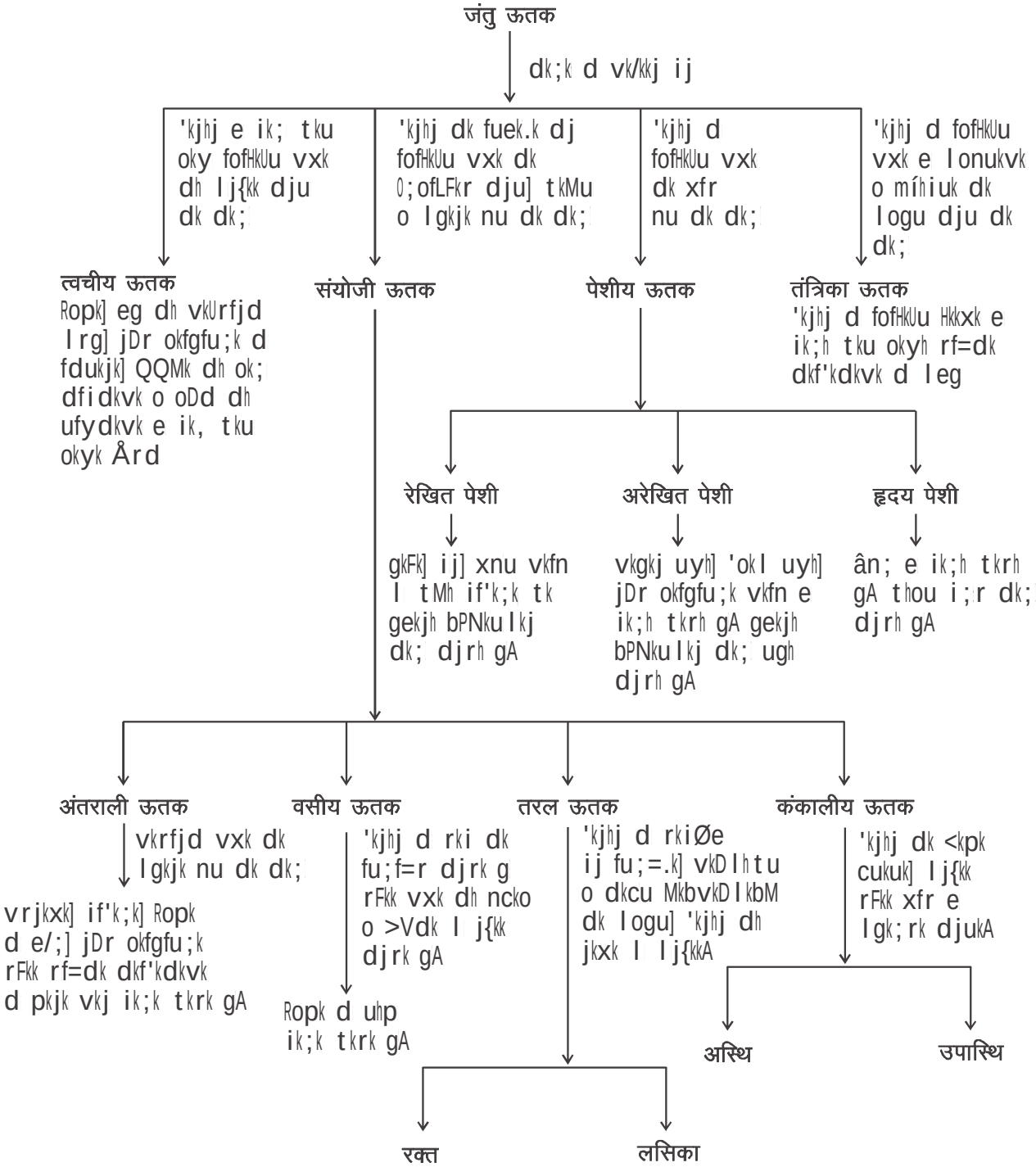


fp= Øekd&7 % fofHkUu ikni Ård

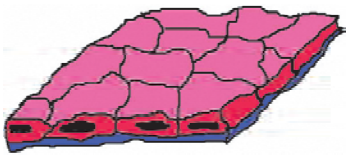
Åij fn, x, leghdj.k dh ,d lhek gA tc ge LFkk;h Årdk dk mÙkjkÙkj leghdr djr g rk ijUdkbek o dkyUdkbek dk LFkk;h Ård dh J.kh e j[kr gA ijr ijUdkbek o dkyUdkbek Hkh foHkk tu dju dh {kerk j[kr gA vr% l{ki e ge ;g dg ldr g fd ifoHkk th Ård o LFkk;h Ård nk fHkUu&fHkUu Ård u gkdj dkf'kdkvk dh 0;oLFkk d vyx&vyx le; d fu:i.k gA blh dkj.k bu nkuk d eè; dh fLFkfr;k Hkh ik;h tkrh gA mnkgj.kkFk o LFkk;h Ård ftue fd foHkk tu dh {kerk Hkh gkrh gA

7.2.2 tr Årdk dk leghdj.k (Grouping of animal tissues)

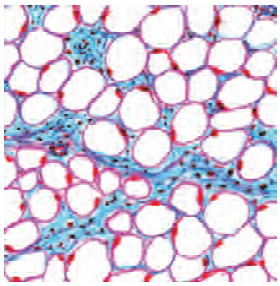
vkb,] vc ge tr Årdk d ,d idkj d leghdj.k dk le>r g&



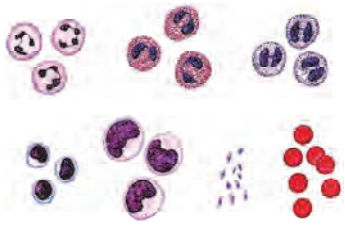
fp= Øekd&8 % tr Ård dk leghdj.k



'kYdh midyk Ård
(Scaly epithelial tissue)

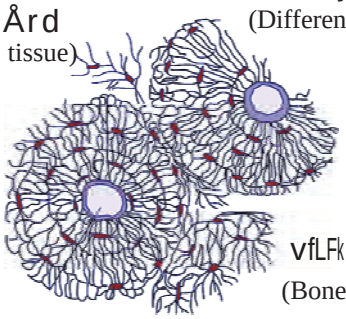


olke; Ård
(Adipose tissue)



fofHkUu jä df.kdk,
(Different blood cells)

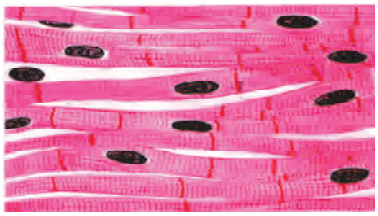
,fjvkyj Ård



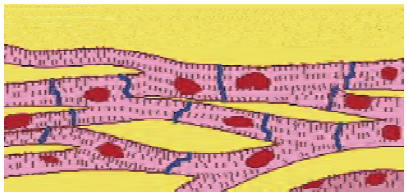
vfLFk Ård
(Bone tissue)

¼v½ Roph; Ård (Dermal tissue)

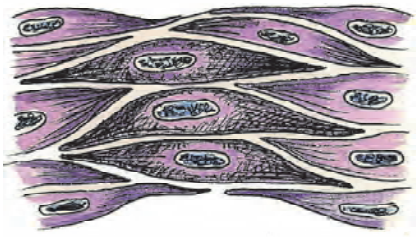
¼c½ l;kth Ård (Connective tissue)



jf[kr i'kh; Ård
(Striated muscle tissue)



ân; i'kh; Ård
(Cardiac muscle tissue)



vjf[kr i'kh; Ård (unstriated muscle tissue)
¼l½ i'kh; Ård (Muscular tissue)

¼n½ rf=dk Ård (Nervous tissue)

fp= Øekd&9 % fofHkUu idkj d tr Ård

vHkh rd geu Årdk d bfrgkl o mud legh dj.k d ckj e i<kA vkb,] vc ge dN Årdk dk voykdu djr gA

7-3 ikni Årdk dk voykdu

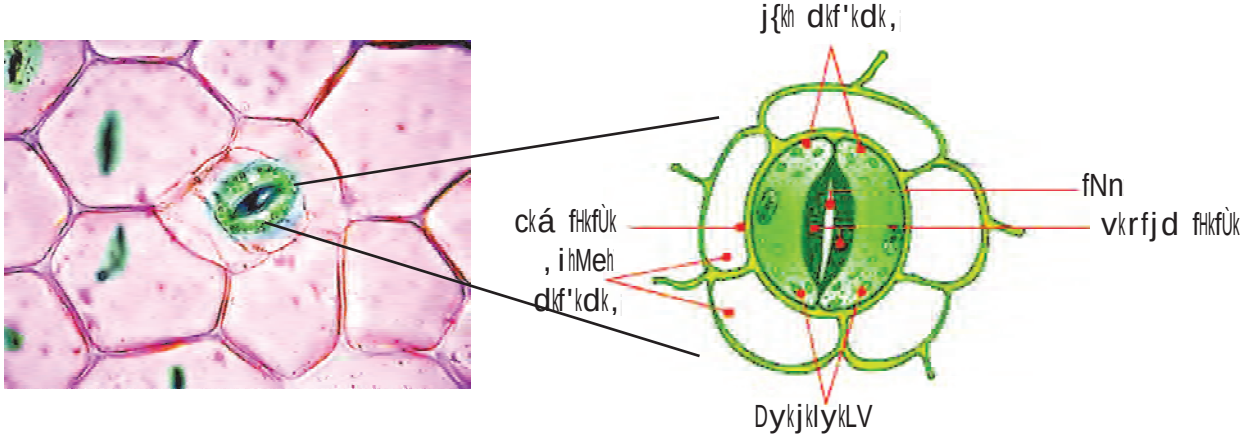
bu fØ;kdykik dk dju d nkjku vki fp= 7 dh enn yA

fØ;kdyki&4

7-3-1 Roph; Ård (Dermal tissues)

ikèkk e Roph; Ård dk voykdu dju d fy, ge fuEu fØ;kdyki djr gA bld fy, ge fj;k dh iÙkh] l{en'kh] doj fLyi] LykbM vkfn dh vko';drk gkxhA

- fj;k dh iÙkh dk ncko yxkdj bl rjg rkM fd iÙkh dh fupyh lrg dh f>Yyh vyx fudy vk,A
- bl f>Yyh dk LykbM ij j[k vkj ,d cn ikuh Mky dj doj fLyi l <d nA
- bldk l{en'kh l voykdu dj o bldk fp= viuh dkih e cuk,A voykdu d fy, vki fp= 10 dh enn y ldr gA
- viu voykduk e dkf'kdkvk dh 0;oLFkk o ljpuk d ckj e foLrkj l fy[kA



fp= Øekd&10 % iÙkh dh fupyh lrg dh f>Yyh dh dkf'kdk, ,o j{kh dkf'kdk,

- D;k vkidk DykjklykLV ;Dr dkf'kdk, fn[kkb nh\ fn, x, fp= dh enn l crk, fd bUg D;k dgr g\

l{en'kh e tk dkf'kdk, vkidk fn[kkb n jgh g o ikèkk dh lcl ckgjh ijr ckg; Ropk ;k Roph; Ård gA trvk dh Ropk dh rjg bldk "h ie[k dk; j{kk djuk gA vr% bldh dkf'kdk, vkil e lVh

gb gkrh gA tlk fd vkiu viu voykdu e Hkh n[kk gkxkA bud chp vrdkf'kdh; LFkku ugh gkrA ik;s 'k"d LFkkuk ij feyu oky ikèkk dk ;g l[ku l cpkrh gA tyh; ikèkk e eke tlh ifrjkèkh lrg cukrh gA LykbM e vkidk dkf'kdkvk l vyx vU; idkj dh jpuk, Hkh fn[kkb nh gkxhA bUg jèk dgr gA jèk dk nk oDd d vkdkj dh dkf'kdk, ?kj gkrh g] ; j{kh dkf'kdk, dgykrh gA ; dkf'kdk, ok;eMy l gok dk vknku&inku dju d fy, lgk;d gA ok"ikRl tu ¼ok"lk d #i e ikuh dk ikèkk l fudyuk½ dh fØ;k “h jèkk d }kjk gkrh gA

fun'k % bl fØ;kdyki d fy, vki vU; ekly ifÙk;k dk Hkh mi;kx dj ldr gA bl fLFkfr e vfèkd Li"V voykdu d fy, iÙkh dh f>Yyh dk yky L;kgh@vkyrk@lÝfuu l vfHkjftr djuk iMxkA

fØ;kdyki&5

7.3.2 enrd (Parenchyma)

bl fØ;kdyki d fy, ge dyk] iVhfM'k@okp Xykl] fMlfDVx uhMy] vk;kfMu foy;u] LykbM] doj fLyi o l{en'kh dh vko';drk gkxhA

- fMlfDVx uhMy dk mi;kx djr g, dy d ue fgLlk dk fudkyA
- bl iVhfM'k ;k okp Xykl e j[k dj fMlfDVx uhMy dh lgk;rk l elyA
- ely g, dy dk FkkMk lk fgLlk ydj LykbM e j[k ,o vk;kMhu foy;u dh dN cn MkyA bl ij doj fLyi yxk,A
- l{en'kh e fuEu vkoèku ij bldk voykdu djA ml Hkkx dk << tgk dkf'kdk, vyx gk] u fd ,d nlj l lVh gbA
- LykbM dk vk;kMhu l vfHkjftr dju ij dkf'kdkvk d vnj fLFkr LVkp d d.k xgj&uhy jx d gk tkr g vkj xPN d :i e fn[kkb iMr gA
- bl Hkkx dk mPp vkoèku ij Qkdl dj bu dkf'kdkvk dh 0;oLFkk dk n[ku dk i;kl djA
- voykdu dh xb dkf'kdkvk dh 0;oLFkk dk fp= vki viuh dkih e cuk,A

vki ik,x fd bu dkf'kdkvk e dnd Li"V gkrk gA dkf'kdk, NkVh gkrh gA bue dkf'kdk n0; de o df.kdke; gkrk gA dkf'kdk f>Yyh Li"V o ckjhd j[kk dh rjg gkrh gA bu dkf'kdkvk d chp fjDr LFkku ¼vrdkf'kdh; vodk'k½ lkk;k tkrk gA

tc ijUdkbek e i.kgfje ¼DykjkfQy½ ik;k tkrk g rc bl DykjUdkbek dgk tkrk gA tyh; ikèkk e ijUdkbek dh dkf'kdkvk d eè; e cMh xfgdk, gkrh g] bl ,jUdkbek dgk tkrk gA

fØ;kdyki&6

7-3-3 n<krd (Sclerenchyma)

bld fy, ge ue o id g, ve#n@uk'kirh] vk;kfMu foy;u] LykbM] doj fLyi o l{en'kh dh vko';drk gkxhA

- uhMy dh lgk;rk l ve#n d dN ue Hkkxk ¼Årdk½ dk fudky dj LykbM d Åij j[kA
- bu Årdk ij vk;kfMu foy;u dh nk cn MkyA
- bu Årdk dk uhMy dh lgk;rk l ely rkfd dkf'kdk, vyx&vyx gk tk,A
- l{en'kh e fuEu vkoèku ij bldk voykdu djA
- vkidk ijUdkbek l f?kjh xgj jx dh jpuk, fn[kkb nxhA
- bue l ,d ;k nk xgjh jpukvk ij l{en'kh e Qkdl djA

LDyjUdkbek Ård ikèk dk dBkj vkj etcr cukrk gA bldh dkf'kdk, ych] iryh vkj er gkrh g D;kfd bl Ård dh fHkfÙk fyfXuu d teko d dkj.k ekVh gkrh gA fyfXuu dkf'kdkvk dk n< cuku d fy, lheV dh rjg dk; dju okyk ,d jklk;fud inkFk gA dkf'kdk fHkfÙk e bld teko d dkj.k dkf'kdkvk d eè; vkrfjd LFkku ugh gkrk gA ukfj;y d j'k] lrjk d chtk dk vkoj.k] l[kh rkjb d j'k vkfn Hkh LDyjUdkbek Ård d mnkgj.k gA

7-4 tr Årdk dk voykdu

bu fØ;kdykik dk dju d nkjku vki fp= 9 dh enn yA

fØ;kdyki&7

7-4-1 Roph; Ård (Dermal tissue)

- vkiu ^^thou dh ekfyd bdkb dkf'kdk** vè;k; e xky d vkrfjd lrg dh LykbM cuk dj l{en'kh l n[kh gkxhA
- bld vykok vki flj e ik;h tku okyh #lh] ,Mh l mrju okyh peMh vkfn dk Hkh l{en'kh l n[kA
- dkf'kdkvk dh 0;oLFkk o bud eè; vrdkf'kdh; LFkku dk è;ku e j[kr g, viu voykduk dk fy[k o fp= Hkh cuk,A

Roph; Ård vxk d "hrj vkj ckgjh vkj lkk;k tku okyk ,d lj{kkRed dop gA vkiu n[kk gkxk fd bl Ård dh dkf'kdk, iryh dnd ;Dr o vi{kkdr lVh gkrh gA dkf'kdkvk d chp LFkku ugh gkrkA lj{kk d lkFk&lkFk ;g logu] lo.k o ejEer vkfn dk; "h djrk gA

fØ;kdyki&8

7.4.2 i'kh; Ård (Muscular tissue)

bl fØ;kdyki d fy, ge ân; dh i'kh; dkf'kdk dh LFkk;h LykbM dk mi;kx djxA i;kx'kkyk d LykbM ckDl e l ân; i'kh; dkf'kdk dh LykbM fudkydj mldk l{en'kh l voykdu djA viu voykduk dk ukV dj fp= Hkh cuk,A bld fy, vki fp= 9 dh enn y ldr gA

- i'kh Ård dh lgk;rk l ge dku&dku l dk; liUu djr g\

trvk d 'kjhj e gku okyh xfr;k i'kh Ård d dkj.k gh gkrh gA pkg ;g xfr ckgjh vxk] gkFkk] ijk] xnu vkfn dh gk ;k vkrfjd vxk vkr] QQM] ân; vkfn dhA

7.5 Årdk d dk; (Function of tissues)

vHkh rd geu ;g le>u dk i;kl fd;k fd Ård dkf'kdkvk d leg o mud ckgj ik; tku oky okrkoj.k dk lfEefyr :i gA bu nkuk dh vkil h fØ;kvk d QyLo:i gh ,d idkj d Ård ,d ;k ,d l vfèkd dk;k dk liUu dj ikr gA

D;k vki tkur g

Ård ,d idkj d no l f?kj jgr g] ;gh no Ård d pkjk vkj dk okrkoj.k gkrk gA bl no d lxBu vkj vk;ru e ifjoru Ård d fØ;kdykik dk iHkkfor djrk gA bld fy, fofHkUu yo.kk dh fuf'pr ek=k vR;Ur vko';d gA lHkh Årdk] pkg o trvk e gk ;k ikèkk e] dk bl no d mfpr ekè;e dh vko';drk gkrh gA Årdk d chp dk no bud dk;k d fu"iknu e egRoi.k Hkfedk fuHkkrk gA

ik;% lHkh cgdkf'kdh; ikèk ,o trvk e dkf'kdk→Ård→vx→vxr= dh 0;oLFkk gkrh gA ; mud fofHkUu tfod dk;k dk lEikfnr djr g tl l thok e ituu d fy, ,d vyx 0;oLFkk vkj mRl tu d fy, ,d vyxA vr% ge ;g dg ldr g fd ikèkk ,o trvk d 'kjhj e JefoHkktu gkrk gA

mnkgj.k d fy, tkbye ,o vfLFk nkuk Ård g tk Øe'kh ikèk ,o tr dk lgkjk nu dk dke djr gA bld lkFk&lkFk tkbye yo.kk vkj ikuh dk logu djr g vkj vfLFk;k vkrfjd vxk dk lj{kk inku djrh gA fdlh Hkh ,d vx e de l de nk Ård gkr g tk fo'k"k 0;oLFkk e lxfBr gkr g vkj feydj ,d ;k vfèkd dk;k dk djr gA tl& iÙkh ikèk dk ,d vx g o vk[k trvk dkA iÙkh i.kgfjr dh lgk;rk l idk'k l'y"k.k o jèkk dh lgk;rk l gok d vknku&inku dk dk; djrh g o vk[k n[ku dkA ikèk d idk'k l'y"k.k dju oky Hkkx vkj trvk dh vk[k e dN ,l h {kerk g fd o idk'k dh lgk;rk l dke djr gA tgk iÙkh dk idk'k l'y"k.k d fy, idk'k dh vko';drk g ogh vk[kk dk n[ku d fy,A

cgdkf'kdh; thok e dN Ård ,l gkr g tk vfr'kh?k of) Hkh djr g vkj foHkktu dh {kerk Hkh j[kr gA ; yxHkx 'kjhj d lHkh Hkkxk e mifLFkr gkr g] mnkgj.k d fy, Ropk vkj o lHkh Ård tk vxk dh vkrfjd lrg cukr gA bld vykok dN Ård ,l gkr g tk 'kjhj e Hkj.k inkFk dh rjg dk; djr gA ; j'k;Dr Ård g tl tr e if'k;k vkj ikèk dh logu Årdk e ik, tku oky j'kA ; nkuk gh lgkjk o yphykiu inku dju d lkFk&lkFk ,d Hkkx dk nlj Hkkx l tkMu dk dk; Hkh djr gA bue vfr'kh?k of) dju dh {kerk Hkh gkrh gA ftll of) vkj ejEer dh ifØ;k ljy gkrh gA

- ikni o tr Årdk d dk;k e lekurk, crk,A

D;k vki tkur g

trvk e ,d lhek rd of) gku d ckn lkeU; dkf'kdkvk dk foHkktu #d tkrk gA ijr dN dkf'kdk, ,lh Hkh gkrh g] tk vHkh Hkh foHkkftr gku dh {kerk j[krh gA bUg LVe dkf'kdk, dgr gA tc Hkh fdlh vx dh dkf'kdk, ejdj >M tkrh g] rk ; dkf'kdk, u;h dkf'kdk, cukdj mudh {kfrifr dj nrh gA tc LVe dkf'kdkvk dk foHkktu gkrk g rk nk e l ,d dkf'kdk rk foHkfnr gkdj ml Ård dh dkf'kdk dk :i y yrh g exj nljh dkf'kdk LVe dkf'kdk d :i e cuh jgrh gA

oKkfudk u ,lh LVe dkf'kdk, [kktu e lQyrk iklr dh g] tk flQ lcfèkr vx gh ugh cfYd vU; vxk dh dkf'kdk, Hkh cuk ldrh gA budh enn l {kfrxLr vx cuku d i;kl fd, tk jg gA vfLFkeTtk o uotkr f'k'k dh xHkuky ¼vkoy½ e Hkh LVe dkf'kdk, ik;h tkrh gA LVe dkf'kdkvk dk i;kx'kkyk e ljf{kr j[kk tkrk gA

7.6 Årdk dh ljpuk o dk; e lcèk

dkf'kdk→Ård→vx→vxr=] bl idkj ;g ljpukRed lxBu le; d lkFk ?kfVr gvk gA bl ifØ;k e igy ,d dkf'kdh; ljpuk, vfLrRo e vkbA bul cgdkf'kdh; lenk;k dk fodkl yxHkx 580 fefy;u o"k igy gvkA bl ifØ;k e dkf'kdkvk dh ljpuk o dk;k e Hkh ifjoru vk;kA

;fn ge ikèkk d tyh; l LFkyh; cuu dh ifØ;k dk n[k rk ge dkf'kdkvk dh ljpuk o dk;k d chp d lcèk dk le> ik,xA tc ikèk tyh; thou dk NkM LFkyh; okrkoj.k e vk, rk mUg idk'k l'y"k.k d fy, i;klr l; dk idk'k vkj dkcu MkbvkDlkbM o 'olu d fy, i;klr ek=k e vkDlhtu miyC;k FkhA ijr bud lkeu viu vkidk l[ku l cpku dh pukrh Hkh FkhA ;fn ge tyh; o LFkyh; ikèkk dh tM] ruk o iÙkh dh vkUrfjd ljpuk dk fp= Hkh n[k rk ge vnktk yxk ldr g fd LFkyh; okrkoj.k e vku ij feêh e fLFkr tMk l ydj ifÙk;k rd ikuh dk logu dl gvk gkxkA

tM 'kkf[kr gb ftl lo vfèkd l vfèkd ikuh dk vo'kk"k.k dj ikbA lkFk gh ufydk: ih ljpuk, Hkh fodflr gb ftl dkj.k vo'kkf"kr ikuh o [kfut yo.k ikèkk e vU; Hkkxk rd igp ik;kA bu uyh : ih ljpuk dk vki fØ;kdyki&1 d fp=k e Hkh n[k ldr gA

blh idkj tyh; okrkoj.k l LFkyh; okrkoj.k e vku ij tr dkf'kdkvk dh ljpuk o dk;k e vk, cnykok dk Hkh le>k tk ldrk gA tyh; trvk e 'kjhj dh lrg d }kjk 'olu d fy, gok dk vknku&inku gkrk gA LFkyh; okrkoj.k e vku ij trvk d 'kjhj dh lrg gok d lEid e vku ij l[ku yxhA QyLo: i LFkyh; trvk e dkf'kdk, ,l ueh;Dr legk e 0;ofLFkr gb ftle vfèkdkfèkd gok xg.k dju dh {kerk FkhA vki le> gh x, gkx fd ge ;gk QQMk dh ckr dj jg gA QQMk dh lrg cgLrjh; o oyf;r gkrh gA budh lrg dk {k=Qy vfèkd gkrk g] ftl gok d lxg.k o vknku&inku e lfoèkk gkrh gA

ie[k 'kCn (Keywords)

Ård (tissue)] JefoHkktu (division of labour)] Roph; Ård (dermal tissue), Hkj.k Ård (ground tissue)] logu Ård (vascular tissue)] tkbye (xylem), ¶yk,e (phloem)] rf=dk Ård (nervous tissue)] l;kth Ård (connective tissue)] i'kh; Ård (muscular tissue)

geu lh[kk

- Ård] dkf'kdkvk d leg o mud ckgjh okrkoj.k ¼no½ dk lfEefyr :i gkr g tk ,d ;k ,d l vfèkd dk; djr gA
- ,d Ård e ,d l vfèkd idkj dh dkf'kdk, gk ldrh gA
- foHkktu o foHknhdj.k dh ifØ;k d QyLo: i leku dkf'kdkvk d leg vyx&vyx idkj d Ård k e foHkfnr gk tkr gA
- vyx&vyx idkj d Ård k e dk;k d cVokj dh ifØ;k dk JefoHkktu dgr gA
- vyx&vyx le; ij oKkfudk u tr o ikni Ård k e lekurk o fofHkUurkvk dk vè;;u fd;kA
- foHkktu dju dh {kerk d vkèkkj ij ikèkk d Ård k dk nk legk e j[kk x;k g ifoHkkth Ård ,o LFkk;h ÅrdA ijr LFkk;h Ård tl ijUdkbek] dkyUdkbek e Hkh foHkktu dju dh {kerk gkrh gA

- trvk d Årdk dk mud vkdkj ,o dk; d vkèkkj ij pkj legk e j[kk x;k g Roph; Ård l;kth Ård] i'kh; Ård vkj rf=dk ÅrdA
- Årdk d ljpuk o dk; ,d nlj dk iHkkfor djr gA

vH;kl

1- lgh fodYi pu&

(i) ikni Årdk dk logu d vkèkkj ij fd;k x;k leghdj.k g&

¼v½ tkbye ,o ijUdkbek ¼c½ tkbye ,o ¶yk,e

¼l½ ¶yk,e ,o Roph; Ård ¼n½ ijUdkbek ,o ,jUdkbek

(ii) Ård g&

¼v½ dkf'kdkvk dk leg ¼c½ dkf'kdk, ,o dkf'kdk n0;

¼l½ dkf'kdk, ,o mld vklikl dk no ¼n½ bue l dkb ugh

(iii) fyfXuu dk teko fdu Årdk e gkrk g&

¼v½ ijUdkbek ¼c½ dkyUdkbek

¼l½ DykjUdkbek ¼n½ LDyjUdkbek

2- fjDr LFkkuk dh ifr dj&

(i) ---------- Ård ikèkk e ikuh vkj [kfut yo.kk dk logu djrk gA

(ii) ---------- Ård eg dh Hkhrjh lrg e ik;k tkrk gA

(iii) 'kjhj d fofHkUu vxk dk xfr o lgkjk nu dk dk; ----------o ---------- Ård djr gA

3- Ård l vki D;k le>r g\

4- fdUgh rhu Årdk d dk;k dk viu 'kCnk e fy[kA

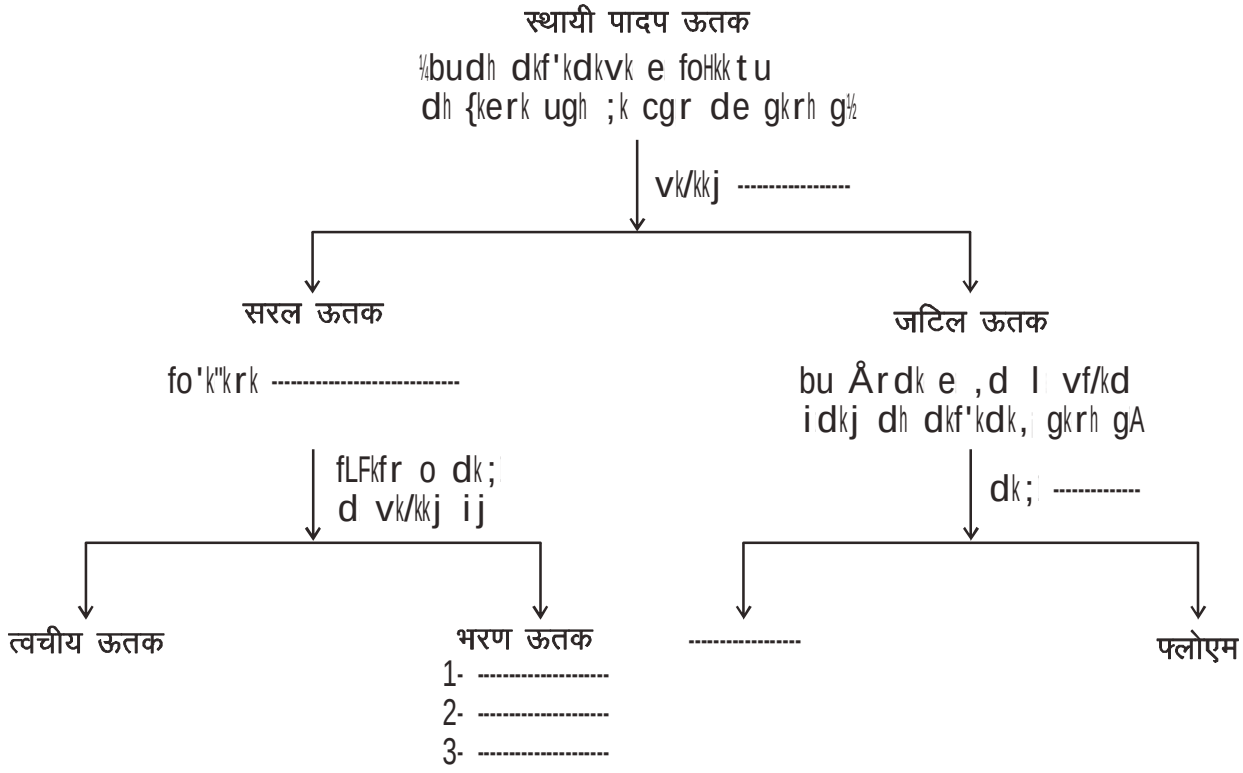
5- cgdkf'kdh; thok d Årdk e JefoHkktu dk egRo crk,A

6- LDyjUdkbek Årdk d dN ,l mnkgj.k fy[k ftUg vki vklkuh l viu vklikl n[k ldr gA

7- jDr dk l;kth Ård D;k dgk tkrk g\

8- Årdk d vè;;u d ,frgkfld ifji{; ij ,d fVli.kh fy[kA

9- ikni Årdk d legdj.k dk è;ku e j[kr g, uhp cu ¶yk pkV dk ijk dj&



10- Årdk dh ljpuk o dk; dk vkil e ?kfu"B lcèk gkrk gA bl dFku dk le>k,A

11- ikni Årdk d legdj.k dk bud dk;k o fo'k"krkvk dk è;ku e j[kr g, crk,A

12- tr Årdk dk fdru legk e ckVk x;k g\ budk ckVu d vkèkkj Hkh crk,A

13- D;k vki tr o ikni Årdk dk fdUgh vU; idkjk e oxhdr dj ldr g\ bld fy, vki fdu vkèkkjk dk pux\

tjk lkfp,

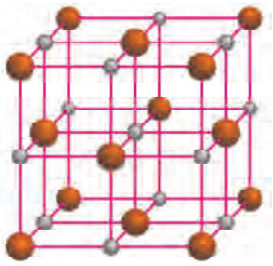
vktdy uotkr f'k'k dh xHkuky@vkoy (placenta) dk i;kx'kyk e D;k ljf{kr j[kk tk jgk g\

UFL6TN

vè;k;&8

jklk;fud vkcèku

(Chemical Bonding)



geu ijek.k ljpuk dk vè;;u djr le; i<k g fd iR;d rRo d ijek.k e byDVkuk dh l[;k fuf'pr gkrh gA lkFk gh iR;d d{k e byDVkuk dh l[;k rFkk 0;oLFkk Hkh fuf'pr gkrh gA ijek.k e byDVkuk dh l[;k rFkk mld ukfHkd e mifLFkr ikVkuk dh l[;k cjkcj rFkk vko'k foijhr gkr g blfy, ijek.k dh idfr o|r mnklhu gkrh gA

;g n[kk x;k g fd idfr e ik, tku oky dN rRo fØ;k'khy gkr g vkj dN rRo vfØ;A bl le>u d fy, ;fn ge rRok d byDVkfud foU;kl dk n[k rk ;g jkpd ckr le> e vkrh g fd rRok d jklk;fud x.k] ijek.k d vfre ¼ckáre½ d{k e mifLFkr byDVkuk dh l[;k ¼l;kth byDVku½ ij fuHkj djr gA ,l rRo] ftud ijek.kvk d ckáre d{k e vkB byDVku ¼ghfy;e dk NkMdj] ble nk byDVku½ gkr g] lkekU;r% ;kfxd ugh cukr vkj ,d ijekf.od xlk d :i e ik, tkr g] ;rRo g& ghfy;e] fuvku] vkxku] fØlVku] thuku vkfnA ;rRo fØ;k ugh djr blfy, bUg vfØ; ¼mRd"V½ xl dgr gA ghfy;e dk NkMdj vU; lHkh vfØ; xlk d ckáre d{k e vkB byDVku ¼v"Vd½ gkr gA

UFV2VB

8.1 vk;fud cèk (Ionic bond)

,l rRo ftud ijek.kvk d ckáre d{k e vkB byDVku l de gkr g ¼gkbMkstu dk NkMdj½] o ckáre d{k e vkB byDVku ikIr dju d fy, viu gh ijek.k ;k nlj ijek.k l l;kx ¼fØ;k½ djr g vFkkr vfØ; xl foU;kl ikIr dju dk i;kl djr g] ij dl\

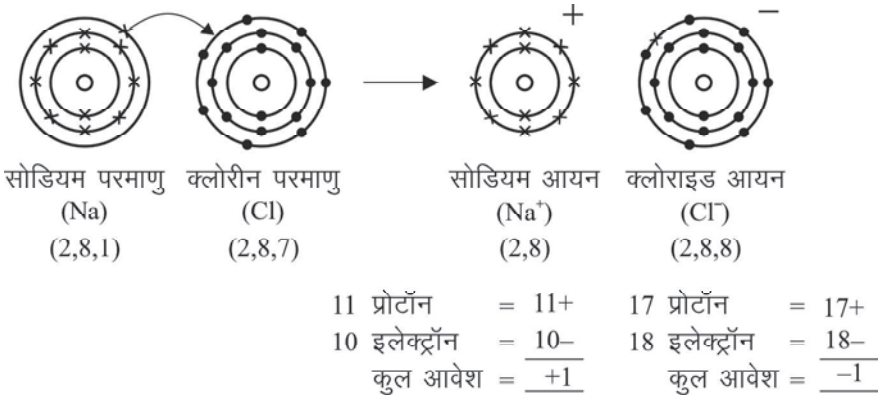
vkb,] bl nfud thou e mi;kx fd, tku oky ued ¼lkfM;e Dykjkb M½ d mnkgj.k }kjk le>A lkfM;e Dykjkb M] lkfM;e rFkk Dykjhu rRok l feydj curk gA vki tkur g fd lkfM;e rFkk Dykjhu dh ijek.k l[;k Øe'k% 11 rFkk 17 gA vkb,] budk byDVkfud foU;kl cuk,&

$$_{11}Na \; - \; 2, 8, 1$$

$$_{17}Cl \; - \; 2, 8, 7$$

vc] nkuk rRok d byDVkfud foU;kl dk n[kdj crk, fd&

- bud ckáre d{k ¼l;kth d{k½ e fdru&fdru byDVku g\
- lkfM;e rFkk Dykjhu ijek.k d ckáre d{k e vkB&vkB byDVkuk dk vkdMk ijk gku dh D;k&D;k lHkkouk, gk ldrh g\



fp= Øekd&1 ¼d½ lkfM;e DykjkbM dk cuuk

vkiu n[kk fd lkfM;e ijek.k d K d{k e 2, L d{k e 8 rFkk M d{k e 1 byDVku gA igyh lHkkouk ;g gk ldrh g fd lkfM;e M d{k d 1 byDVku dk R;kx n] ft ll mld K rFkk L d{k e Øe'k% 2 rFkk 8 byDVku jg tk,A ,h fLFkfr e og vfØ; xl foU;kl ¼fuvku 2] 8½ ikIr dj yxkA

nljh lHkkouk ;g gk ldrh g fd lkfM;e 7 byDVku xg.k dj] ft ll mld K d{k e 2, L d{k e 8 rFkk M d{k e 8 byDVkUk gk tk,A ,h fLFkfr e og vfØ; xl foU;kl ¼vkxku 2] 8] 8½ ikIr dj yxkA

lkfM;e dh ijek.k l[;k 11 gA bldk vFk g fd mld ukfHkd e 11 ikVku rFkk d{kk e 11 byDVkUk gA ;fn og ,d byDVku dk R;kx djrk g ;k lkr byDVku xg.k djrk g rk D;k vki crk ldr g fd ml ij fdruk vko'k gkxk\

ijek.k o|r mnkluhu gkrk g D;kfd mld ukfHkd e mifLFkr èku vkof'kr ikVkuk dh l[;k d{kk e mifLFkr _.k vkof'kr byDVkuk dh l[;k d cjkcj gkrh gA byDVkUk d xg.k dju ij ijek.k _.k vkof'kr vk;u ¼_.kk;u½ rFkk R;kx dju ij èku vkof'kr vk;u ¼èkuk;u½ cukr gA vk;u ij ik;k tku okyk vko'k xg.k ;k R;kx fd, x, byDVkUkk dh l[;k d cjkcj gkrk gA

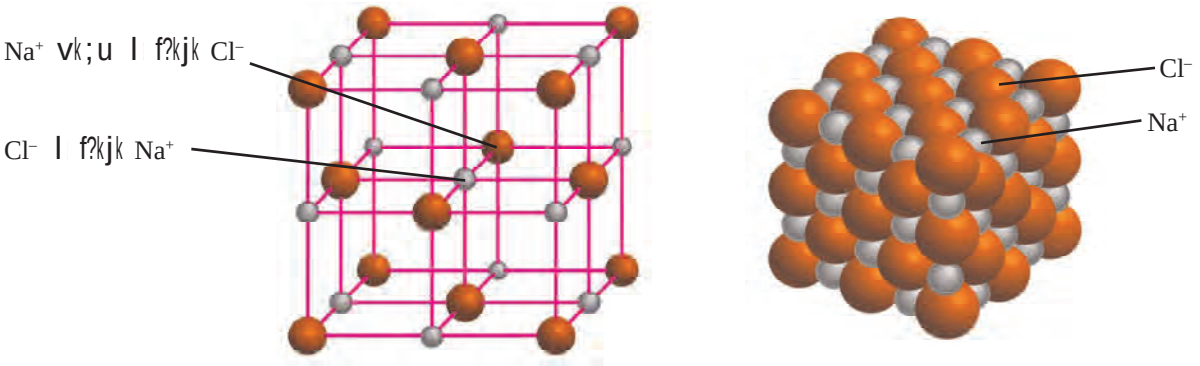
vkb,] vc Dykjhu ijek.k ij fopkj djA vfØ; xl foU;kl ikIr dju d fy, Dykjhu Hkh ,d byDVku xg.k ;k lkr byDVku dk R;kx dj ldrk gA ;fn Dykjhu ,d byDVku xg.k djrk g rc mld K d{k e 2] L d{k e 8 o M d{k e 8 byDVku gk tk,x rFkk og Dykjkbd vk;u $(Cl^{\ominus})$ cuk,xkA ;fn og lkr byDVkuk dk R;kx djrk g rc mld K d{k e 2] L d{k e 8 byDVku gk tk,x rFkk og Cl^{7+} vk;u cuk,xkA

lkfM;e ukfHkd lkr vfrfjDr byDVkuk dk ckèk j[ku e l{ke ugh gkrkA mlh idkj Dykjhu d fy, Hkh Cl^{7+} dh fLFkfr ikIr djuk dfBu gA bldk vFk g lkfM;e ijek.k d fy, ,d byDVku dk R;kx djuk rFkk Dykjhu ijek.k d fy, ,d byDVku xg.k djuk ljy g vr% lkfM;e ijek.k ,d byDVku R;kx dj Na^{+} vk;u rFkk Dykjhu ijek.k ,d byDVku xg.k dj Cl^{-} vk;u cukrk gA

foijhr vko'k gku d dkj.k lkfM;e rFkk Dykjkb M vk;u ijLij vkdf"kr gkdj fLFkj o|r cy e cèkdj lkfM;e DYkkjkbM ¼NaCl½ dk fuek.k djr gA

bl idkj cuk cèk o|r l;ktd cèk ;k vk;fud cèk dgykrk gA ftu ;kfxdk dk fuek.k bl idkj d vkcèku l gkrk g mUg o|r l;ktd ;kfxd ;k vk;fud ;kfxd dgr gA è;ku nu ;kX; ckr ;g g fd lkfM;e Dykjkb M v.k d :i e ugh ik;k tkrk cfYd ;g foijhr vkof'kr vk;uk dk lePp; gkrk gA

;gk cèk ,d lkfM;e vk;u vkj ,d Dykjkb M vk;u d eè; gh ugh curk cfYd ,d f=foeh; fØLVy dk fuek.k gkrk g ftle iR;d èku vkof'kr lkfM;e vk;u] _.k vkof'kr Dykjkb M vk;u l f?kjk gkrk g] Bhd ol gh _.k vkof'kr Dykjkb M vk;u] èku vkof'kr lkfM;e vk;u l f?kjk jgrk gA fØLVy e lkfM;e vk;u dh l[;k Dykjkb M vk;u dh l[;k d cjkcj gkrh gA



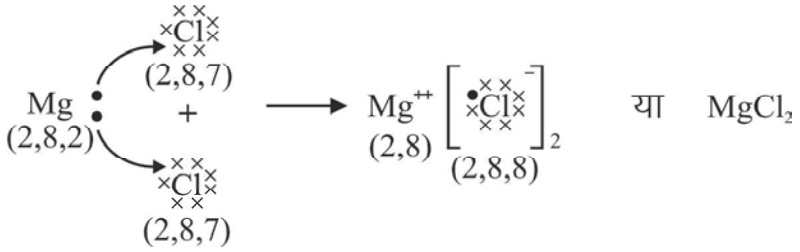
fp= Øekd&1 % ¼[k½ lkfM;e Dykjkb M dh f=foeh; ljpuk

vefjdh jlk;uK fxycV U;Vu ybl (Gilbert Newton Lewis) u ijek.k e mifLFkr l;kth byDVkuk dk n'kku d fy, byDVku fcn ljpuk ;k ybl irhd (Lewis symbol) dk mi;kx fd;kA bl fofèk e ijek.k d ckáre dk'k e mifLFkr byDVkuk dk n'kku d fy, ml rRo d irhd d pkjk vkj mru gh fcn yxk, tkr g ftru byDVku mld ckáre dk'k e mifLFkr jgr gA

vkb,] vc ge dN vkj ;kfxdk dk vè;;u djr g ftue vk;fud cèk ik;k tkrk gA eXuhf'k;e ,o Dykjhu d eè; Hkh vk;fud cèk dk fuek.k gkrk gA eXuhf'k;e dh ijek.k l[;k 12 gA bldk byDVkfud foU;kl fyf[k, rFkk ;g Hkh lkfp, fd og dl vfØ; xl foU;kl ikIr djxk\

ge tkur g fd eXuhf'k;e ½2] 8] 2½ dk vfØ; xl foU;kl ½2] 8½ ikIr dju d fy, nk byDVkuk dk R;kx djuk gkxk yfdu Dykjhu ijek.k dk vfØ; xl foU;kl ikIr dju d fy, ek= ,d gh byDVku

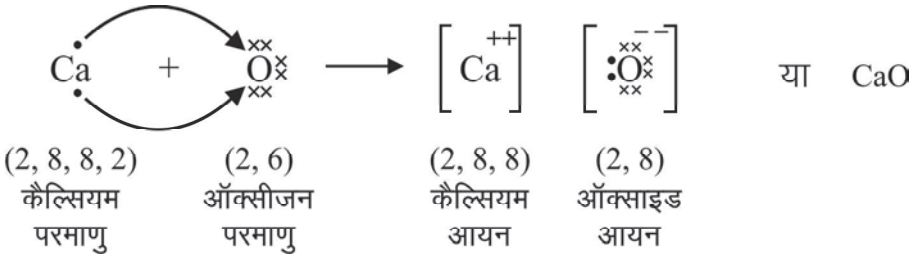
dh vko';drk gkrh gA lkfp,] eXuhf'k;e }kjk R;kx x, nk byDVkuk dk lek;kstu dl gkxk\ ;gk Dykjhu d nk ijek.k eXuhf'k;e d ,d ijek.k d lkFk cèk cuku e Hkkx yr g vFkkr iR;d Dykjhu ijek.k eXuhf'k;e }kjk R;kx x, nk byDVku e l ,d&,d byDVku dk xg.k dj vfØ; xl foU;kl ½2] 8] 8½ ikIr djrk gA ;gh dkj.k g fd ;kfxd dk l= $MgCl_2$ gkrk gA D;k vki eXuhf'k;e vk;u ij mRiUu vko'k dh l[;k crk ldr g\



fp= Øekd&2 % eXuhf'k;e DykjkbM dk cuuk

vkb,] vc ge ,d vkj ;kfxd dk n[k tk fd dfYl;e vkj vkDlhtu l feydj cuk gA dfYl;e dh ijek.k l[;k 20 rFkk vkDlhtu dh ijek.k l[;k 8 gA bud byDVkfud foU;kl fy[kdj crkb, o dl vfØ; xl foU;kl ikIr djx\

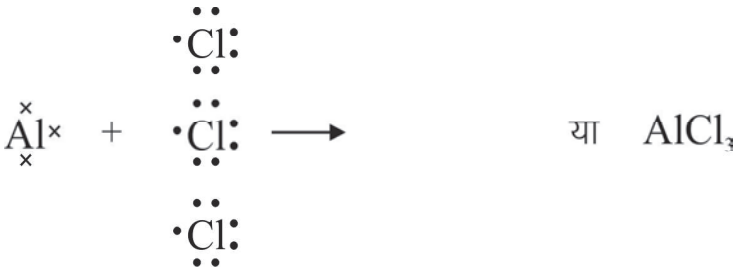
geu n[kk fd dfYl;e d ckáre d{k e 2 byDVku g tcfd vkDlhtu d ckáre d{k e 6 byDVku gA vr% dfYl;e d fy, nk byDVku R;kxuk vkj vkDlhtu d fy, nk byDVku xg.k djuk vklku gA bl idkj vkDlhtu] dfYl;e }kjk R;kx x, 2 byDVkuk dk xg.k dj vk;fud cèk cukrk gA dfYl;e vkDlkbM e dfYl;e rFkk vkDlhtu vk;uk ij vko'k D;k gkx\



fp= Øekd&3 % dfYl;e vkDlkbM dk cuuk

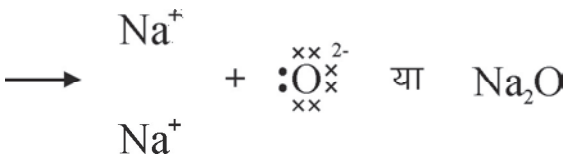
vHkh rd geu n[kk fd rRok d vkcèku e ,d ijek.k }kjk ,d ;k nk byDVku R;kx tkr g rFkk nlj ijek.k }kjk xg.k fd, tkr gA vkb,] vc ,d vkj mnkgj.k ,yfefu;e dk n[kr gA

,Ykfefu;e rFkk Dykjhu dh ijek.k l[;k Øe'k% 13 rFkk 17 gA byDVku d LFkkukrj.k }kjk $AlCl_3$ d byDVku fcn ljpuk fp= dk ijk dhft,A



fp= Øekd&4 % ,yfefu;e DykjkbM dk cuuk

geu mnkgj.kk e n[kk fd cèk cuku d fy, lkfM;e ,d byDVku dk R;kx djrk g] ogh vkDlhtu dk nk byDVkuk dh vko';drk gkrh g vFkkr nk byDVku xg.k djrk gA bl idkj nkuk d ckáre d{k e vkB&vkB byDVku gk tkr gA lkfp,] ;fn lkfM;e rFkk vkDlhtu d eè; vkcèku gk rk cuu oky ;kfxd lkfM;e vkDlkbM dk l= D;k gkxk\ vk;fud cèk dl cuxk\ fn, x, byDVku fcn ljpuk fp= dk byDVku LFkkukrj.k n'kkr g, ijk dhft,A



fp= Øekd&5 % lkfM;e vkDlkbM dk cuuk

8.2 l;ktdrk (Valency)

geu dN mnkgj.kk }kjk n[kk fd fofHkUu rRo vfØ; xl foU;kl ikIr dju d fy, ;k rk byDVkuk dk R;kx djr g ;k xg.k djr gA vr% l;ktdrk dk ge bl idkj le> ldr gA

- lkfM;e d l;kth d{k e ,d byDVku gkrk g tk vfØ; xl foU;kl ikIr dju gr R;kxk tkrk g vr% bldh l;ktdrk ,d gkrh gA
- dfYl;e viu l;kth d{k l nk byDVkuk dk R;kx djrk g vr% dfYl;e dh l;ktdrk nk gkrh gA
- Dykjhu d l;kth d{k e 7 byDVku gkr g vkj og v"Vd ijk dju d fy, ,d byDVku xg.k djrk g vr% Dykjhu dh l;ktdrk ,d gkrh gA

l;ktdrk ge ;g crkrh g fd fdlh rRo dk ijek.k vfØ; xl foU;kl ikIr dju d fy, fdru byDVkuk dk xg.k djxk vFkok R;kx djxkA bl idkj ge n[kr g fd rRok d ijek.k l;kth d{k l byDVku R;kx dj vkj dN ijek.k byDVku xg.k dj v"Vd ijk djr gA ge èkkrvk vkj vèkkrvk dk

mud Hkkfrd x.kk d vkèkkj ij igpkur gA vk;fud cèk fuek.k e ftl rRo d ijek.k byDVku R;kxr g o èkkr dgykr g vkj ftl rRo d ijek.k byDVku xg.k djr g o vèkkr dgykr gA

i'u

1- ikVf'k;e rFkk Dykjhu dh ijek.k l[;k Øe'kh 19 rFkk 17 g&

(i) bud byDVkfud foU;kl fyf[k,A

(ii) bud }kjk vfØ; xl foU;kl ikIr dju dh D;k&D;k lHkkouk, gk ldrh g\

(iii) ikVf'k;e Dykjkb M e cuu oky vk;fud cèk dk byDVku fcn ljpuk fp= cukdj n'kkb,A

(iv) ikVf'k;e Dykjkb M e ikVf'k;e rFkk Dykjkb M vk;u ij vko'k D;k gkx\

2- fyfFk;e dh ijek.k l[;k 3 rFkk ¶yvkjhu dh ijek.k l[;k 9 g] bud chp cuu oky cèk dk byDVku fcn ljpuk fp= }kjk inf'kr dhft,A

3- vkDlhtu ,o ikVf'k;e dh l;ktdrk fdruh g\ le>kb,A

4- ,d rRo d M d{k e byDVkuk dh l[;k 7 g rFkk mldh l;ktdrk 1 g rk mll cuu oky vk;u dk byDVkfud foU;kl D;k gkxk\

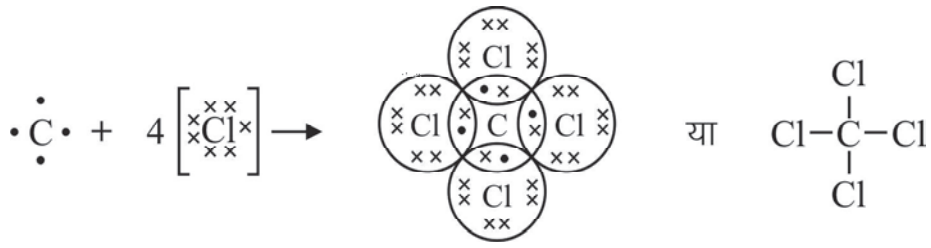
vki tkur g fd ,Ykfefu;e d ckáre d{k e rhu byDVku gkr g ftUg R;kx dj og Al^{3+} vk;u cukrk gA D;k vki ,l rRo dk uke crk ldr g ftld ckáre d{k e pkj byDVku gkr g\

8-3 lgl;ktd cèk (Covalent bond)

vc ge dkcu rRo ij fopkj djr g ftldh ijek.k l[;k 6 vkj byDVkfud foU;kl 2] 4 gA ;fn dkcu] cèk cuku d fy, 4 byDVku dk R;kx dj ghfy;e ijek.k ¼K d{k e 2 byDVku½ dk foU;kl ikIr dj rc C^{4+} vk;u cuxk ;k 4 byDVku xg.k dj fuvku ijek.k ¼K d{k e 2] L d{k e 8 byDVku½ d leku foU;kl ikIr dj rc C^{4-} vk;u cuxkA

mi;DRk nkuk gh fLFkfr;k e vLFkkb vk;u dh ikflr gkxh vr% nkuk gh fLFkfr;k lHko ugh gA bl fLFkfr e dkcUk] cèk dk fuek.k dl djxk\ vkb,] n[k ;g dl lHko gA

vc ,d fodYi ;g gk ldrk g fd og nlj rRo l byDVkuk dk lk>k djA lk> dk D;k rkRi;g\ vkb,] dkcu VVkDykjkbM d mnkgj.k l bl le>A ;g ,d dkcu rFkk pkj Dykjhu ijek.k l feydj curk gA ge Kkr g fd Dykjhu ijek.k dk v"Vd ijk dju d fy, ,d byDVku dh vko';drk gkrh gA ;gk iR;d Dykjhu ijek.k viu ,d byDVkUk dk lk>k dkcu d ,d byDVku l djrk g] mlh idkj dkcu Hkh iR;d Dykjhu ijek.k l viu ,d byDVku dk lk>k dj cèk cukrk gA bl Øe e dkcu rFkk iR;d Dykjhu ijek.k vfØ; xl foU;kl ½2] 8 rFkk 2] 8½ ikIr djr gA lk> d byDVkuk ij nkuk ijek.kvk dk leku vfèkdkj gkrk g vFkkr lk> d byDVkUkk dh x.kuk nkuk ijek.kvk d v"Vd e dh tkrh g ¼fp= Øekd&6½A



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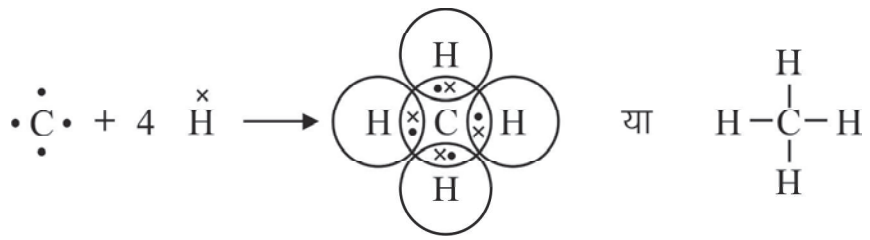
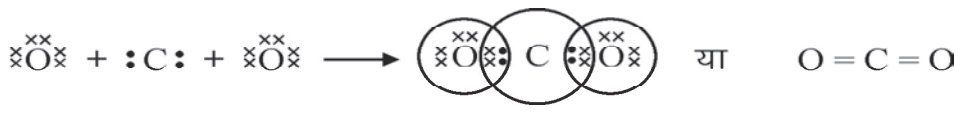


fp= Øekd&7 % eFku e lgl;ktd cèk

vkb,] vc ge dkcu d ,d vkj ;kfxd dkcu MkbvkDlkbM dk n[kr gA uke l Li"V g fd ble nk vkDlhtu ijek.k ¼Mkb ,d milx g ftldk vFk nk g] MkbvkDlkbM dk rkRi; nk vkDLkhtu ijek.k½ gkr gA io e geu n[kk fd vkDlhtu lkekU;r% nk byDVku xg.k dj f}l ;kth vk;u O^{2-} cukrk g] ogh dkcu] byDVku nu dh vi{kk lk> d }kjk cèk cukrk gA D;k vki crk ldr g fd dl dkcu vkj vkDlhtu feydj LFkk;h ;kfxd dkcu MkbvkDlkbM dk fuek.k djr g\ ;g rHkh lHko gkrk g tc iR;d vkDlhtu ijek.k nk byDVkuk dk lk>k dkcu d nk&nk byDVkuk d lkFk djrk g ¼fp= Øekd&8½A



fp= Øekd&8 % dkcu MkbvkDlkbM e lgl;ktd cèk

mi;Dr ljpuk n[kdj vki crk ldr g fd dkcu ,o vkDlhtu d eè; fdru cèk cux\ bl ;kfxd e dkcu d nk tkMh byDVku ¼4 byDVku½ vkj iR;d vkDlhtu d 1 tkMh byDVku ½2 byDVku½ d eè; lk> l f}cèk dk fuek.k gkrk gA io d mnkgj.kk e dkcu u Dykjhu d lkFk CCl_4 rFkk gkbMktu d lkFk CH_4 ,d&,d byDVku d lk> d }kjk ,dy cèk dk fuek.k fd;k FkkA dkcu MkbvkDLkbM v.k e dkcu rFkk vkDLkhtu d eè; f}cèk dk fuek.k gkrk gA ,dy vkj f}cèk dk nk ijek.kvk d eè; Øe'kh ,d j[kk ¼&½ vkj nk j[kkvk ¼3¾½ }kjk inf'kr djr gA

bl idkj d ;kfxd] ftue nk ijek.kvk d eè; byDVkuk d lk> }kjk c/k dk fuek.k gkrk g] lgl;ktd ;kfxd dgykr gA ;gk è;ku nu okyh ckr ;g g fd nk ;k vfèkd ijek.k byDVkuk d lk> }kjk leh i d vfØ; xl foU;kl dk ikIr dj yr gA bl idkj d ijek.k leg dk v.k dgr g vrh lgl;kth ;kfxd d v.k nk ;k nk l vfèkd ijek.kvk l cu gkr gA

ty ,d ;kfxd g tk gkbMktu ,o vkDlhtu d l;kx l cuk gkrk gA vki tkur g fd gkbMktu dk lk> d fy, ,d byDVku tcfd vkDlhtu dk lk> d fy, nk byDVkuk dh vko';drk gkrh gA ty dh byDVku fcn ljpuk cukb, ftle gkbMktu vkj vkDlhtu nkuk dh l;ktdrk lr"V gk ¼fp= Øekd&9½A

fp= Øekd&9 % ty e lgl;ktd cèk

vkfu;k ,d ;kfxd g ftldk v.kl= NH_3 gA ;g ukbVktu vkj gkbMktu l feydj cuk gA gkbMktu dk lk>k dju d fy, ,d byDVku tcfd ukbVktu dk Lkk>k dju d fy, rhu byDVku dh vko';drk gkrh g ftll o vfØ; xl foU;kl ikIr dj ld ¼fp= Øekd&10½A D;k vki bl ;kfxd dh byDVku fcn ljpuk cuk ldr g\

fp= Øekd&10 % vekfu;k e lgl;ktd cèk

vkb,] vc ge gkbMktu e vkcèku ij fopkj djr gA vkidk irk g fd gkbMktu lcl gYdh xl gA bldk byDVkfud foU;kl n[ku ij ;g ckr Li"V gkrh g fd bld ckáre d{k (K) e ek= ,d byDVku g vkj ge ;g Hkh tkur g fd gkbMktu v.k dk vfLrRo gA gkbMktu dk ,d ijek.k] nlj

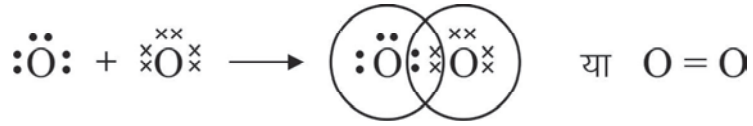
gkbMkt tu ijek.k d lkFk ,d&,d byDVku dk lk>k dj gkbMkt tu dk ,d v.k cuk yrk gA bl bl idkj inf'kr dj ldr g ¼fp= Øekd&11½A

fp= Øekd&11 % gkbMkt tu e lgl;kt d cèk

;gk geu n[kk fd v.k dk fuek.k fHkUu&fHkUu rRok d ijek.kvk d l;kx l gh ugh] cfYd ,d gh rRo d leku ijek.k d feyu l Hkh gkrk gA

gkbMkt tu rRo dk vfLrRo f}ijek.k v.k d :i e g ¼;gk milx f} dk vFk g nk vr% f}ijek.k dk rkRi; g nk ijek.k½ rFkk ble ,dy cèk gA

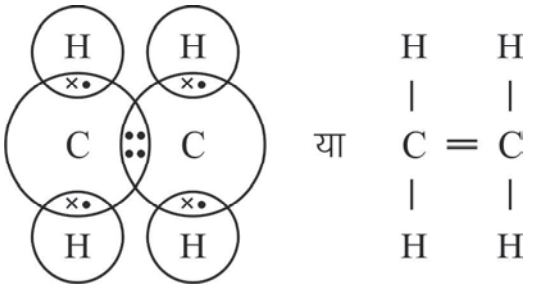
D;k fdlh rRo d ijek.kvk d eè; f}cèk Hkh gkrk g\ vkb,] ,d rRo vkDlhtu ij fopkj djr gA ge tkur g fd vkDLkhtu dh l;kt drk 2 gkrh g rFkk bldk byDVkfud foU;kl 2] 6 g vr% vfØ; xl foU;kl ikIr dju d fy, vkDlhtu d ijek.k vkil e nk&nk byDVkuk dk lk>k djr g vkj bud eè; f}cèk curk g ¼fp= Øekd&12½A



fp= Øekd&12 % vkDlhtu e lgl;kt d cèk

vkidk ;g tkudj vk'p; gkxk fd dkcu ijek.kvk d eè; f}cèk vkj f=cèk Hkh ik;k tkrk gA

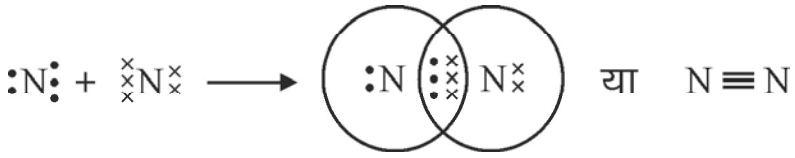
vkb,] ,d mnkgj.k C_2H_4 ¼;k $H_2C = CH_2$½ dk n[k ftle ,d dkcu ijek.k] nlj dkcu ijek.k d lkFk nk byDVkuk d lk> }kjk viuh nk l;kt drk, lr"V djrk g tcfd 'k"k nk l;kt drk, vU; ijek.kvk l lr"V gkrh g ¼fp= Øekd&13½A



fp= Øekd&13 % ,Fkhu e lgl;kt d cèk

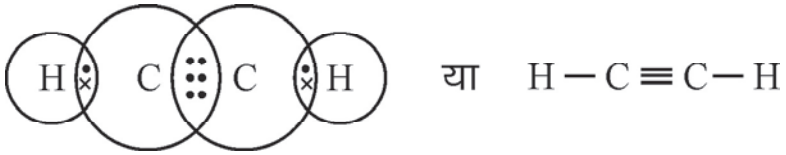
mlh idkj ge f=cèk dk cuuk Hkh nk ijek.kvk d eè; byDVkuk d lk> }kjk le>k ldr gA

vc ge ukbVktu ij fopkj dj ftle iR;d ukbVktu ijek.k rhu&rhu byDVkuk dk lk>k djrk g D;kfd ukbVktu dh ijek.k l[;k 7 g rFkk bldk byDVkfud foU;kl 2] 5 gkrk gA pfd ukbVktu d nk ijek.k feydj v.k dk fuek.k djr g vr% ukbVktu dk vfLrRo f}ijek.k xl d :i e gkrk g ¼fp= Øekd&14½A



fp= Øekd&14 % ukbVktu e lgl;ktd cèk

io e vkiu n[kk fd dkcu&dkcu d eè; ,dy ;k f}cèk gkrk gA mlh idkj dkcu&dkcu d eè; f=cèk Hkh ik;k tkrk gA v.k C_2H_2 $(HC \equiv CH)$ dh fuEufyf[kr ljpuk gkrh g ¼fp= Øekd&15½A



fp= Øekd&15 % ,Fkkbu e lgl;ktd cèk

geu bl vè;k; e n[kk fd rRok dh l;ktdrk bl ckr ij fuHkj djrh g fd rRo vfØ; xl foU;kl ikIr dju e viu l;kth d{k l fdru byDVkuk dk R;kx djrk g ;k fQj xg.k djrk gA geu ;g Hkh n[kk fd rRo viu gh ijek.k ;k vU; rRok d ijek.k l byDVkuk d lk> }kjk Hkh v"Vd ijk dju dk i;kl djrk gA vr% ge l;ktdrk dk bl idkj Hkh le> ldr g fd dkb rRo v"Vd ijk dju d fy, ftru byDVku lk> gr miyCèk djkrk g og mldh ¼rRo dh½ l;ktdrk dgykrh g mnkgj.k d fy, dkcu dk y] pfd dkcu v"Vd ijk dju d fy, pkj byDVkuk dk lk>k djrk g] vr% dkcu dh l;ktdrk pkj gA dfYl;e vkDlkbM e vkDlhtu ijek.k] dfYl;e ijek.k l nk byDVku xg.k djrk g fdUr dkcu Mkbvkdlkbe iR;d vkDlhtu ijek.k] dkcu l nk byDVkuk dk lk>k djrk g rk nkuk fLFkfr;k e vkDlhtu dh l;ktdrk crkb,A vr% rRok dh l;ktdrk cèk cuku d fy, R;kx ;k xg.k fd, ;k fQj lk> d fy, miyCèk fd, tku oky byDVku dh l[;k gA

i'u

1- ,Fku (C_2H_6) dh byDVku fcn ljpuk cukb,A

2- ,d ,l v.k dh byDVku fcn ljpuk cukb, ftle f}cèk ¼3¾½ ik;k tkrk gA

3- Dykjhu dh ijek.k l[;k 17 gA

(i) bldk byDVkfud foU;kl fyf[k,A

(ii) byDVku fcn ljpuk }kjk Dykjhu v.k dk cuuk le>kb,A

8-4 vk;fud rFkk lgl;kth ;kfxd (Ionic and covalent compounds)

geu n[kk fd ijek.kvk }kjk l;kth d{kk l byDVku d R;kx tku vFkok xg.k fd, tku l vk;fud cèk rFkk byDVkuk d lk>k dju ij lgl;kth cèk cur gA o ;kfxd ftue vk;fud cèk ik;k tkrk g] vk;fud ;kfxd ;k o|r l;kth ;kfxd dgykr g rFkk o ;kfxd ftue lgl;ktd cèk ik;k tkrk g] lgl;kth ;kfxd dgykr gA vkb,] vc ge bu ;kfxdk d x.kk dk n[kr gA

8-4-1 vk;fud ;kfxdk d x.k (Properties of ionic compounds)

1- lkekU;r% vk;fud ;kfxd ty e ?kyu'khy gkr gA

2- vk;fud ;kfxdk d xyukd ,o DoFkukd mPp gkr g D;kfd bue foijhr vk;u vkil e icy o|r vkd"k.k cy }kjk cèk gkr gA icy vkd"k.k cy l cu c/k dk rkMu d fy, vfèkd Åtk dh vko';drk gkrh gA

3- vk;fud ;kfxd ty e ?kyu ij vFkok fi?kyh gb voLFkk e vk;fur gk tkr g vr% ;o|r d lpkyd gkr gA

8-4-2 lgl;kth ;kfxdk d x.k (Properties of covalent compounds)

1- lkekU;r% lgl;kth ;kfxd ty e v?kyu'khy gkr gA

2- bud xyukd ,o DoFkukd vk;fud ;kfxdk dh ryuk e ik;% de gkr gA

3- lgl;kth ;kfxd fo|r d dpkyd gkr g D;kfd bue vk;uhdj.k ugh gkrkA

vkb,] ,d fØ;kdyki }kjk ;kfxdk e o|r pkyu dk ijh{k.k djA

fØ;kdyki&1

loiFke pkj chdj yhft,A vc bUg Øe'k% ^d*] ^[k*] ^x* vkj ^?k* ukekfdr dhft,A iR;d chdj e 100&100 mL ty ydj fuEu inkFkk dk feykdj foy;u r;kj dhft,A

1- chdj ^d* e 2 pEep lkèkkj.k uedA

2- chdj ^[k* e 2 pEep dfYl;e Dykjkbm A

3- chdj ^x* e 2 pEep 'kDdjA

4- chdj ^?k* e 2 pEep Xydkt A

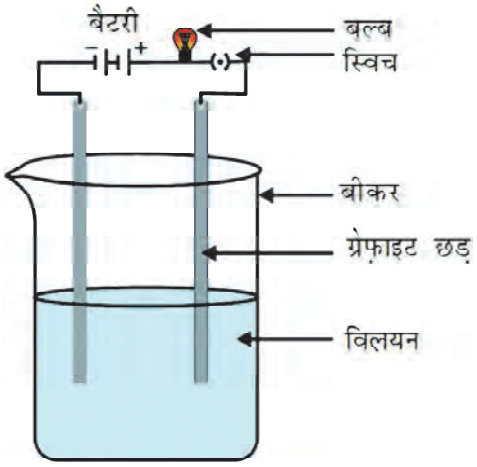
vc lcl igy chdj ^d* d foy;u e nk xQkbV dh NM Mckb, ¼fp= Øekd&16½ xQkbV dh NM byDVkM dh rjg dk; djrh gA bUg rkj d }kjk cYc ,o 9 okYV cVjh l tkM fp=kulkj ifjiFk

ijk djA è;ku jg fd nkuk NM vkil e Li'k u djA

- D;k cYc tyk\
- bl i;kx dk vU; chdj ^[k*] ^x*] ^?k* e j[k foy;uk d lkFk nkgjk, ,o voykdu dk ukV djA

vc fuEufyf[kr i'uk d mÙkj n&

- chdj ^d* ,o ^[k* e cYc D;k tyk\
- chdj ^x* ,o ^?k* e cYc D;k ugh tyk\
- vc vki le> x, gkx fd ued rFkk dfYl;e DykjkbM e o|r l;ktdrk cèk d dkj.k fo|r pkyu gkrk g rFkk 'kDdj ,o Xydkt e lgl;ktd cèk d dkj.k fo|r pkyu ugh gkrkA



fp= Øekd&16 ¼
;kfxd d foy;u dh pkydrk dk ijh{k.k

i'u

1- vk;fud ;kfxd ,o lgl;ktd ;kfxd e vrj fyf[k,A

2- vk;fud ;kfxdk d xyukd ,o DoFkukd mPp gkr g] D;k\ le>kb,A

e[; 'kCn (Keywords)

vk;u ¼ion½] èkuk;u ¼cation½] _.kk;u ¼anion½] vk;fud cèk ¼ionic bond½] lgl;ktd cèk ¼covalent bond½] lk>k ¼sharing½] l;ktdrk ¼valency½] vk;fud ;kfxd ¼ionic compound½] lgl;ktd ;kfxd ¼covalent compound½] mRd"V ;k vfØ; xl ¼noble or inert gas½] l;kth d{k ¼valence orbit½ v"Vd ¼octet½] fLFkj o|r vkd"k.k (electrostatic attraction), byDVku fcn ljpuk ;k ybl ljpuk ¼electron dot structure or Lewis structure½

geu lh[kk

- vk;fud cèk fuek.k e ,d ijek.k byDVku R;kxdj èkuk;u rFkk nljk ijek.k byDVku xg.k dj _.kk;u cukrk gA foijhr vko'k oky vk;u fLFkj fo|r vkd"k.k e cèkdj vk;fud cèk cukr gA
- lgl;ktd cèk ijek.kvk d eè; byDVkuk d lk> }kjk curk gA

- nk ijek.kvk d eè; ,d&,d byDVku d lk> }kjk ,dy cèk] nk&nk byDVkuk d lk> l f}cèk rFkk rhu&rhu byDVkuk d lk> l f=cèk curk gA
- vfØ; xl foU;kl ikfIr gr ckáre d{k ;k l;kth d{k l ftru byDVku R;kx ;k xg.k fd, tkr g ;k lk>k fd, tkr g og ml rRo dh l;ktdrk dgykrh gA
- vk;fud ;kfxd ty e foy;] mPp xyukd] DoFkukd oky rFkk tyh; foy;u ;k fi?kyh gb voLFkk e vk;fur gkr gA
- lgl;kth ;kfxd ty e vfoy;] fuEu xyukd ,o DoFkukd oky gkr g rFkk bue vk;uhdj.k ugh gkrkA

vH;kl

1- lgh fodYi pfu,&

(i) tc lkfM;e Dykjhu l fØ;k djrk g rc&

¼v½ iR;d lkfM;e ijek.k ,d byDVku xg.k djrk gA

¼c½ iR;d Dykjhu ijek.k ,d byDVku xg.k djrk gA

¼l½ iR;d lkfM;e ijek.k lkr byDVku xg.k djrk gA

¼n½ iR;d Dykjhu ijek.k lkr byDVku R;kx djrk gA

(ii) ,d lkfM;e ijek.k vkj lkfM;e vk;u&

¼v½ jklk;fud :i l leku gA

¼c½ ikVkuk dh l[;k leku gA

¼Lk½ lgl;ktd cèk dk fuek.k gkrk gA

¼n½ byDVkuk dh l[;k leku gA

(iii) ,d vk;fud cèk dk fuek.k gkrk g tc&

¼v½ l;Dr gku oky ijek.k byDVku xg.k djr gA

¼c½ l;Dr gku oky ijek.k byDVku dk R;kx djr gA

¼l½ ,d ijek.k byDVku dk R;kx djrk g nljk xg.k djrk gA

¼n½ l;Dr gku oky ijek.k byDVkuk dk lk>k djr gA

(iv) dku&lk rRo vkxku dk byDVkfud foU;kl ikIr dju gr nk byDVku [kkrk g\

¼v½ eXuhf'k;e ¼c½ lkfM;e

¼l½ dfYl;e ¼n½ lYQj

(v) fdl v.k e f}cèk ik;k tkrk g&

¼v½ N_2 ¼c½ C_2H_4

¼l½ Cl_2 ¼n½ CCl_4

2- fjDr LFkku dh ifr dhft,&

(i) lkfM;e ijek.k ,d byDVku ---------- dj ----------rRo dk byDVkfud foU;kl ikIr djrk gA

(ii) ukbVktu d nk ijek.k ---------- tkMh byDVku d lk> }kjk ukbVktu v.k dk fuek.k djr gA

(iii) vfØ; xlk d ckáre d{k e byDVkuk dh l[;k ---------- fdr ghfy;e e ;g ---------- gkrh gA

(iv) Dykjhu v.k e ---------- cèk gkrk g tcfd eXuhf'k;e Dykjkb M e ---------- cèk gkrk gA

(v) vk;fud ;kfxd lkekU;r% ty e ---------- tcfd lgl;kth ;kfxd ty e ---------- gkr gA

3- byDVku dk LFkkukrj.k ;fn ,d ijek.k l nlj ijek.k ij gk rk fdl idkj d cèk dk fuek.k gkxk\ le>kb,A

4- ,d ,l v.k dh byDVku fcn ljpuk cukb, ftle f=cèk gkrk g\

5- vkxku ijek.k lgl;ktd cèk }kjk vkxu v.k ¼Ar_2½ dk fuek.k ugh djrkA D;k\

6- rRo X ,o Y dk byDVkfud foU;kl g&

X = 2, 8, 8, 2 Y = 2, 6

rc X ,o Y d eè; cuu oky cèk dk idkj crkr g, byDVku fcn ljpuk cukb,A

7- l;kth byDVkuk dk jklk;fud ;kfxd cuku e D;k ;kxnku gkrk g\ le>kb,A

8- (i) vekfu;k v.k e lgl;ktd cèkk dh l[;k crkb,A

(ii) ^lkfM;e Dykjkb M ,d v.k g* & ;g dFku xyr D;k g\ le>kb,A

9- fuEufyf[kr ;kfxdk dh byDVku fcn ljpuk cukdj cèk d idkj fyf[k,&

(i) ty (ii) ukbVktu

(iii) eXuhf'k;e vkDlkbM (iv) dfYl;e DykjkbM

10- vk;fud ,o lgl;kth ;kfxdk d x.k fyf[k,A

11- ,d ijek.k dh l;ktdrk mld byDVkfud foU;kl l fdl idkj lcfèkr g\ Li"V dhft,A

12- rhu rRok d ijek.k Øekd 6] 7 ,o 8 gA

(i) rhuk rRok dh l;ktdrk ,o byDVkfud foU;kl fyf[k,A

(ii) rhuk rRo fdl idkj d ;kfxdk dk fuek.k djx\ le>kb,A

13- fuEufyf[kr e l lgl;ktd ,o vk;fud ;kfxdk dk iFkd dhft, rFkk mldk dkj.k Hkh le>kb,A

dfYl;e vkDLkkbM] Xydkt] lkfM;e lYQkbM] dkcu VVkDykjkbM] ikVf'k;e DykjkbM

14- fuEufyf[kr e l fdldk fuek.k gkxk\ rd lfgr mRrj nhft,A

(i) Mg_2 (ii) $MgCl_2$ (iii) Cl_2

vè;k;&9

jklk;fud l= vkj eky ldYiuk

(Chemical Formula and Mole Concept)

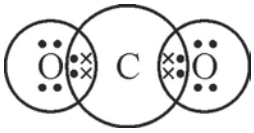
UGHL2H


Amadeo Avogadro
(1776 - 1856)

ge tkur g fd nk ;k nk l vfèkd rRo vkil e fØ;k djd ;kfxd cukr gA ; ;kfxd rRok d ijek.kvk dh fuf'pr l[;kvk d vkil e l;kx l cur gA ge ikuh] ued] 'kDdj] [kku dk lkMk bR;kfn inkFkk dk mi;kx djr g] ; lHkh inkFk ;kfxd gA geu igy Hkh l= dl cur g] lh[kk gA vkb,] ge ;kfxdk d l=k d ckj e vkj foLrkj l le>A

9-1 lgl;kth ;kfxdk d l= ¼Formula of covalent compounds½

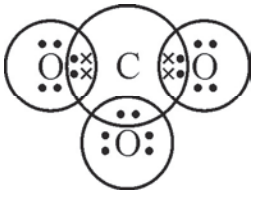
geu fofHkUu lgl;kth ;kfxdk] tl dkcu MkbvkDlkbM] ikuh] vekfu;k vkfn e cuu oky cèk d ckj e lh[kk gA dkcu MkbvkDlkbM v.k e ,d dkcu d nk&nk byDVkuk dk lgHkktu nk vyx&vyx vkDlhtu ijek.kvk d nk&nk byDVkuk d lkFk gkrk g ¼fp= Øekd&1 d½A



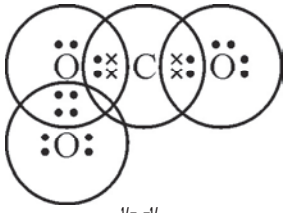
fp= Øekd&1 % ¼d½

;fn ge dkcu MkbvkDlkbM d v.k e ,d vkj vkDlhtu ijek.k tkMuk pkg rk mldh] fdl ijek.k l byDVkuk dk lk>k dju dh lEHkkouk gkxh\

igyh ;g fd og dkcu ijek.k l lk>k djA nljh ;g fd og fdlh Hkh vkDlhtu ijek.k l lk>k djA vkDlhtu ijek.k dkcu ijek.k l byDVku lk>k ugh dj ldxk D;kfd dkCku d nkuk byDVku ;Xek dk lgHkktu nk vkDlhtu ijek.kvk l gk pdk g vkj og vfØ; xl foU;kl ikIr dj pdk g ¼fp= Øekd&1 [k½A ;fn ge vkDlhtu ijek.k d lkFk] vfrfjDr vkDlhtu d lgHkktu ij fopkj dj ¼fp= Øekd&1 x½ rk ;g Hkh lHko ugh g D;kfd bll vfrfjDr vkDlhtu ijek.k ij byDVkuk dh l[;k rk vkB gk tk,xh ijr igy vkDlhtu ijek.k ij byDVkuk dh l[;k nl gk tk,xh] tcfd mld vfre dk'k e byDVkuk dh vfèkdre l[;k 8 gh gk ldrh gA



¼[½



¼x½

fp= Øekd&1 % ¼[½ rFkk ¼x½

vr% ;gk ij vfrfjDr vkDlhtu ijek.k d lkFk byDVkuk dk lgHkktu ugh gk ldrk g blfy, CO_3 ;kfxd cuu dh lHkkouk ugh gA dkcu dk ,d ijek.k vkj vkDlhtu d nk ijek.k gh feydj ,d LFkk;h ;kfxd cuk,x ftldk l= CO_2 gkxkA blh idkj vU; ;kfxdk d l= Hkh fy[k tk ldr gA bld fy, ge rRok d irhd ,o mudh l;ktu {kerk, Kkr gkuh pkfg,A

9.2 lgl;kth ;kfxdk d v.kHkkj ¼Molecular weight of covalent compounds½

ge tkur g fd ,d gh rRo d ijek.k vFkok fHkUu&fHkUu rRok d ijek.k ijLij l;kx dj v.k dk fuek.k djr gA rRok d ijek.k Hkkj l ;kfxd d v.kHkkj dh x.kuk dh tk ldrh g D;kfd ;kfxd dk v.kHkkj mld lHkh ?kVd ijek.kvk d Hkkjk dk ;kx gkrk g tl gkbMktu d 2 ijek.k rFkk vkDlhtu dk 1 ijek.k feydj ikuh d 1 v.k dk fuek.k djr gA ;fn ge gkbMktu rFkk vkDlhtu d ijek.k Hkkj Kkr gk rk ge ikuh d v.kHkkj dh x.kuk dj ldr gA gkbMktu dk ijek.kHkkj 1u rFkk vkDlhtu dk ijek.kHkkj 16u g] blfy, ikuh dk v.kHkkj $2 \times 1 + 16 = 18$ u gkxkA

vkb,] dN vkj ;kfxdk d v.kHkkj dh x.kuk dj&

lYQj MkbvkDlkbM dk l= SO_2 gA lYQj dk ijek.k Hkkj 32u g rc

lYQj MkbvkDlkbM dk v.kHkkj $= 32 + 2 \times 16$

$= 64$ u

blh idkj ukbVktu dk v.kHkkj gkxk $= 2 \times 14$

$= 28$ u

vk;fud ;kfxd d eykuikrh l= ,o l= bdkb n0;eku

lkfM;e DykjkbM dk vk.kfod l= lHko ugh g] D;kfd Bkl vk;fud ;kfxd e v.k ugh gkr mld ?kVd] vk;u gkr gA Bkl lkfM;e DykjkbM dk l= NaCl vFkok $Na^+ Cl^-$ gkrk gA ;g mldk eykuikrh l= gA fofHkUu vk;fud ;kfxdk d bu l=k }kjk Hkkj Kkr fd, tk ldr g ;g Hkkj ,d v.k dk Hkkj ugh gkrk] bl ge vk;fud ;kfxd dk l= bdkb n0;eku dgr g mnkgj.k d fy, Dykjhu dk ijek.k Hkkj 35.5u g vkj lkfM;e dk ijek.k Hkkj 23u g rk lkfM;e DykjkbM dk l= bdkb n0;eku $35.5 + 23 = 58.5$ u gkxkA

i'u

1- ;fn dkcu dk ijek.k Hkkj 12u g rk dkcu MkbvkDlkbM dk v.kHkkj D;k gkxk\

2- ;fn ukbVktu dk ijek.k Hkkj 14u g rk vekfu;k dk v.kHkkj D;k gkxk\

3- gkbMktu d v.kHkkj dh x.kuk dhft,A

4- fuEufyf[kr vk;fud ;kfxdk d l= bdkb n0;eku dh x.kuk dhft,A

Na_2O, $MgCl_2$, $CaCl_2$, CaO

9.3 cgijek.kd vk;u ¼Polyatomic ions½

ge tkur g fd vk;fud ;kfxdk d tyh; foy;u fo|r d lpkyd gkr gA vè;k; jklk;fud vkcèku e geu fØ;kdyki 1 e n[kk g fd lkfM;e DykjkbM dk tyh; foy;u fo|r dk lpkyd gkrk g rFkk og vk;fur gkdj lkfM;e vk;u (Na^+) o DykjkbM vk;u (Cl^-) cukrk gA ;fn ogh fØ;kdyki ge lkfM;e ukbVV foy;u d lkFk djr g rc ;g Hkh o|r lpkydrk n'kkrk gA bl vkèkkj ij ge dg ldr g fd lkfM;e ukbVV Hkh ,d vk;fud ;kfxd gA ble Hkh NaCl d leku Na^+ vk;u gA bldk vFk g fd bl foy;u e Na^+ vk;u d vfrfjDr ,d _.kkof'kr vk;u NO_3^- Hkh g ftle ,d ukbVktu vkj rhu vkDlhtu ijek.k ij dy ,d _.k vko'k gA ijek.kvk d ,l leg ftu ij dy vko'k fo|eku gk mUg cgijek.kd vk;u dgr gA

$$NaNO_3 \longrightarrow Na^+ + NO_3^-$$

vU; vk;fud ;kfxd Hkh ikuh e foy; gku ij èkuk;u rFkk _.kk;u e foHkDr gkr g tl&

$$NH_4Cl \longrightarrow NH_4^+ + Cl^-$$

$$Na_2SO_4 \longrightarrow 2Na^+ + SO_4^{2-}$$

$$Ca(OH)_2 \longrightarrow Ca^{2+} + 2OH^-$$

$$Na_2CO_3 \longrightarrow 2Na^+ + CO_3^{2-}$$

mi;Dr vfHkfØ;kvk e cu NH_4^+, SO_4^{2-}, OH^- vkj CO_3^{2-} vk;u cgijek.kd vk;u gA

vk;uk ij tk vko'k ik;k tkrk g ogh mldh l;ktdrk gkrh gA lkj.kh Øekd 1 e dN vk;uk dh l;ktdrk, nh xb gA

lkj.kh Øekd&1 % vk;uk dh l;ktdrk,

,d l;kth	f}l;kth	Ckgl;kth
Na^+, Ag^+, NH_4^+	Cu^{2+}, Zn^{2+}, Fe^{2+}, Mg^{2+}	Al^{3+}
Br^- ¼ckekbM½ I^- ¼vk;kMkbM½ HCO_3^- ¼gkbMkstudkckuV½ OH^- ¼gkbMkDlkbM½	S^{2-} ¼lYQkbM½ CO_3^{2-} ¼dkckuV½	PO_4^{3-} ¼QkLQV½

eyd ¼Radicals½

vkof'kr ijek.k rFkk ijek.kvk d vkof'kr leg dk eyd Hkh dgr gA eyd nk idkj d gkr g& èkukRed vkj _.kkRed eydA

ik;s èku vk;u tk {kkj l ikIr gkr g mUg {kkjh; eyd dgr g tl&

$NaOH \longrightarrow Na^+ + OH^-$

$NH_4OH \longrightarrow NH_4^+ + OH^-$

$Ca(OH)_2 \longrightarrow Ca^{2+} + 2OH^-$

fn, x, mnkgj.kk e Na^+, NH_4^+ ¼vekfu;e½ rFkk Ca^{2+} {kkjh; eyd gA

ik;s _.k vk;u tk vEy l ikIr gkr g mUg vEyh; eyd dgr g tl&

$HCl \longrightarrow H^+ + Cl^-$

$HNO_3 \longrightarrow H^+ + NO_3^-$

$H_2SO_4 \longrightarrow 2H^+ + SO_4^{--}$

fn, x, mnkgj.kk e Cl^- ¼DykbkbM½] NO_3^- ¼ukbVV½ rFkk SO_4^{2-} ¼lYQV½ vEyh; eyd gA

9-3-1 cgijek.kd vk;u oky ;kfxdk d jklk;fud l=

ge vc ,d fo'k"k vkMk&frjNk i)fr ¼criss-cross method½ d vulkj vk;uk ij mifLFkr vko'k vFkok l;ktdrk dk mi;kx djr g, jklk;fud l= fy[kxA jklk;fud l= fy[kr le; fuEufyf[kr pj.kk dk ikyu fd;k tkrk gA

mnkgj.k& vekfu;e dkckuV

1- lcl igy l?kVd vk;uk d irhd@l= fy[k tkr gA lkèkkj.kr% èkukRed Hkkx dk irhd@l= ckb vkj rFkk _.kkRed Hkkx dk irhd nkb vkj fy[kr gA

NH_4 CO_3

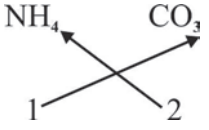
2- l?kVd vk;uk dh l;ktdrk, mud uhp fy[kh tkrh gA

irhd@l=	NH_4	CO_3
l;ktdrk	1	2

3- vk;uk dh l;ktdrkvk dk vkMk&frjNk djd ;kfxd e mudk vuikr Kkr fd;k tkrk gA

irhd@l=

l;ktdrk



vekfu;e dkckuV e vekfu;e dk vuikr 2 rFkk dkckuV dk 1 gkxkA

4- cgijek.kd vk;u dk igy dk"Bd e j[kr g] rRi'pkr vuikrk dk n'kku okyh l[;k dk iknkd d :Ik e fy[kr gA ;fn cgijek.kd vk;u dh l[;k 1 gk rk dk"Bd dh vko';drk ugh gkrh] lkFk gh 1 vd dk Hkh ugh fy[kk tkrkA

$(NH_4)_2\ CO_3$

vr% vekfu;e dkckuV dk l= & $(NH_4)_2 CO_3$ gA

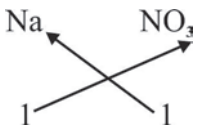
vkb,] dN vU; mnkgj.kk l bl vkj le>&

- lkfM;e ukbVV

  irhd@l=

  l;kt drk

  vr% l=&$NaNO_3$

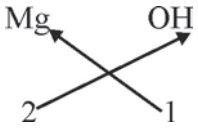


- eXuhf'k;e gkbMkDlkbM

  irhd@l=

  l;kt drk

  vr% l=&$Mg(OH)_2$

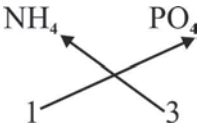


- vekfu;e QkLQV

  irhd@l=

  l;kt drk

  vr% l=&$(NH_4)_3PO_4$

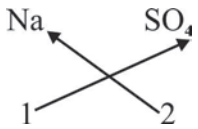


- lkfM;e lYQV

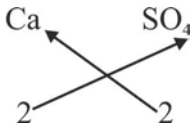
  irhd@l=

  l;kt drk

  vr% l=&Na_2SO_4



- dfYl;e lYQV

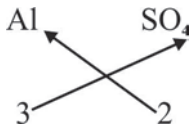
  irhd@l= 

  l;ktdrk

  vrh l=&$CaSO_4$

  tc l= e nkuk vk;uk ij vko'k leku gk rk ge l= dk ljyhdr djr gA blfy, ;gk ij l= $Ca_2(SO_4)_2$ dk $CaSO_4$ d :lk e ljyhdr djr gA

- ,Ykfefu;e lYQV

  irhd@l= 

  l;ktdrk

  l=&$Al_2(SO_4)_3$

i'u

1- fuEufyf[kr lkj.kh dk ijk dhft,&&

;kfxdk d uke	mifLFkr eyd		vko'kk dh l[;k		;kfXkd dk l=
	èkUkkRed	_.kkRed	èkUkkRed	_.kkRed	
vekfu;e ukbVV			1		
lkfM;e dkckuV				2	Na_2CO_3
vekfu;e gkbMkDlkbM				1	
eXuhf'k;e dkckuV			2		$MgCO_3$
vk;ju QkLQV	Fe^{++}				

2- fuEufyf[kr vk;fud ;kfxdk d l= dk vkMk&frjNk i)fr l cukb,&

vekfu;e DYkkjkbM] dfYl;e gkbMkDLkkbM] eXuhf'k;e lYQV] vekfu;e lYQV] dfYl;e QkLQV

9-4 eky ldYiuk ¼Mole concept½

eky D;k g\ ;g ,d l[;k gA vkb,] n[k fd ;g vk;k dgk l vkj ;g mi;kxh D;k gA bldh dgkuh dh 'k#vkr dN jklk;fud fØ;kvk l gkrh gA lu 1799 e irk pyk fd rRo vkil e ,d fuf'pr vuikr e gh fØ;k djr gA igy ;g fuf'pr vuikr Hkkj d vulkj gh igpkuk x;k FkkA fQj oKkfud xylkd u vud xlk dh jklk;fud

fØ;kvk dk vè;;u fd;kA mUgku n[kk fd fuf'pr rki vkj nkc ij xl lno vk;ru d vulkj ljy vuikr e gh fØ;k djrh g vkj bl ,d fu;e d :i e ifrikfnr fd;kA MkYVu u viu ijek.k fLk)kr e rRok }kjk Hkkj d vulkj ,d fuf'pr vuikr e fØ;k gku dh 0;k[;k dh Fkh yfdu tk fu;e xylkd u 0;Dr fd;k mldk D;k dkj.k g bl i'u dk mud ikl dkb mÙkj ugh FkkA xylkd u tc viuh [kkt d lcèk e vU; oKkfudk d lkFk feydj fopkj foe'k fd;k rc oKkfud cthfy;l u bl cgr ljy rjhd l le>k;kA mud vulkj fdlh Hkh xl d fn, x, vk;ru e d.kk dh l[;k leku gkrh gA bldk vk'k; g fd ,d yhVj gkbMkt u e d.kk dh l[;k mruh gh g ftruh fd Dykjhu d ,d yhVj eA tc ,d yhVj gkbMkt u] ,d yhVj Dykjhu l fØ;k djrh g rk gkbMkt u Dykjkb M curh gA cthfy;l d vulkj bu nkuk xlk d ,d&,d yhVj ijh rjg l blfy, fØ;k dj jg Fk D;kfd bu nkuk e cjkcj&cjkcj l[;k e ijek.k FkA blh nkjku fofHkUu rRok d lkif{kd ijek.k Hkkj dh Hkh x.kuk dh xb vkj bl rjg ijek.k Hkkj d vkèkkj ij v.kHkkj dh x.kuk dh xbA vc xlk d ?kuRo vkj Hkkj dh x.kuk djuk lHko gk x;kA tc vyXk&vyx xlk d v.k ;k ijek.k dk Hkkj d vulkj fy;k x;k vkj mudk ,d fuf'pr nkc vkj rki ij j[kk x;k rc ;g ik;k x;k fd ;g Hkh ,d fuf'pr vk;ru FkkA tl fd&

1- 0°C rki rFkk 1 ok;eMyh; nkc (1 atm) ij 2 g gkbMkt u dk vk;ru 22.4 L FkkA

2- 0°C rki rFkk 1 ok;eMyh; nkc ij 36.5 g gkbMkt u Dykjkb M dk vk;ru Hkh 22.4 L FkkA

3- Lkeku rki o nkc ij ;fn 18 g Hkkji yh xb rc mldk Hkh vk;ru 22.4 L FkkA

4- blh rjg l tc fdlh xl dk 0°C rki o 1 ok;eMyh; nkc ij lkif{kd v.kHkkj xke e fy;k x;k rc mldk Hkh vk;ru 22.4 L iklr gvkA

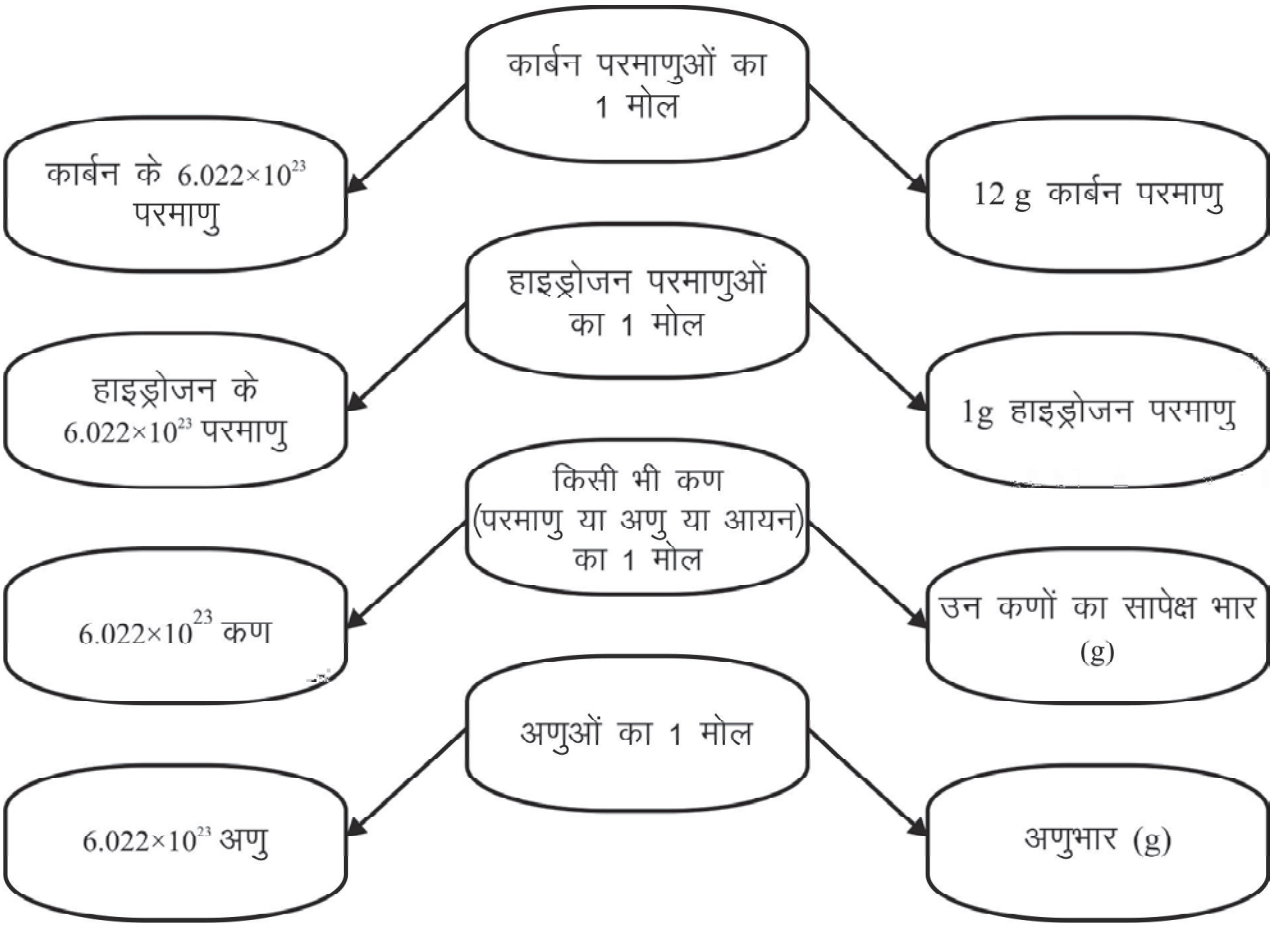
fofHkUu x.kukvk }kjk ckn e ;g irk pyk fd 0°C rki o 1 ok;eMyh; nkc ij fdlh Hkh xl d 22-4 yhVj vk;ru e d.kk fd l[;k 6.022×10^{23} gkrh gA ;g cthfy;l d dFku d vu:i FkkA 6.022×10^{23} dk vkokxknk l[;k Hkh dgr g vkj bl N_0 l n'kk;k tkrk gA

mi;Dr x.kukvk dk ;fn ge no rFkk Bkl inkFkk d fy, dj rk ;g dg ldr g fd fdlh Hkh inkFk d xke v.kHkkj vkj xke ijek.k Hkkj e d.kk dh l[;k 6.022×10^{23} gkxh ¼inkFk dk v.kHkkj o ijek.k Hkkj xke e yr g½A

lu 1896 e oKkfud foYgYe vkLVokYM (Wilhelm Ostwald) u vkokxknk l[;k d fy, eky 'kCn iLrkfor fd;k Fkk tk ,d yfVu 'kCn g ftldk vFk <j (heap or pile) gA lu 1967 e eky bdkb Lohdkj dj yh xb] tk ijek.kvk ,o v.kvk dh ogn l[;k dk fu:fir dju dk ljyre mik; gA

1 eky = 6.022×10^{23} ¼vkokxknk l[;k N_0½

eky ;k vkokxknk l[;k dh voèkkj.kk ge ;g crkrh g fd fdlh Hkh inkFk dh fuf'pr ek=k e d.kk dh l[;k fdruh gkrh g tl 23 xke lkfM;e e 1 eky lkfM;e ijek.k g vkj d.kk dh l[;k 6.022×10^{23} gA ;fn 46 xke lkfM;e g rk bldk rkRi; g fd lkfM;e ijek.k d 2 eky gkx vkj d.kk dh l[;k 12.044×10^{23} gkxhA



fp= Øekd&3 % Ekky] vkokxknk l[;k ,o Hkkj d chp lcèk

9.5 inkFk d Hkkj dk eky e n'kkuk

geu vè;;u fd;k fd rRok dk ijek.k Hkkj ;k xke ijek.k Hkkj gkrk g rFkk ;kfxd d fy, v.k Hkkj ;k xke v.k Hkkj gkrk gA bud vkèkkj ij ekyk dh l[;k dk ge bl idkj n'kk ldr g&

rRok d fy,&

$$\text{ekyk dh l[;k (n)} = \frac{\text{fn;k x;k n0;eku (m)}}{\text{xke ijek.k Hkkj (M)}}$$

;kfxdk ;k v.kvk d fy,&

$$\text{ekyk dh l[;k (n)} = \frac{\text{fn;k x;k n0;eku (m)}}{\text{xke v.k Hkkj (M)}}$$

d.kk dh l[;k dk eky e n'kkuk

fdlh Hkh ijek.k@v.k@vk;u bR;kfn dh l[;k] eky l fuEufyf[kr idkj l lcfèkr g&

$$\text{ekyk dh l[;k (n)} = \frac{\text{fn, x, d.kk dh l[;k (N)}}{\text{vkokxknk l[;k } (N_0)}$$

mnkgj.k % 1- fuEufyf[kr e ekyk dh l[;k dk ifjdyu dhft,&

¼d½ 92 xke lkfM;e

gy % ekyk dh l[;k (n) = ?

fn;k x;k n0;eku (m) = 92 g

xke ijek.k Hkkj (M) = 23 g

l=&
$$n = \frac{m}{M}$$
$$= \frac{92}{23}$$
$$= 4 \text{ eky}$$

¼[k½ 36 xke ikuh

gy % ekyk dh l[;k (n) = ?

fn;k x;k n0;eku (m) = 36 g

xke ijek.k Hkkj (M) = 18 g

l=&
$$n = \frac{m}{M}$$
$$= \frac{36}{18}$$
$$= 2 \text{ eky}$$

2- fuEufyf[kr e ekyk dh l[;k Kkr dhft,&

¼d½ 18.066×10^{23} vkDlhtu ijek.k

gy % ekyk dh l[;k (n) = ?

fn, x, d.kk dh l[;k (N) = 18.066×10^{23}

vkokxknk l[;k (N_0) = 6.022×10^{23}

l=& $n = \frac{N}{N_0}$

$n = \frac{18.066 \times 10^{23}}{6.022 \times 10^{23}}$

= 3 eky

¼[k½ 6.022×10^{23} vkD lh tu v.k

gy % ekyk dh l[;k (n) = ?

fn, x, d.kk dh l[;k (N) = 6.022×10^{23}

vkokxknk l[;k (N_0) = 6.022×10^{23}

l=& $n = \frac{N}{N_0}$

$n = \frac{6.022 \times 10^{23}}{6.022 \times 10^{23}}$

= 1 eky

3- fuEufyf[kr e d.kk dh l[;k Kkr dhft,&

¼d½ 10 xke ukbVk tu (N_2) v.k

gy % d.kk dh l[;k (N) = ?

fn;k x;k n0;eku (m) = 10 xke

xke v.kHkkj (M) = 28 xke

l=& $N = n \times N_0$

$n = \frac{m}{M}$

$N = \frac{m \times N_0}{M}$

$N = \frac{10 \times 6.022 \times 10^{23}}{28}$

$= 2.15 \times 10^{23}$ v.k

¼[k½ 2 eky dkcu ijek.k

gy % d.kk dh l[;k (N) = ?

Ekkyk dh l[;k (n) = 2 eky

$$\text{vkokxknk } l[;k\ (N_0) = 6.022 \times 10^{23}$$

$$l=\&\ N = n \times N_0$$

$$= 2 \times 6.022 \times 10^{23}$$

$$= 12.044 \times 10^{23} \text{ ijek.k}$$

9-5-1 vkb,] eky d ckj e le>

geu n[kk fd fdlh 'k) inkFk d lkif{kd ijek.k] v.k ;k l= Hkkj dk xke e n'kk;k tkrk g] ftle mlh inkFk d 1 eky ¼6-022×10^{23}½ d.k lfEefyr jgr gA xlk d fy, ge bud Hkkj d LFkku ij vk;ru dk Hkh uki ldr gA 0°C rki o 1 ok;eMyh; nkc ij fdlh xl dk 1 eky 22-4 yhVj LFkku ?kjrk gA

bll ge fdlh l= vkj vfHkfØ;k d leh dj.k dk fy[ku vkj le>u dk ,d vkj rjhdk feyrk gA tc ge dgr g fd dkcu MkbvkDlkbM fdlh vfHkfØ;k e Hkkx y jgh g vkj bl CO_2 d :Ik e fy[kr g] rk D;k bldk vFk ;g g fd ge CO_2 d ,d v.k d ckj e ckr dj jg g\

geu tkuk fd ijek.k vkj v.k vR;r l{e d.k g vkj gekj fy, ,d ,lh vfHkfØ;k dk djkuk vlHko g] ftle dkcu MkbvkDlkbM ;k fdlh vU; inkFk dk doy ,d gh v.k fy;k tk, vFkkr tc ge CO_2 fy[kr g rk bldk vFk 1 eky CO_2 v.k Hkh gkrk gA vkb,] n[k fd ; fdl idkj mi;kxh gA gkbMkt u vkj vkDlhtu d l;kx l ikuh cuu dh vfHkfØ;k dk bl idkj inf'kr fd;k tk ldrk g&

$$2H_2 + O_2 \longrightarrow 2H_2O$$

mi;Dr vfHkfØ;k e tc gkbMkt u d nk v.k] vkDlhtu d ,d v.k l vfHkfØ;k djr g rk ge ikuh d nk v.k ikIr gkr gA ijr fuEufyf[kr vfHkfØ;k e ge vkèk v.k vkDlhtu dk fdl idkj yx\

$$H_2 + \tfrac{1}{2} O_2 \longrightarrow H_2O$$

bl idkj dh vfHkfØ;k dk ekyk dh l[;k }kjk le>k tk ldrk gA ;gk 1 eky gkbMkt u v.k vkj vkèkk eky vkDlhtu v.k l;kx djd 1 eky v.k ty dk cukr gA blfy, tc ge H_2 fy[kr g] rc bld nk vFk gk ldr g&

- 1 gkbMkt u v.k ftldk fd lkif{kd v.kHkkj 2 u gA
- 1 eky gkbMkt u v.k ftldk xke v.kHkkj 2 xke gA

vkb,] vc ge ,d vU; fØ;k dk n[k&

$$H_2 + Cl_2 \longrightarrow 2HCl$$

bl vfHkfØ;k dh 0;k[;k nk rjg l dj ldr g&

- 1 v.k gkbMkt u tc 1 v.k Dykjhu l vfHkfØ;k djrk g rc 2 v.k gkbMkt u Dykjkb M cur g ;k
- 1 eky gkbMkt u v.k tc 1 eky Dykjhu v.k l vfHkfØ;k djrk g rk 2 eky gkbMkt u Dykjkb M v.k cur gA

i'u%

1- Ekky voèkkj.kk d vkèkkj ij fuEufyf[kr vfHkfØ;kvk dk le>kb,&

¼d½ $C + ½\ O_2 \longrightarrow CO$

¼[k½ $\frac{1}{2}Al_2O_3 + 3\ HCl \longrightarrow AlCl_3 + 1\frac{1}{2}H_2O$

geu lh[kk

- fdlh ;kfxd dk jklk;fud l= mld l?kVdk dk irhdkRed fu:i.k gkrk gA
- Lkgl;kth ;kfxd d l= e mifLFkr lHkh ijek.kvk d Hkkj l v.kHkkj Kkr fd;k tk ldrk gA
- vk;fud ;kfxdk d ?kVd] vk;u ¼èkuk;u o _.kk;u½ gkr gA
- o èkukof'kr vk;u tk {kkj l ikIr gkr g {kkjh; eyd rFkk o _.kkof'kr vk;u tk vEy l ikIr gkr g vEyh; eyd dgykr gA
- ijek.kvk d ,l leg ftu ij dy vko'k fo|eku gk mUg cgijek.kd vk;u dgr gA
- vk;fud ;kfxdk e ?kVd vk;uk dh l;ktdrk }kjk ;kfxdk d jklk;fud l= Kkr fd, tkr gA
- vk;fud ;kfxd d l= e mifLFkr lHkh vk;uk d Hkkj l l= bdkb n0;eku dh x.kuk dh tkrh gA
- fdlh inkFk d eky e d.kk dh l[;k dk vkokxknk l[;k dgr gA bldk eku $6\text{-}022\times10^{23}$ gkrk gA

vrjk"Vh; eky fnol

23 vDVcj dk ifro"k vrjk"Vh; eky fnol euk;k tkrk gA fnol dh 'k#vkr lcg 6-02 ct vkj lekfIr 'kke 6-02 ct gkrh gA le; d bl ik:i dk dkj.k vkokxknk l[;k $6\text{-}022\times10^{23}$ gA

e[; 'kCn (Keywords)

v.kHkkj (molecular weight), eykuikrh l= (empirical formula)] l= bdkb n0;eku (unit formula mass), vkMk&frjNk i)fr (criss-cross method), eky (mole), vkokxknk l[;k (Avogadro number)

vH;kl

1- lgh fodYi pfu,&

(i) CH_3OH dk v.kHkkj gkrk g&

¼v½ 32 u ¼c½ 29 u

¼l½ 25 u ¼n½ 20 u

(ii) {kkjh; eyd gkr g&

¼v½ èkukof'kr vk;u ¼c½ _.kkof'kr vk;u

¼l½ mnklhu ijek.k ¼n½ bue l dkb ugh

(iii) ftu vk;uk ij _.k vko'k gkrk g o &

¼v½ èkukof'kr vk;u gkr gA ¼c½ {kkjh; eyd gkr gA

¼l½ vEYkh; eyd gkr gA ¼n½ mnklhu ijek.k gkr gA

(iv) vkokxknk l[;k dk eku g&

¼v½ $6\text{-}022 \times 10^{23}$ ¼c½ $6\text{-}022 \times 10^{22}$

¼l½ $6\text{-}022 \times 10^{24}$ ¼n½ $60\text{-}22 \times 10^{23}$

(v) $0°C$ rki o 1 ok;eMyh; nkc ij 1 eky xl dk vk;ru gkrk g&

¼v½ 11-2 yhVj ¼c½ 22-4 yhVj

¼l½ 100 yhVj ¼n½ 33-8 yhVj

2 fjDr LFkku dh ifr dhft,&

(i) ----------;kfxdk d fy, l= bdkb n0;eku gkrk gA

(ii) $C_{12}H_{22}O_{11}$ dk v.kHkkj ----------gA

(iii) PO_4^{3-} vk;u e rRok dh l[;k ----------gA

(iv) ,d eky dkcu e ijek.kvk dh l[;k ----------gkrh gA

(v) ,d eky ty dk n0;eku ----------xke gkrk gA

3- vEyh; o {kkjh; eyd dl ikIr gkr g\

4- cgijek.kd vk;u fdl dgr g\ mnkgj.k nhft,A

5- mfpr lcèk tkfM, &

	LrHk ^v*		LrHk ^c*
(i)	1 eky e v.kvk dh l[;k	(i)	14 xke
(ii)	vEyh; eyd g	(ii)	Mg^{2+}
(iii)	{kkjh; eyd g	(iii)	SO_4^{2-}
(iv)	1 eky ukbVk tu ijek.k dk Hkkj	(iv)	2 eky
(v)	CO_2 d 88 xke e ekyk dh l[;k	(v)	6.022×10^{23}

6- l= bdkb n0;eku fdl dgr g\ $MgSO_4$ d l= bdkb n0;eku dh x.kuk dhft,A

7- fdlh èkkr d dkckuV dk l= M_2CO_3 gk] rc bld ukbVV dk l= D;k gkxk\

8- ;fn ,yfefu;e lYQV dk l= $Al_2(SO_4)_3$ gk] rc Al vk;u ij fdruk vko'k gkxk vkj ftd lYQV dk l= D;k gkxk\

9- ,d vk;u X g] ftl ij nk èku vko'k g] bld ukbVV] lYQV vkj QkLQV d l= fyf[k,A

10- fuEufyf[kr d v.kHkkj fyf[k,&

NH_3, PCl_5, H_2O_2, S_8, HCl

11- fuEufyf[kr d n0;eku dh x.kuk dhft,&

5 eky vekfu;k] 0-5 eky ty] 1-50 eky Na^+ vk;u] 0-2 eky vkDlhtu ijek.k

12- fuEufyf[kr e ekyk dh l[;k dh x.kuk dhft,&

12 xke O_2] 22 xke CO_2

13- vkMk&frjNk i)fr l fuEufyf[kr d l= cukb,&

vk;ju lYQV] dkij ukbVV] lkfM;e lYQkbM] eXuhf'k;e gkbMk tudkckuV

v/;k;&10

jklk;fud vfHkfØ;k, ,o lehdj.k

(Chemical Reactions and Equations)

nfud thou e gku okyh ?kVukvk ij /;ku nhft, vkj mue gku oky ifjoruk d ckj e lkfp, tl&

- n/k l ngh cuuk
- dk;y dk tyuk
- Hkktu dk iduk
- Ykkg dh dhy ij tx yxuk

vkiu n[kk fd Åij nh xb lHkh ?kVukvk e ifjoru d ckn oLr dh idfr vkj igpku dN u dN cny tkrh gA Hkkfrd vkj jklk;fud ifjoru d ckj e ge fiNyh d{kkvk e i< pd gA tc jklk;fud ifjoru gkrk g rc ge ;g dgr g fd ,d jklk;fud vfHkfØ;k gb gA

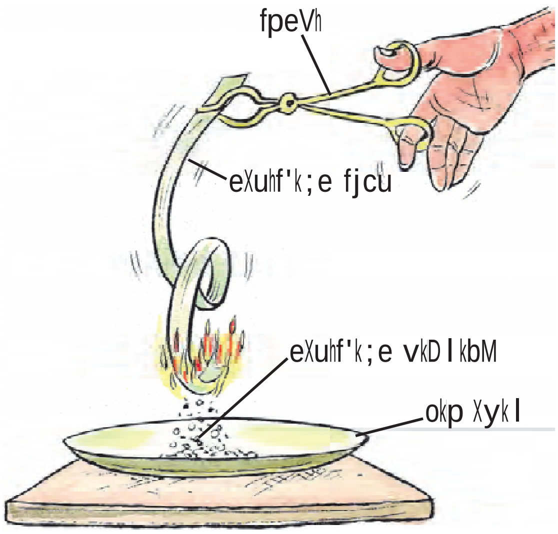
jklk;fud vfHkfØ;k dk le>u d fy, vkb,] dN fØ;kdyki djr gA

fØ;kdyki&1

- yxHkx 2 lVhehVj yc eXuhf'k;e fjcu dk jreky iij l jxMdj lkQ dj yhft,A
- bl fpeVh l idMdj fLiV yi ;k cuj dh lgk;rk l tykb, rFkk bl l cuh jk[k dk okp Xykl e bdëk dhft, ¼fp= Øekd&1½A bl jk[k dk ty e ?kkydj fyVel iij l bldk ijh{k.k dhft,A
- bl fØ;kdyki dk f'k{kd d lg;kx l dhft, rFkk viuh vk[kk dk ;Fkk lHko nj jf[k,A

¼d½ D;k ble dkb u;k inkFk cuk\

¼[k½ D;k eXuhf'k;e dh voLFkk e dkb ifjoru gvk\



fp= Øekd&1 ½ eXuhf'k;e fjcu dk ngu

vkiu n[kk fd pednkj lQn jx dh yk d lkFk eXuhf'k;e dk ngu gkrk g vkj og lQn p.k e ifjofrr gk tkrk gA ;g eXuhf'k;e vkDlkbM dk p.k g tk ok;e mifLFkr vkDlhtu rFkk eXuhf'k;e d chp gku okyh vfHkfØ;k d dkj.k curk gA ftldk tyh; foy;u {kkjh; i—fr d dkj.k yky fyVel dk uhyk dj nrk gA

fØ;kdyki&2

- nk vyx&vyx ij[kufy;k e lkfM;e lYQV rFkk cfj;e DykjkbM dk tyh; foy;u r;kj dhft,A
- ,d ij[kuyh e 10 mL lkfM;e lYQV dk foy;u ydj mle /khj&/khj cfj;e DykjkbM dk foy;u feykb,A

¼d½ D;k dkb vo{ki ikIr gvk\

¼[k½ vo{ki d jx dk ukV dhft,A

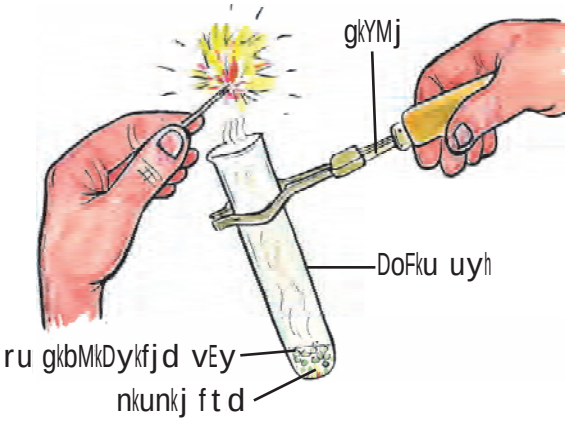
fØ;kdyki&3

- ,d DoFku uyh e dN nkunkj ftd yhft,A
- mle ru gkbMkDYkkfjd vEy feyk nhft,A

¼d½ D;k ftd d nkuk d vkl&ikl dN fØ;k gkrh fn[kkb n jgh g ¼fp= Øekd&2½\

¼[k½ DoFku uyh dk Li'k dhft,A D;k vkiu bld rkieku e dkb ifjoru egIl fd;k\

¼x½ DoFku uyh d eg d ikl tyrh ekfpl dh rhyh y tku ij D;k gkrk g\



fp= Øekd&2 ¼ ftd ij ru gkbMkDykfjd vEy dh fØ;k l H_2 xl dk cuuk

Åij fn, x, rhuk fØ;kdyki e u, inkFkk d cuu d lkFk&lkFk fuEufyf[kr ifjoRku inf'kr djr g fd ;gk jklk;fud vfHkfØ;k gk jgh g&

- inkFkk dh voLFkk e ifjoru
- inkFkk d jx e ifjoru
- fØ;k d nkjku xl mRiUu gkuk
- fØ;k d QyLo:i rkieku e ifjoru

ifrfnu ge viu vkl&ikl ,lh cgr lh jklk;fud vfHkfØ;k, n[kr g ftue ; y{k.k fn[kkb nr gA bl v/;k; e ge jklk;fud vfHkfØ;kvk vkj mudh lkdfrd vfHk0;fDRk dk vè;;u djxA

10.1 jklk;fud lehdj.k ¼Chemical equation½

fØ;kdyki 1 e tc vkDlhtu dh mifLFkfr e eXuhf'k;e fjcu dk ngu gkrk g rc og eXuhf'k;e vkDlkbM e ifjofrr gk tkrk gA okD; d :Ik e fdlh jklk;fud vfHkfØ;k dk o.ku cgr yck gk tkrk gA bl l{ki e 'kCn lehdj.k d :Ik e fy[kuk ljy gkrk gA

bl vfHkfØ;k dk 'kCn lehdj.k bl idkj gkxk&

eXuhf'k;e $ vkDlhtu ⟶ eXuhf'k;e vkDlkbM -------- ¼1½

¼vfHkdkjd½ ¼mRikn½

vfHkfØ;k e eXuhf'k;e vkj vkDlhtu ,l inkFk g ftue jklk;fud ifjoru gkrk g] bUg vfHkdkjd dgr g vkj u, cu g, inkFk eXuhf'k;e vkDlkbM dk mRikn dgr gA

'kkfCnd lehdj.k d :lk e fy[kh xb jklk;fud vfHkfØ;k e vfHkdkjdk d mRiknk e ifjoru dk mud chp rhj d fu'kku ¼→½ l n'kkr gA vfHkdkjdk dk rhj d fu'kku d ckb vkj rFkk mRikn dk nkb vkj fy[kk tkrk gA vfHkdkjd ;k mRikn ,d l vf/kd gkr g rk mud chp ;kx ¼$½ dk fpà yxkr gA

10-2 jklk;fud lehdj.k fy[kuk

'kCnk dh txg jklk;fud l= fy[kdj jklk;fud lehdj.k dk vf/kd lf{kIr vkj mi;kxh cuk;k tk ldrk gA 'kCn lehdj.k ¼1½ dk bl idkj fy[kk tk ldrk gA

$$Mg + O_2 \longrightarrow MgO \text{ -------- } ¼2½$$

Rkhj d fu'kku d ckb rFkk nkb vkj d rRok d ijek.kvk dh l[;k dh fxurh dj mudh ryuk djr gA ;fn nkuk vkj rRok d ijek.kvk dh l[;k leku ugh gk rk lehdj.k vlrfyr gkrk gA

inkFk dh vfoukf'krk d fu;ekulkj fdlh Hkh jklk;fud vfHkfØ;k e inkFk dk u rk fuek.k gkrk g vkj u gh fouk'k vFkkr vfHkfØ;k d nkjku ijek.k u rk cur g vkj u gh u"V gkr gA

vr% fdlh jklk;fud vfHkfØ;k e vfHkdkjdk dk dy n0;eku] mRiknk d dy n0;eku d cjkcj gkrk gA nlj 'kCnk e jklk;fud vfHkfØ;k d igy vkj ckn e iR;d rRo d ijek.kvk dh l[;k leku gkrh g blfy, lehdj.k dk lrfyr djuk vko';d gA

10-3 jklk;fud lehdj.k dk lrfyr djuk

vkb,] ge jklk;fud lehdj.k dk Øec) rjhd l lrfyr djA

mnkgj.k& gkbMkt.u vkj vkDlhtu l ikuh cuu dh vfHkfØ;k dk jklk;fud lehdj.k bl idkj fy[kr g&

$$H_2 + O_2 \longrightarrow H_2O \text{ ..... (3)}$$

pj.k 1- jklk;fud lehdj.k dk lrfyr dju d fy, lcl igy l= d pkjk vkj ckDl cuk yhft,A lehdj.k dk lrfyr djr le; ckDl d vnj dN Hkh ifjoRku ugh dhft,A

$$\boxed{H_2} + \boxed{O_2} \longrightarrow \boxed{H_2O} \text{ .....(4)}$$

Pkj.k 2- vlrfyr lehdj.k ¼4½ e mifLFkr fofHkUu rRok d ijek.kvk dh l[;k dh lph cuk yhft,&

rRo	vfHkdkjdk d ijek.kvk dh l[;k ¼ckb vkj½	mRiknk d ijek.kvk dh l[;k ¼nkb vkj½
H	2	2
O	2	1

Pkj.k 3- lehdj.k ¼4½ e ckb vkj vkDlhtu ijek.k dh l[;k nk g tcfd nkb vkj ek= ,dA vr% vkDlhtu ijek.k dk lrfyr dju d fy,&

vkDlhtu d ijek.k	vfHkdkjd e	mRikn e
ikjHk e	2 (O_2 e)	1 (H_2O e)
lrfyr dju d fy,	2	1×2

;g ;kn j[kuk vko';d g fd ijek.kvk dh l[;k cjkcj dju d fy, ge vfHkfØ;k e Hkkx yu oky rRok vkj ;kfxdk d l=k dk ugh cny ldr g tl fd vkDlhtu ijek.k dk lrfyr dju d fy, ge 2 l x.kk djd $2H_2O$ fy[k ldr g yfdu H_2O_2 ughA

vkf'kd :Ik l lrfyr lehdj.k vc bl idkj gkxk&

$$\boxed{H_2} + \boxed{O_2} \longrightarrow 2\,\boxed{H_2O} \quad \text{..... (5)}$$

pj.k 4- vc gkbMkstu ijek.k lrfyr ugh g vkf'kd :Ik l lrfyr lehdj.k ¼5½ e gkbMkstu dk lrfyr djr g&

gkbMkstu d ijek.k	vfHkdkjd e	mRikn e
vkf'kd lrfyr lehdj.k e	2 ¼ H_2 e½	4 ¼ $2H_2O$ e½
lrfyr dju d fy,	2×2	4

gkbMkstu ijek.k dk cjkcj dju d fy, ckb vkj 2 l x.kk djr gA lehdj.k vc bl idkj gkxk&

$$2\boxed{H_2} + \boxed{O_2} \longrightarrow 2\,\boxed{H_2O} \quad \text{..... (6)}$$

vr e bl lrfyr lehdj.k dh tkp d fy, ge lehdj.k d nkuk vkj d rRok d ijek.kvk dh l[;k dh ryuk djr gA

$$2H_2 + O_2 \longrightarrow 2H_2O \quad \text{lrfyr lehdj.k ..... (7)}$$

blh rjg l vki uhp fn, x, lehdj.k dk lrfyr dhft,&

$$Mg + O_2 \longrightarrow MgO \quad \text{..... (8)}$$

vkb,] dN vkj vfHkfØ;kvk d mnkgj.kk dk ydj lehdj.k dk lrfyr djuk lh[k&

$$N_2 + H_2 \longrightarrow NH_3 \quad \text{..... (9)}$$

pj.k 1- jklk;fud lehdj.k dk lrfyr dju d fy, lcl igy l= d pkjk vkj ckDl cuk yhft,A /;ku n fd lehdj.k dk lrfyr djr le; ckDl d vnj dN Hkh ifjoru ugh djuk g&

$$\boxed{N_2} + \boxed{H_2} \longrightarrow \boxed{NH_3} \quad \text{..... (10)}$$

Pkj.k 2- vlrfyr lehdj.k e mifLFkr fofHkUu rRok d ijek.kvk dh l[;k dh lph cuk yhft,&

rRo	vfHkdkjdk d ijek.kvk dh l[;k ¼ckb vkj½	mRikn d ijek.kvk dh l[;k ¼nkb vkj½
N	2	1
H	2	3

Pkj.k 3- lehdj.k d ckb vkj ukbVkt u ijek.kvk dh l[;k 2 g tcfd nkb vkj ek= 1A ukbVkt u dk lrfyr dju d fy,&

ukbVkt u ijek.k	vfHkdkjd e	mRikn e
ikjHk e	2 (N_2 e)	1 (NH_3 e)
lrfyr dju d fy,	2	1×2

vkf'kd :Ik l lrfyr lehdj.k vc bl idkj gkxk&

$$\boxed{N_2} + \boxed{H_2} \longrightarrow 2\ \boxed{NH_3}$$ vkf'kd :Ik l lrfyr lehdj.k -----¼11½

Pkj.k 4- gkbMkt u ijek.k vc Hkh lrfyr ugh gA vkf'kd :Ik l lrfyr lehdj.k e gkbMkt u dk lrfyr djr g&

gkbMkt u ijek.k	vfHkdkjd e	mRikn e
vkf'kd lrfyr lehdj.k	2 (H_2 e)	6 ($2NH_3$)
lrfyr dju d fy,	2×3	6

gkbMkt u ijek.k dk cjkcj dju d fy, ckb vkj 3 l x.kk djr gA lehdj.k vc bl idkj gkxk&

$$\boxed{N_2} + 3\boxed{H_2} \longrightarrow 2\boxed{NH_3}$$ ---------- ¼12½

vr e bl lrfyr lehdj.k dh tkp d fy, ge lehdj.k d nkuk vkj d rRok d ijek.kvk dh l[;k dh x.kuk djr gA

$$N_2 + 3H_2 \longrightarrow 2\,NH_3$$ lrfyr lehdj.k ---------- ¼13½

Lkehdj.k e nkuk vkj rRok d ijek.kvk dh l[;k cjkcj gA vr% ;g lehdj.k vc lrfyr gA jklk;fud lehdj.kk dk lrfyr dju dh bl fof/k dk vueku fof/k dgr gA bl fof/k e lcl NkVh i.kkd l[;k l lrfyr djuk vkjHk dj vko';drkulkj mld x.kkd dk mi;kx djd lehdj.k dk lrfyr dju dk i;kl djr gA

i'u

1- fuEufyf[kr jklk;fud vfHkfØ;kvk d fy, lrfyr jklk;fud lehdj.k fyf[k,&

¼v½ gkbMkt u $ Dykjhu ⟶ gkbMkt u DykjkbM

¼c½ lkfM;e gkbMkDlkbM $ lY¶;fjd vEy ⟶ lkfM;e lYQV $ ikuh

2- fuEufyf[kr jklk;fud lehdj.kk dk lrfyr dhft,&

¼v½ $CH_4 + O_2 \longrightarrow H_2O + CO_2$

¼c½ $Fe + O_2 \longrightarrow Fe_3O_4$

¼l½ $KClO_3 \longrightarrow KCl + O_2$

10-4 jklk;fud vfHkfØ;kvk d idkj

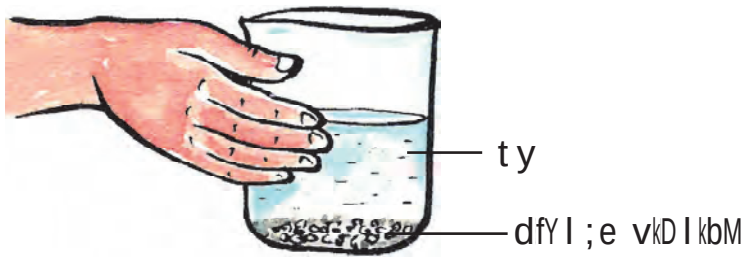
jklk;fud vfHkfØ;k e ijek.k u rk cur g vkj u gh u"V gkr gA jklk;fud vfHkfØ;k e jklk;fud ifjoru gkrk g] ft le vfHkdkjd fØ;k djd u, inkFk ¼mRikn½ cukr g ftld x.k vfHkdkjd l fHkUu gkr gA okLro e fdlh jklk;fud vfHkfØ;k e ijek.kvk d vkilh cèk VVu ,o tMu l u, inkFkk dk fuek.k gkrk gA vkb,] n[k fd jklk;fud vfHkfØ;k, fdru idkj dh gkrh g&

10-4-1 l;ktu vfHkfØ;k

fØ;kdyki&4

- ,d chdj e dfYl;e vkDlkbM ¼fcuk c>k puk½ d FkkM l VdM yhft,A
- ble /kh&/kh j ty feykb,A
- vc chdj dk Li'k dhft,A
- D;k bld rki e dkb ifjoru gvk\

dfYl;e vkDlkbM ty d lkFk rhork l vfHkfØ;k djd c> pu ¼dfYl;e gkbMkDlkbM½ dk fuek.k djd vf/kd ek=k e Å"ek mRiUu djrk g ¼fp= Øekd&3½A



fp= Øekd&3

$$CaO + H_2O \longrightarrow Ca(OH)_2 \quad \text{------ ¼14½}$$

bl vfHkfØ;k e dfYl;e vkDlkbM vkj ty feydj ,dy mRikn dfYl;e gkbMkDlkbM cukr gA ,lh vfHkfØ;k ftle nk ;k nk l vf/kd vfHkdkjd feydj ,d mRikn dk fuek.k djr g bl l;ktu vfHkfØ;k dgr gA fØ;kdyki 1 e nh xb vfHkfØ;k d idkj dk igpkfu,A

vkb,] l;ktu vfHkfØ;k d dN vkj mnkgj.k n[k&

1- dk;y dk ngu&

$$C + O_2 \longrightarrow CO_2 \quad \text{..... (15)}$$

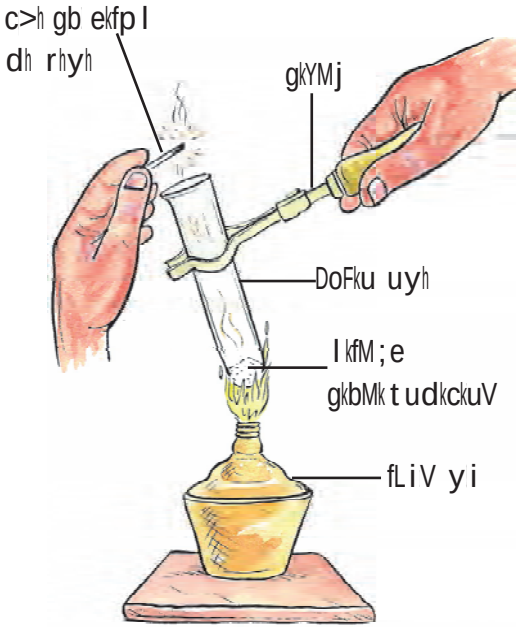
2- gkbMktu vkj vkDlhtu l ty dk fuek.k

$$2H_2 + O_2 \longrightarrow 2H_2O \text{ ..... (16)}$$

10-4-2 fo;ktu ¼vi?kVu½ vfHkfØ;k

fØ;kdyki&5

- ,d DoFku uyh e FkkMk lk [kku dk lkMk ¼lkfM;e gkbMktudkckuV½ yhft ,A
- DoFku uyh dk fLiV yi dh lgk;rk l xe dhft ,A
- vc fp= Øekd&4 e n'kk, vulkj ,d tyrh gb ekfpl dh rhyh] fudyrh gb xl d lehi y tkb,A
- vkiu D;k n[kk\
- vki n[kx fd ekfpl dh rhyh c> tkrh gA



fp= Øekd&4 ¼ lkfM;e gkbMktudkckuV dk vi?kVu rFkk dkcu MkbvkDlkbM dk mRltu vkj ijh{k.k

lkfM;e gkbMkstudkckuV xe dju ij lkfM;e dkckuV] ikuh vkj dkcu MkbvkDlkbM e VV tkrk gA

$$2NaHCO_3 \longrightarrow Na_2CO_3 + H_2O + CO_2 \quad \text{..... (17)}$$

vki n[k ldr g fd bl vfHkfØ;k e ,dy vfHkdkjd VVdj nk ;k vf/kd mRiknk e cny tkrk g ;g ,d fo;kstu vfHkfØ;k gA tc fo;kstu fØ;k Å"ek d }kjk lEiUu gkrh g rk ml Å"eh; fo;kstu dgr gA

vkb,] fo;kstu vfHkfØ;k d vU; mnkgj.kk ij ppk dj&

1- fo|r /kkjk iokfgr dju ij ikuh] gkbMkstu vkj vkDlhtu xl e fo;kftr gk tkrk g&

$$2H_2O \longrightarrow 2H_2 + O_2 \quad \text{..... (18)}$$

bl idkj dk fo;kstu fo|r vi?kVu dgykrk gA

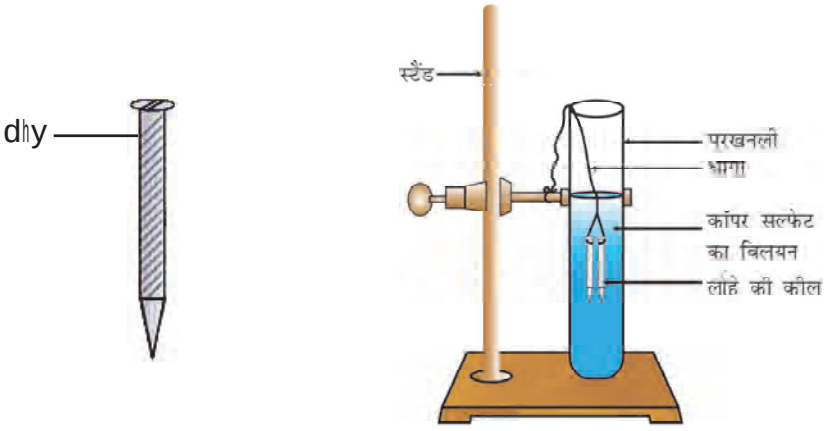
2- dfYl;e dkckuV dk dfYl;e vkDlkbM rFkk dkcu MkbvkDlkbM e VVuk ,d fo;kstu vfHkfØ;k g ftldk mi;kx fofHkUu m|kxk e gkrk g ftle lheV m|kx ie[k gA

$$CaCO_3 \xrightarrow{1000^oC} CaO + CO_2 \quad \text{..... (19)}$$

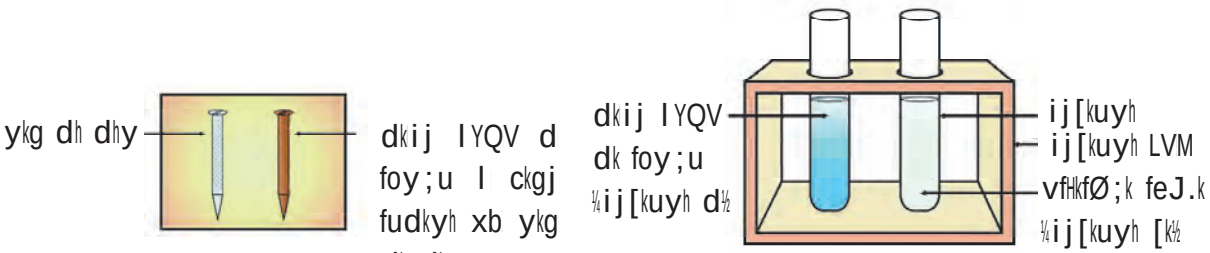
10-4-3 foLFkkiu vfHkfØ;k

fØ;kdyki&6

- ykg dh rhu dhy ;k vkyfiu yhft,] mUg jreky iij l jxMdj lkQ dhft,A
- *d* vkj *[k* fpfàr dh gb nk ij[kufy;k yhft,A iR;d ij[kuyh e 5&10 mL dkij lYQV dk foy;u yhft,A
- nk dhyk dk /kkx l ck/kdj lko/kkuhiod ij[kuyh ^[k* d dkij lYQV d foy;u e yxHkx 30 feuV rd Mckdj jf[k,] ryuk dju d fy, ,d dhy dk vyx jf[k,A ¼fp= Øekd&5 v rFkk c½



fp= Øekd&5 ¼v½ ¼ ckgj j[kh rFkk dkij lYQV d foy;u e Mch ykg dh dhy



fp= Øekd&5 ¼c½ % i;kx l igy rFkk mld mijkr ykg dh dhy rFkk dkij lYQV d foy;u dh ryuk

- 30 feuV lk'pkr nkuk dhyk dk dkij lYQV d foy;u l ckgj fudky yhft,A
- lkj[kuyh *d* vkj *[k* e j[k dkij lYQV foy;u d uhy jx dh ryuk dhft,A
- dkij lYQV d foy;u e Mch dhy d jx dh ryuk ckgj j[kh dhy l dhft,A

lkfp,] Ykkg dh dhy dk jx Hkjk rFkk dkij lYQV d foy;u dk jx Qhdk D;k gk x;k\ bl fØ;kdyki e fUkEufyf[kr vfHkfØ;k gb&

$$Fe + CuSO_4 \longrightarrow FeSO_4 + Cu \quad \text{..... (20)}$$

bl vfHkfØ;k e ykg ¼vk;ju½ u dkij dk mld ;kfxd dkij lYQV d foy;u l foLFkkfir dj mldk LFkku Lo; y fy;kA bl vfHkfØ;k dk foLFkkiu vfHkfØ;k dgr gA

vkb,] foLFkkiu vfHkfØ;k d dN vU; mnkgj.k n[k&

$$Pb + CuCl_2 \longrightarrow PbCl_2 + Cu \quad \text{..... (21)}$$

$$Zn + 2AgNO_3 \longrightarrow Zn(NO_3)_2 + 2Ag \quad \text{..... (22)}$$

mi;Dr mnkgj.kk l irk pyrk g fd vk;ju vkj yM] dkij dh vi{kk vf/kd fØ;k'khy rRo gA o dkij dk mld ;kfxd l foLFkkfir dj nr gA blh idkj ftd] flYoj dh vi{kk vf/kd fØ;k'khy rRo g rFkk og flYoj dk mld ;kfxd l foLFkkfir dj nrk gA fØ;kdyki 3 ij /;ku n ftle vkiu ftd dh fØ;k ru gkMkDykfjd vEy l dh gA

1- bl vfHkfØ;k d fy, lrfyr jklk;fud lehdj.k fyf[k,A

2- D;k ;g Hkh foLFkkiu vfHkfØ;k g\ dkj.k fyf[k,A

10-4-4 f}foLFkkiu vfHkfØ;k

fØ;kdyki 2 e vkiu n[kk fd lQn jx d ,d inkFk dk fuek.k gkrk g tk ty e vfoy; g] bl vfoy; inkFk dk vo{ki dgr gA bl vfHkfØ;k e lkfM;e lYQV e cfj;e Dykjkb M feyku ij cfj;e lYQV dk lQn vo{ki ikIr gkrk gA

$$Na_2SO_4 + BaCl_2 \longrightarrow BaSO_4 + 2NaCl \text{ ..... (23)}$$

,lk D;k gkrk g\ Ba^{++} vk;u dh SO_4^{--} vk;u d l;ktu l $BaSO_4$ d vo{ki dk fuek.k gkrk gA ,d vU; mRikn lkfM;e DykjkbM dk fuek.k Na^+ vk;u rFkk Cl^- vk;u d tMu l gkrk g tk foy;u e gh jgrk gA o vfHkfØ;k, ftue vfHkdkjdk d chp vk;uk dk vknku&inku gkrk g rFkk mue l ,d foijhr vk;uk dk ;Xe foy;u l vyx gk tkrk g mUg f}foLFkkiu vfHkfØ;k, dgr gA f}foLFkkiu d vU; mnkgj.k bl idkj g&

1- yM ukbVV foy;u dk ikVf'k;e vk;kMkbM d foy;u e feyk, rk yM vk;kMkbM dk ihyk vo{ki vkj ikVf'k;e ukbVV dk foy;u ikIr gkrk gA bl idkj dh vfHkfØ;k vo{kihdj.k dgykrh gA

$$Pb(NO_3)_2 + 2KI \longrightarrow PbI_2 + 2KNO_3 \text{ ..... (24)}$$

2- lkfM;e gkbMkDlkbM ¼{kkj½ vkj gkbMkDykfjd vEy dh fØ;k e H^+ vk;u vkj OH^- vk;u feydj ikuh cukr g rFkk Na^+ vk;u vkj Cl^- vk;u feydj lkfM;e Dykjkbm cukr g tk foy;u e gh jgrk g] ;g vfHkfØ;k mnkslhuhdj.k dgykrh gA

$$NaOH + HCl \longrightarrow NaCl + H_2O \text{ ..... (25)}$$

i'u

1- fuEufyf[kr vfHkfØ;kvk d fy, lrfyr jklk;fud lehdj.k fyf[k, ,o iR;d vfHkfØ;k dk idkj crkb,&

¼v½ ftd dkckuV $\longrightarrow$ ftd vkDlkbM $ dkcu MkbvkDlkbM

¼c½ lkfM;e gkbMkDlkbM $ lY¶;fjd vEy $\longrightarrow$ lkfM;e lYQV $ ikuh

¼l½ ikVf'k;e ckekbM $ cfj;e vk;kMkbM $\longrightarrow$ ikVf'k;e vk;kMkbM $ cfj;e ckekbM

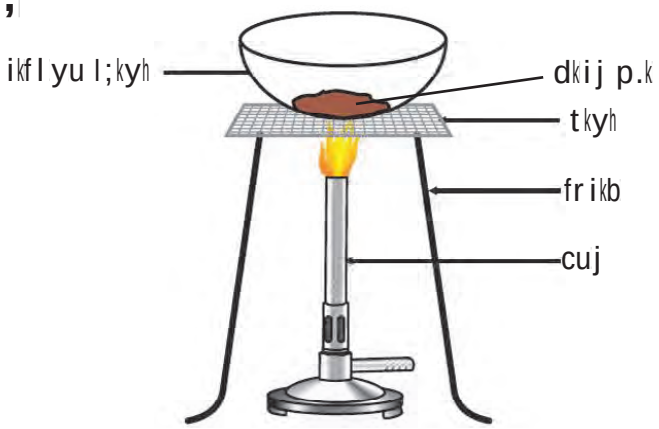
2- tc ykg dh dhy dk dkij lYQV d foy;u e Mck;k tkrk g] rc foy;u dk jx D;k cny tkrk g\

10-4-5 vkDlhdj.k vkj vip;u vfHkfØ;k,

fØ;kdyki&7

- ikflyu l;kyh e 1 xke dkij p.k ydj ml fp= Øekd 6 d vulkj xe dhft,A
- vkiu D;k n[kk\
- dkij p.k dh lrg ij dkyh ijr p< tkrh gA ;g dkyk inkFk D;k cuk\

;g dkij vkDlkbM g tk dkij vkj vkDlhtu dh fØ;k l cuk gA



fp= Øekd&6 % dkij dk vkDlhdj.k

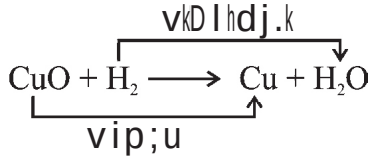
$$2Cu + O_2 \longrightarrow 2CuO \quad \text{..... (26)}$$

;fn bl xe inkFk d Åij gkbMk tu xl iokfgr dh tk, rk lrg dh dkyh ijr] Hkj jx dh gk tkrh g D;kfd dkij vkDlkbM] vkDlhtu [kk nrk g vkj fQj dkij ikIr gk tkrk gA

$$CuO + H_2 \longrightarrow Cu + H_2O \quad \text{..... (27)}$$

vfHkfØ;k d le; tc fdlh inkFk }kjk vkDlhtu xg.k dh tkrh g rc mldk vkDlhdj.k gkrk g rFkk tc vfHkfØ;k e fdlh inkFk }kjk vkDlhtu dh deh gkrh g rk mldk vip;u gkrk gA

vfHkfØ;k ¼27½ e dkij vkDlkbM e vkDlhtu dh deh gk jgh g blfy, dkij vkDlkbM vipf;r gvk g vkj gkbMk tu e vkDlhtu dh of) gk jgh g blfy, gkbMk tu vkDlhdr gk jgk g vFkkr bl vfHkfØ;k e ,d vfHkdkjd vkDlhdr rFkk nljk vipf;r gkrk gA bl vfHkfØ;k dk vkDlhdj.k&vip;u vFkok jMkDl vfHkfØ;k dgr gA



jMkDl vfHkfØ;k d dN vU; mnkgj.k g&

$$ZnO + C \longrightarrow Zn + CO \quad \text{..... (28)}$$

$$MnO_2 + 4HCl \longrightarrow MnCl_2 + 2H_2O + Cl_2 \quad \text{..... (29)}$$

vfHkfØ;k ¼28½ e dkcu] vkDlhdr gkdj CO rFkk ZnO vipf;r gkdj Zn cukrk gA

vfHkfØ;k ¼29½ e exuht Mkbv kDlkbM e vkDlhtu dh deh gk jgh g vFkkr mldk vip;u gk jgk g rFkk HCl dk gkbMk tu] vkDlhtu xg.k djd ikuh e vkDlhdr gk jgk gA

Åij fn, x, mnkgj.kk d vkèkkj ij ge dgr g fd fdlh vfHkfØ;k e inkFk }kjk vkDlhtu xg.k dju ;k gkbMk tu R;kx dju dh ifØ;k vkDlhdj.k ,o gkbMk tu xg.k dju ;k vkDlhtu R;kx dju dh ifØ;k vip;u dgykrh gA

D;k vkDlhdj.k&vip;u ¼jMkDl½ vfHkfØ;kvk dk byDVku LFkkukrj.k d vk/kkj ij le>k;k tk ldrk g\

fØ;kdyki 1 e eXuhf'k;e dk rkj vkDlhtu d lkFk tydj eXuhf'k;e vkDlkbM ¼lQn p.k½ cukrk gA

$$2Mg + O_2 \longrightarrow 2MgO \quad \text{..... (30)}$$

ge dg ldr g fd eXuhf'k;e d vkDlhdj.k l eXuhf'k;e vkDlkbM cukA ;fn ge eXuhf'k;e vkj vkDlhtu d byDVkfud foU;kl d vk/kkj ij eXuhf'k;e vkDlkbM cuu dh vfHkfØ;k ij fopkj dj rk eXuhf'k;e d vfre dk'k e nk bYkDVku ik, tkr g ftUg R;kxdj eXuhf'k;e /kuk;u cukrk gA

$$Mg \longrightarrow Mg^{++} + 2e^- \quad \text{..... (31)}$$

bu byDVkuk dk vkDlhtu xg.k djd vkDlkbM vk;u ¼_.kk;u½ e ifjofrr gk tkrh gA

$$O + 2e^- \longrightarrow O^{2-}$$

vFkok $O_2 + 4e^- \longrightarrow 2O^{2-}$ ..... (32)

bl idkj Mg }kjk byDVku R;kxuk vkDlhdj.k vkj vkDlhtu }kjk byDVku xg.k djuk vip;u dgykrk gA mi;Dr vfHkfØ;k e nkuk vfHkfØ;k,¡ lkFk&lkFk py jgh g] bl jMkDl vfHkfØ;k dgr gA

vc rd geu vfHkdkjd vkj mRikn d cuu d vk/kkj ij jklk;fud vfHkfØ;kvk d fofHkUu idkjk dk v/;;u fd;k gA vkb,] vc ge bl v/;k; e fd, x, dN fØ;kdykik d ckj e fQj l fopkj djA

fØ;kdyki&4 e vkiu n[kk fd dfYl;e gkbMkDlkbM d fuek.k d lkFk vf/kd ek=k e Å"ek mRiUu gk jgh g A bl idkj dh vfHkfØ;k Å"ek{kih vfHkfØ;k dgykrh gA

fØ;kdyki&1 ij /;ku n ftle eXuhf'k;e fjcu dk fLiV yi dh lgk;rk l tykr gA

1- D;k ;g ,d l;ktu vfHkfØ;k g\

2- D;k ble vkDlhdj.k ;k vip;u gk jgk g\

3- D;k ;g Å"ek{kih vfHkfØ;k g\

fØ;kdyki 3 ij /;ku nA ftle vkiu ftd dh fØ;k ru gkbMkDykfjd vEy l djkbA D;k ;g foLFkkiu vfHkfØ;k d lkFk&lkFk Å"ek{kih vfHkfØ;k Hkh g\

Å"ek{kih vfHkfØ;k d dN vU; mnkgj.k g&

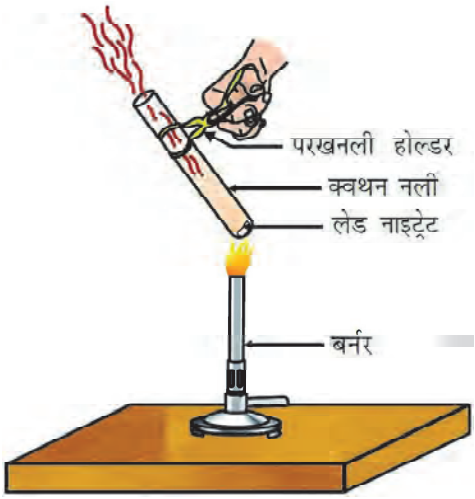
1- lkdfrd xl dk ngu&

$$CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O + \text{Å"ek} \quad \text{..... (33)}$$

2- 'olu rFkk gjh lfCt;k l [kkn cuuk Hkh ,d Å"ek{kih vfHkfØ;k gA

fØ;kdyki&8

- ,d DoFku uyh e yM ukbVV dh FkkMh ek=k yhft,A
- ij[kuyh gkYMj l DoFku uyh dk idMdj Tokyk d Åij j[kdj xEk dhft, ¼fp= Øekd&7½A
- vkiu D;k n[kk\ ;fn dkb ifjoRku gvk g rk ml ukV dhft,A



fp= Øekd&7

vki n[kx fd Hkj jx dh ukbVk tu MkbvkDlkbM xl fudyrh gA ;g vfHkfØ;k bl idkj gkrh g&

$$2Pb(NO_3)_2 \longrightarrow 2PbO + 4NO_2 + O_2 \quad \text{..... (35)}$$

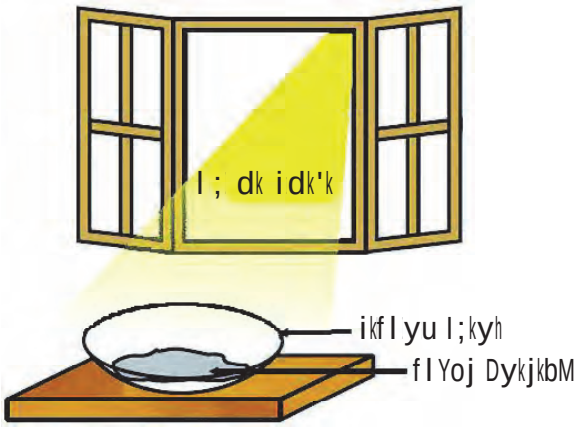
bl vfHkfØ;k e vfHkdkjd d fo?kVu d fy, Å"ek dh vko';drk gkrh gA ftu vfHkfØ;kvk e Å"ek vo'kkf"kr gkrh g mUg Å"ek'kk"kh vfHkfØ;k dgr gA

fuEufyf[kr fd;kdyki dj&

,d ij[kuyh e 2 g cfj;e gkbMkDlkbM rFkk 1g vekfu;e Dykjkb M ydj dkp dh NM l feykb,A viuh Åxfy;k l ij[kuyh d fupy flj dk N,A D;k vkiu rkieku e ifjoru egll fd;k\ ;g vfHkfØ;k Å"ek{kih g ;k Å"ek'kk"kh\

fØ;kdyki&9

- ikflyu l;kyh e 2 xke flYoj Dykjkb M yhft, rFkk bldk jx ukV dhft,A
- bl l;kyh dk FkkMh nj d fy, l; d idk'k e j[k nhft, ¼fp= Øekd&8½A FkkMh nj ckn flYoj Dykjkb M d jx dk ukV dhft,A



fp= Øekd&8 % l; d idk'k e flYoj Dykjkb M /klj jx dk gkdj flYoj /kkr cukrk g

vki n[kx fd l; d idk'k e 'or jx dk flYoj Dykjkb M /klj (grey) jx dk gk tkrk gA idk'k dh mifLFkfr d dkj.k flYoj Dykjkb M d flYoj vkj Dykjhu e fo;kt u d dkj.k ,lk gkrk gA

$$2AgCl \longrightarrow 2Ag + Cl_2 \quad \text{..... (36)}$$

;g vi?kVu fØ;k l; d idk'k dh mifLFkfr e gkrh g vkj bl idkj dh fØ;kvk dk idk'k jklk;fud vfHkfØ;k (photochemical reaction) dgr gA

,lh lHkh vfHkfØ;k,a ftue vfHkdkjdk dk mRiknk e ifjofrr dju d fy, Å"ek] idk'k ;k fo|r d :i e Åtk dh vko';drk gkrh g] Å"ek'kk"kh vfHkfØ;k, dgr gA

10-5 jklk;fud lehdj.k dk vf/kd lpukRed cukuk

fofHkUu idkj dh jklk;fud vfHkfØ;kvk d jklk;fud lehdj.k e vfHkdkjdk vkj mRiknk dh fuEufyf[kr fo'k"krkvk dk n'kkdj ml vf/kd lpukRed cuk;k tk ldrk g] ; bl idkj g&

1- Hkkfrd voLFkk 2- Å"ek e ifjoru 3- xl dk fudyuk

4- vo{ki.k gkuk 5- fofHkUu ifjfLFkfr;k

1- Hkkfrd voLFkk dk vfHk0;Dr djuk& jklk;fud lehdj.k dk vf/kd lpukRed cuku d fy, inkFkk dh Hkkfrd voLFkk dk mud l=k d lkFk vfHk0;Dr fd;k tk ldrk g tl& xl] no] Bkl rFkk tyh; foy;u dk Øe'k% (g), (l), (s) rFkk (aq) l n'kk;k tkrk gA vc lrfyr lehdj.k ¼35½ bl idkj gkxk&

$$2Pb(NO_3)_2(s) \xrightarrow{rki} 2PbO(s) + 4NO_2(g) + O_2(g) \quad \text{..... (37)}$$

2- Å"ek e ifjoru dk vfHk0;Dr djuk& Å"ek{kih fØ;k e Å"ek mRiUu gkrh g vkj Å"ek'kk"kh vfHkfØ;k e Å"ek vo'kkf"kr gkrh gA uhp fn, x, mnkgj.kk dk nf[k,A

$$C(s) + O_2(g) \longrightarrow CO_2(g) + Q \text{ Å"ek{kih vfHkfØ;k} \quad \text{..... (38)}$$

$$N_2(g) + O_2(g) \longrightarrow 2NO(g) - Q \text{ Å"ek'kk"kh vfHkfØ;k} \quad \text{..... (39)}$$

Å"ek{kih vfHkfØ;kvk e mRiUu gb Å"ek dh ek=k (Q) dk mRiknk dh vkj ¼$½ fpà d lkFk vfHk0;Dr fd;k tkrk gA Å"ek'kk"kh vfHkfØ;kvk e vo'kkf"kr gb Å"ek dh ek=k dk ¼&½ fpà d lkFk vfHk0;Dr fd;k tkrk gA

3- xl d fudyu dk vfHk0;Dr djuk& ;fn vfHkfØ;k e dkb xl eDr gk jgh g rk bl Å/o rhj ¼↑½ fu'kku l vfHk0;Dr fd;k tkrk gA

$$Zn(s) + H_2SO_4(aq) \longrightarrow ZnSO_4(aq) + H_2\uparrow \quad \text{..... (40)}$$

4- vo{ki d cuu dk vfHk0;Dr djuk& ;fn fdlh jklk;fud vfHkfØ;k e dkb vo{ki cu jgk gk rk ml uhp dh vkj rhj ¼↓½ l vfHk0;Dr djr gA

$$AgNO_3(aq) + NaCl(aq) \longrightarrow AgCl\downarrow + NaNO_3(aq) \quad \text{..... (41)}$$

5- fofHkUu ifjfLFkfr;k dk vfHk0;Dr djuk& dHkh&dHkh jklk;fud vfHkfØ;kvk dh ifjfLFkfr;k tl& rki] nkc] mRijd vkfn dk Hkh rhj d fu'kku d Åij ;k uhp fy[kdj n'kk;k tkrk gA

$$6CO_2(g) + 6H_2O(l) \xrightarrow[Dykjkfqy]{l;\ idk'k} C_6H_{12}O_6(aq) + 6O_2(g) \quad \text{..... (42)}$$

$$2AgCl(s) \xrightarrow{l;\ idk'k} 2Ag(s) + Cl_2(g) \quad \text{..... (43)}$$

blh idkj vki bl v/;k; e fn, x, lHkh lehdj.kk dk vf/kd lpukRed cukdj vfHk0;Dr dhft,A

i'u

1- fuEufyf[kr vfHkfØ;k e vkDlhdr vkj vipf;r inkFkk dk igpkfu,&

¼v½ $2Na + O_2 \longrightarrow 2NaO$

¼c½ $CuO + H_2 \longrightarrow Cu + H_2O$

2- jklk;fud vfHkfØ;k e Å"ek dk xg.k djuk rFkk Å"ek dk eDr gkuk lehdj.k e fdl idkj n'kk;k tkrk g] mnkgj.k ndj le>kb,A

e[; 'kCn (Keywords)

vfHkdkjd (reactant)] mRikn (product)] l;ktu vfHkfØ;k (combination reaction)] fo;ktu (decomposition reaction)] foLFkkiu vfHkfØ;k (displacement reaction)] f}foLFkkiu vfHkfØ;k (double displacement reaction)] vkDlhdj.k (oxidation)] vip;u (reduction)] Å"ek{kih (exothermic)] Å"ek'kk"kh (endothermic)] vkDlhdj.k&vip;u (redox)

geu lh[kk

- jklk;fud ifjoru e ge'kk u;k inkFk curk gA
- jklk;fud lehdj.k] jklk;fud vfHkfØ;k dk n'kku dk ,d rjhdk gA
- ,d li.k jklk;fud lehdj.k vfHkdkjdk] mRiknk vkj mudh Hkkfrd voLFkk dk inf'kr djrk gA
- inkFk dh vfoukf'krk d fu;ekulkj jklk;fud lehdj.k dk lrfyr gkuk vko';d g ftle vfHkdkjdk rFkk mRiknk d lHkh ijek.kvk dh l[;k leku gkrh gA
- l;ktu vfHkfØ;k e nk ;k nk l vf/kd inkFk feydj ,dy mRikn cukr gA
- fo;ktu vfHkfØ;k] l;ktu vfHkfØ;k d foijhr gkrh gA fo;ktu vfHkfØ;k e ,dy inkFk fo;kftr gkdj nk ;k nk l vf/kd inkFk cukrk gA
- fdlh jklk;fud vfHkfØ;k e tc ,d rRo nlj rRo dk mld ;kfxd l foLFkkfir dj nrk g] foLFkkiu vfHkfØ;k dgykrh gA
- f}foLFkkiu vfHkfØ;k e vfHkdkjdk d chp vk;uk dk vknku&inku gkrk gA
- vkDlhtu dk tMuk ;k gkbMktu dk fudyuk ;k byDVku R;kxuk vkDlhdj.k dgykrk gA
- gkbMktu dk tMuk ;k vkDlhtu dk fudyuk ;k byDVku xg.k djuk vip;u dgykrk gA
- ftu vfHkfØ;kvk e mRikn d lkFk Å"ek dk mRltu gkrk g mUg Å"ek{kih vfHkfØ;k,a dgr gA
- ftu vfHkfØ;kvk e Å"ek dk vo'kk"k.k gkrk g] mUg Å"ek'kk"kh vfHkfØ;k,a dgr gA

UUV5TC

vH;kl

1- lgh fodYi pfu,

(i) gkbMkt tu vkj Dykjhu l gkbMkt tu Dykjkb M dk cuuk fuEufyf[kr e l dku lh fØ;k dk n'kkrk g&

¼v½ fo;kt tu ¼c½ foLFkkiu

¼l½ l;kt tu ¼n½ f}foLFkkiu

(ii) $Fe_2O_3 + 2Al \longrightarrow Al_2O_3 + 2Fe$

nh xb vfHkfØ;k fuEufyf[kr e l fdl dk mnkgj.k g&

¼v½ l;kt tu ¼c½ fo;kt tu

¼l½ foLFkkiu ¼n½ f}foLFkkiu

(iii) $2PbO(s) + C(s) \longrightarrow 2Pb(s) + CO_2(g)$ bl fØ;k d fy, dku lk dFku lgh g&

¼1½ yM dk vkDlhdj.k gk jgk g

¼2½ dkcu MkbvkDlkb M dk vkDlhdj.k gk jgk g

¼3½ dkcu dk dkcu MkbvkDlkb M e vkDlhdj.k gk jgk g

¼4½ yM vkDlkb M dk yM e vip;u gk jgk g

¼v½ 1 vkj 2 ¼c½ 3 vkj 4

¼l½ 2 vkj 3 ¼n½ lHkh

(iv) $NaCl(aq) + AgNO_3(aq) \longrightarrow AgCl\downarrow + NaNO_3(aq)$

fuEufyf[kr jklk;fud vfHkfØ;k n'kkrh g&

¼v½ foLFkkiu ¼c½ l;kt tu

¼l½ fo;kt tu ¼n½ f}foLFkkiu

2- fjDr LFkkuk dh ifr dhft,&

(i) jklk;fud lehdj.k e rhj d fu'kku d ckb vkj dk inkFk ---------- vkj nkb vkj dk inkFk ---------- dgykrk gA

(ii) $2H_2O \longrightarrow 2H_2 + O_2$ ---------- fØ;k dk mnkgj.k gA

(iii) vfHkdkjdk vkj mRikn d chp rhj dk fu'kku vfHkfØ;k dh ---------- dk n'kkrk gA

(iv) og jklk;fud vfHkfØ;k ftle u;k inkFk cuku d fy, Å"ek dk vo'kk"k.k gkrk g ---------- fØ;k dgykrh gA

3- jklk;fud lehdj.k D;k g\ bl lrfyr djuk D;k vko';d g\

4- fuEufyf[kr vfHkfØ;kvk d fy, lrfyr lehdj.k fyf[k,&

(i) ikVf'k;e èkkr ty d lkFk vfHkfØ;k djd ikVf'k;e gkbMkDlkbM ,o gkbMktu xl nrh gA

(ii) ukbVktu] gkbMktu l l;ktu djd vekfu;k cukrh gA

(iii) gkbMktu lYQkbM xl dk ok; e ngu gku ij ty ,o lYQj MkbvkDlkbM curh gA

(iv) ,Ykfefu;e lYQV d lkFk vfHkfØ;k dj cfj;e Dykjkb M] ,Ykfefu;e Dykjkb M dk foy;u ,o cfj;e lYQV dk vo{ki nrk gA

5- fuEufyf[kr jklk;fud lehdj.kk dk lrfyr dhft,&

(i) $C_3H_8 + O_2 \longrightarrow H_2O + CO_2$

(ii) $C_6H_{12}O_6 \longrightarrow C_2H_5OH + CO_2$

(iii) $Hg(NO_3)_2 + KI \longrightarrow HgI_2 + KNO_3$

(iv) $HNO_3 + Ca(OH)_2 \longrightarrow Ca(NO_3)_2 + H_2O$

6- fuEufyf[kr vfHkfØ;kvk d fy, lrfyr jklk;fud lehdj.k ,o vfHkfØ;k dk idkj crkb,&

(i) eXuhf'k;e $ vk;kMhu ⟶ eXuhf'k;e vk;kMkbM

(ii) eXuhf'k;e $ gkbMkDykfjd vEy ⟶ eXuhf'k;e Dykjkb M $ gkbMktu

(iii) ftd $ dkij ukbVV ⟶ ftd ukbVV $ dkij

(iv) lkfM;e gkbMktudkckuV ⟶ lkfM;e dkckuV $ dkcu MkbvkDlkbM $ ikuh

7- fo;ktu vfHkfØ;k dk l;ktu vfHkfØ;k d foijhr D;k dgk tkrk g\ bu nkuk vfHkfØ;kvk d fy, lehdj.k fyf[k,A

8- fo;ktu vfHkfØ;kvk dk ,d&,d lehdj.k fyf[k, ftue Å"ek] idk'k ,o fo|r d :i e Åtk inku dh tkrh gA

9- foLFkkiu ,o f}foLFkkiu vfHkfØ;k e D;k vrj g\ bu vfHkfØ;kvk d fy, lehdj.k fyf[k,A

10- vkDlhdj.k&vip;u ¼jMkDl½ vfHkfØ;kvk d nk&nk mnkgj.k fyf[k,A

11- l; d idk'k dh mifLFkfr e gku okyh jklk;fud vfHkfØ;k dk le>kb,A

12- vo{ki.k vfHkfØ;k l vki D;k le>r g\ mnkgj.k ndj le>kb,A

13- Å"ek{kih vkj Å"ek'kk"kh vfHkfØ;k dk mnkgj.k ndj le>kb,A

14- guhQ u eXuhf'k;e fjcu dk fLiV yi dh lgk;rk l tyk;k vkj ikIr voykdu d vk/kkj ij mlu dgk fd ;g l;ktu] Å"ek{kih vkj vkDlhdj.k vfHkfØ;k gA D;k vki bl dFku l lger g\ rd lfgr 0;k[;k dhft,A

vè;k;&11

x#Rokd"k.k

(Gravitation)

vki cy vkj xfr d vè;k; e ,lh cgr lh ?kVukvk l ifjfpr g, g tgk oLr iFoh dh vkj xfr djrh g tl ,d iRFkj dk iFoh dh lrg l Åij dh vkj Qdu ij okil lrg ij vk tkrk gA ckfj'k dh cnk l ydj l[kk iÙkk] èky d d.k] lc dN iFoh ij gh vk fxjr gA D;k vkiu dHkh lkpk fd oLr, iFoh ij D;k fxjrh g\

fdlh iRFkj dk Åpkb l fxjku ij iFoh dh lrg rd vkr&vkr mldk ox D;k c< tkrk g\

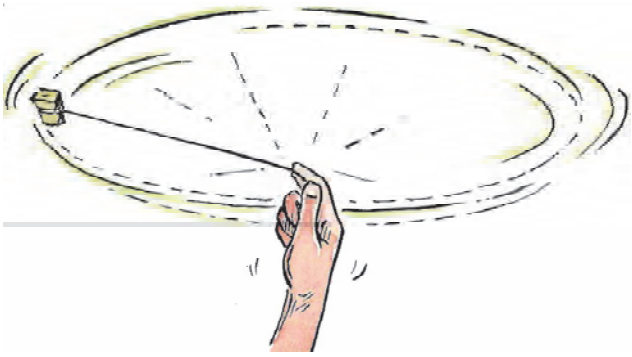
vkiu fiNyh d{kk e tkuk fd lkj eMy e iFoh tl db xg l; d pDdj yxkr g vkj pæek tl mixg] xgk d pDdj yxkr gA ,l fLFkfr e iFoh l; d Åij ;k pæek iFoh d Åij D;k ugh fxjrk\

fØ;kdyki&1

,d ydMh d xVd dk èkkx l ckfèk,A èkkx d ,d flj dk gkFk l idMdj xVd l cèk g, nlj flj dk NkM nhft,A D;k gvk\

fp= 1 e fn[kk, vulkj vc èkhj&èkhj xVd dk oRrkdkj ?kek,A ml rth l ?kek dj n[kA D;k vki viuh mxyh ij T;knk ruko egl l djr g\

;fn vki xVd dk rth l ?kekr g, èkkx dk NkM n ;k èkkxk VV tk, rk xVdk fdl rjQ tk,xk\ D;k èkkxk VVu d ckn Hkh xVdk oRrkdkj iFk e ?kerk jgxk\ D;k vki u xVd dh xfr d fn'kk d ckj e dN lkpk g\ vkil e ppk djA



fp= Øekd&1
iRFkj }kjk oÙkkdkj iFk e xfr

lkoèkkuh l ç;kx djd nf[k, rFkk irk yxk, fd ;fn ?keku dh xfr dk Ëkhj&èkhj de djr g rk D;k gkxk\

11-1 x#Rokd"k.k dh voèkkj.kk (Concept of Gravitation)

Åij d i;kx e vkiu n[kk fd rth l oÙkkdkj xfr e ?ke jg xVd dk /kkxk tkM j[krk g yfdu iFoh vkj pæek d chp e rk ,lk dkb etcr èkkxk ugh g] tk pæek dk ckËk dj j[kA fQj Hkh ,lk dku lk cy g ftld dkj.k pæek iFoh dk dæ e j[kdj fu;r ?ke jgk g\

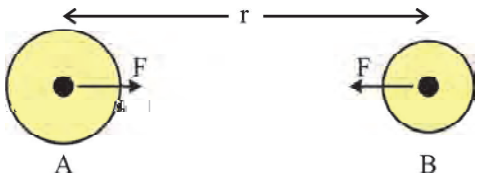
dkQh le; rd ykxk dk ;g ekuuk Fkk fd pæek vkj vU; oLrvk dk vkdf"kr djuk iFoh dk fo'k"k x.k g vkj blh d dkj.k pæek vkj vU; lHkh rkj iFoh d pkjk vkj ?ke jg gA fdr rkjk eMy rFkk xgk e fofHkUu voykduk d lkFk ;g ekU; rk ey ugh [kk jgh FkhA bu voykduk d vkèkkj ij cuh dkijfudl d lkj dfæd cãkM dh èkkj.kk ,o diyj d fu;ek d lkFk Hkh ;g ekU; rk Bhd ugh cB jgh FkhA mud vulkj vxj l; dn e g vkj xg mld pkjk vkj ?ke jg g dN ol gh t l iFoh d bn&fxn pnek dk ?keuk] rk ;g ekuuk gkxk fd t l iFoh pæek dk vkdf"kr djrh g mlh çdkj l; Hkh iFoh dk viuh vkj vkdf"kr djrk gA

bl lnHk e vkbtd U;Vu (Issac Newton) u vU; oKkfudk d dke dk le> dj rFkk lHkh voykduk dk n[kdj ;g fu"d"k fudkyk fd vkd"k.k cy doy iFoh] pæek vkj l; d chp e gh ugh cfYd l lkj dh gj NkVh cMh lHkh oLrvk d chp gkrk gA iRFkj] èky d.k] ikuh] xg] rkj bR;kfn iR;d oLr n0;eku (mass) d dkj.k gj nljh oLr ij vkd"k.k cy yxkr gA n0;eku d dkj.k vkdf"kr dju dk ;g x.k x#Rokd"k.k cy dgykrk gA

x#Rokd"k.k d lkof=d fu;e (Law of Universal Gravitation)

U;Vu d vulkj cãk.M dh **fdUgh nk oLrvk d chp yxu okyk vkd"k.k cy nkuk oLrvk d n0;eku ,o mud chp dh njh ij fuHkj djrk gA**

fp= 2 e fn[kk, vulkj eku y fd dkb nk fi.M A vkj B] r njh ij fLFkr gA ; ,d nlj dk F cy l vkdf"kr djr gA fi.M A vkj B dk n0;eku Øe'kh m_1 rFkk m_2 g] rk U;Vu d fu;e d vulkj mud chp yxu oky cy dk eku nkuk oLrvk d n0;eku d x.kuQy d vuØekuikrh gkrk gA



fp= Øekd&2 % fdUgh nk fi.Mk d chp x#Rokd"k.k cy

vFkkr] $F \alpha m_1 \times m_2$ .....(1)

,o nkuk oLrvk d chp yxu okyk cy mud chp dh njh d ox d 0;RØekuikrh gkrk gA

$$F \alpha \frac{1}{r^2} \quad \text{.....(2)}$$

leh- ¼1½ vkj ¼2½ l]

$$F \alpha \frac{m_1 \times m_2}{r^2} \quad \text{.....(3)}$$

$$F = G\frac{m_1 \times m_2}{r^2} \quad \text{.....(4)}$$

U;Vu d le; G dk eku irk ugh FkkA lu 1797 e dofM'k (Cavendish) u Kkr n0;eku dh nk oLrvk dk dN njh ij j[kdj mud chp d vkd"k.k cy dk vkdyu dj lehdj.k ¼4½ l G dk eku Kkr fd;kA

;gk G lkof=d x#Rokd"k.k fu;rkd gA SI i)fr e G dk eku $6.67\times10^{-11}\ Nm^2/kg^2$ gA

lkfp,] ;fn oLrvk d eè; dh njh nkxuh dj nh tk, rk cy dk eku D;k gkxk\ njh dk frxuk dj fn;k tk, rk cy dk eku D;k gkxk\ ge n[k ldr g fd njh c<u d lkFk&lkFk cy dk eku rth l de gkrk gA

- D;k vki crk ldr g fd G dk eku de ;k T;knk gku l gekj thou ij D;k çHkko iMxk\ ;fn x#Rokd"k.k cy ugh gkrk rk D;k gkrk\ viu lkfFk;k d lkFk leg e ppk djA

mnkgj.k&1 % l; dk n0;eku $2\times10^{30}\ kg$ rFkk iFoh dk n0;eku $6\times10^{24}\ kg$ gA ;fn iFoh rFkk l; d chp dh vkl r njh $1.5\times10^{11}\ m$ g rk l; }kjk iFoh ij yxk, x, cy dh x.kuk djA iFoh }kjk l; ij yxk, x, cy dk eku D;k gkxk\

gy % l; }kjk iFoh ij yxk;k x;k cy vkj iFoh }kjk l; ij yxk;k x;k cy cjkcj gA nkuk e l ,d dh x.kuk dju ij ge nljk cy Hkh Kkr gk tk,xkA

lehdj.k ¼4½ d vulkj iFoh ,o l; d chp ,d nlj ij yxk, x, cy]

$$F=G\frac{m_e\times m_s}{r^2}$$

;gk m_e = iFoh dk n0;eku $=6\times10^{24}\ kg$, m_s = l; dk n0;eku $=2\times10^{30}\ kg$, r = iFoh rFkk l; d chp dh vkl r njh $=1.5\times10^{11}\ m$, $G=6.67\times10^{-11}\ Nm^2/kg^2$

vr %

$$F=\frac{6.67\times10^{-11}\times6\times10^{24}\times2\times10^{30}}{(1.5\times10^{11})^2}\ N$$

$$F=\frac{6.67\times6\times2\times10^{-11}\times10^{24}\times10^{30}}{\left(1.5\times10^{11}\right)^2}\ N$$

$$=\frac{6.67\times6\times2\times10^{-11+24+30-22}}{1.5^2}\ N$$

$$=\frac{6.67\times6\times2}{1.5^2}\times10^{21}\ N=35.57\times10^{21}N$$

vr% l; ,o iFoh ,d nlj dk $35.57\times10^{21}N$ cy l vkdf"kr djr gA

fØ;kdyki&2

vki viu rFkk viu l 1 ehVj nj cB viu fe= d chp yxu oky x#Rokd"k.k cy d eku dk vfHkdyu dhft,A crkb, D;k vki bl cy dk vuHko dj ikr g\ ;fn ugh rk D;k\

11.2 x#Roh; Roj.k 'g' (Gravitational acceleration 'g')

xfr d vè;k; e vkiu tkuk fd cy d dkj.k fdlh oLr e Roj.k mRiUu gkrk gA **fdlh oLr dk tc iFoh x#Rokd"k.k cy l vkdf"kr djrh g rc ml oLr e Hkh Roj.k mRiUu gkrk gA iFoh d x#Rokd"k.k cy d dkj.k oLr e mRiUu Roj.k dk x#Roh; Roj.k dgr gA x#Roh; Roj.k dk 'g' l n'kkr gA**

lehdj.k 4 ,o U;Vu d xfr d f}rh; fu;e dh lgk;rk l ge 'g' dk eku fudky ldr gA eku y fd iFoh d lrg ij ,d 'm' æ0;eku dh oLr gA iFoh ml oLr d Åij F cy yxk jgh gA lehdj.k ¼4½ l]

$$F = G\frac{Mm}{R^2} \quad .....(5)$$

M = iFoh dk æ0;eku] R = iFoh d dæ l lrg dh njh] m = oLr dk n0;eku gA

bl oLr e x#Rokd"k.k cy fdruk Roj.k mRiUu djxk\

U;Vu d xfr d f}rh; fu;e vulkj] ;fn ;g Roj.k 'g' g rk

$$F = mg \quad .....(6)$$

lehdj.k ¼5½ ,o ¼6½ dk ,d lkFk fy[ku ij

$$mg = G\frac{Mm}{R^2}$$

$$g = G\frac{M}{R^2} \quad .....(7)$$

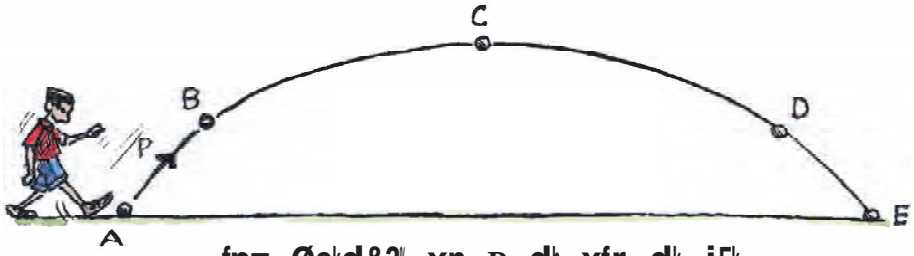
lehdj.k ¼7½ dh lgk;rk l ge 'g' d eku dh x.kuk dj ldr gA iFoh dk æ0;eku $M = 6 \times 10^{24}$ kg vkj f=T;k $R = 6.4 \times 10^6$ mA

x.kuk dju ij 'g' dk eku 9.81 m/s^2 d yxHkx gA bl vè;k; e lHkh xf.krh; lokyk dk gy dju d fy, lfoèkk d fy, ge 'g' d eku dk 10 ms^{-2} yxA D;k 'g' dk eku lHkh LFkku ij ,d gh g\ D;k 'g' dk eku oLr d æ0;eku] vk;ru] vkdkj] oLr dh ç—fr] ?kuRo] iFoh d Åij dh voLFkk vkj iFoh d dæ l njh ij fuHkj djxk\ bue l dku l dkjd egRoi.k g\

D;k iFoh d èko vkj Hke/; j[kk ij 'g' dk eku leku g\ dgk ij ;g eku vfèkd gkxk\ viu lkfFk;k l ppk dj\

11.3 eDr iru (Free fall)

fp= 3 e fn[kk, vulkj ,d ckyd xn dk iFoh l Åij fdd djrk gA xn dk Åij tku l ydj uhp vku rd dk iFk ABCDE }kjk fn[kk;k x;k g ft le A xn dh ikjfHkd fLFkfr] C xn dh vfèkdre Åpkb rFkk E xn dh vfre fLFkfr gA



fp= Øekd&3% xn P dh xfr dk iFk

- D;k vki crk ldr g fd B, C, D ,o E voLFkkvk ij P d Åij dku dku l cy fØ;k'khy g\
- D;k x#Rokd"k.k cy d vykok oLr P ij dkb vU; cy Hkh fØ;k'khy g tk oLr dk xfr'khy dju d fy, ç;kx e vk;k g\
- D;k oLr dk ij l fdd dju d ckn Hkh og cy fØ;k'khy gkrk g\ ;fn gk rk fdru le; rd fØ;k'khy jgxk\
- bl fØ;k'khy cy d dkj.k oLr e fdruk Roj.k mRiUu gkxk\ ;fn bl iFk ij oLr P ij flQ iFoh }kjk yxk;k x;k x#Rokd"k.k cy fØ;k'khy g vkj ;g cy iFoh d dæ dh vkj fØ;k'khy g] ,l e oLr dl Åij dh vkj tk jgh g\ ; lHkh i'u LokHkkfod gA

,lk vDlj lkpk tkrk g fd ;fn oLr e xfr g rk ml ij t:j xfr dh fn'kk e cy yx jgk gkxkA exj ,lk ge'kk ugh gkrkA vkiu cy ,o xfr d fu;e d vË;k; e n[kk fd t:jh ugh g fd ;fn oLr xfr dj jgh g rk ml ij dkb cy fØ;k dj jgk gkA ge u xfr d f}rh; fu;e l ;g Hkh n[kk g fd oLr d Åij fØ;k'khy cy] lox d ifjoru d nj d vuØekuikrh gkrk gA fdUr ;g vko';d ugh g fd og lox dh fn'kk e gkA ;fn og lox dh fn'kk d foijhr g rk og lox dk ?kVk,xkA

okLro e pyrh gb gj oLr dh xfr d foijhr ok; cy yxkrh gA exj ;g cy cgr de gkrk g vkj lgtrk d fy, ok; }kjk yxk, x, cy dk ge vfèkdk'krk utjvnkt dj nr gA

ge tc fdlh oLr ij cy yxk dj ml Åij dh vkj Qdr g rk ge oLr dk ikjfEHkd xfr nr gA bl ikjfEHkd xfr rFkk lox d fy, cy pkfg,A 'k: e Qdr le; ge cy yxkr g] ij loky ;g g fd tc oLr gkFk l fudy tkrh g] rc D;k gkFk l fn;k gvk cy oLr ij vc Hkh fØ;k dj jgk gkxk\

xfr d çFke fu;e d vulkj cy yxku ij oLr e xfr dk lpkj gkrk g vkj fQj tMRo d dkj.k oLr Åij dh fn'kk e pyrh jgrh gA gkFk l fudyu d ckn oLr ij flQ x#Rokd"k.k cy gh fØ;k'khy gkrk gA bldk vFk ;g gvk dh oLr e tk Roj.k gkxk og flQ x#Rokd"k.k cy d dkj.k gh gkxkA

oLr dh xfr dh ftl&ftl fLFkfr e oLr ij flQ x#Rokd"k.k cy fØ;k'khy gk] ml fLFkfr dk Lor= :i l uhp fxjuk ;k eDr iru dgk tkrk gA D;k vki ,lh dN vkj ifjfLFkfr;k d ckj e lkp ldr g tgk oLr eä iru dh voLFkk e gkrh g\ leg e ppk djA

vkiu xfr d vè;k; e oLr dh xfr d lehdj.kk d ckj e i<k gA mu lehdj.kk e Roj.k ‘a’ d LFkku ij 'g' fy[kdj ge ;g crkr g fd ;g Roj.k x#Rokd"k.k cy d dkj.k gA

x#Roh; Roj.k e xfr d lehdj.k

1- $v = u + gt$

2- $h = ut + \frac{1}{2} gt^2$

3- $v^2 = u^2 + 2gh$, ¼h = oLr dh iFoh d ry l Åpkb½

ge dN mnkgj.k ydj bl le>u dh dkf'k'k djxA eku y fd vki nk vyx&vyx æ0;eku dh oLrvk A ,o B dk 100 m Åij l fLFkjkoLFkk l NkMr gA A ,o B d æ0;eku Øe'k% 2 kg vkj 10 kg gA 10 m njh r; dju d ckn nkuk d pky dk eku D;k gkxk\ vxy 10 m d ckn e pky D;k gkxh\ bud pky dh x.kuk djd rkfydk 1 dh ifr djA

lkj.kh Øekd&1 eDr iru e oLrvk dh fLFkfr] le; ,o pky

r; dh xb njh ¼m e½	oLr A dh pky (m/s)	oLr B dh pky (m/s)	oLr A dk njh r; dju e yxk le; (s)	oLr B dk njh r; dju e yxk le; (s)
0				
10			$\sqrt{2}$	
20	20 ¼yxHkx½			

100		$20\sqrt{5}$		$2\sqrt{5}$

bl lkj.kh d vkèkkj ij fLFkfr vkj le; d chp] pky vkj le; d chp rFkk fLFkfr vkj pky d chp xkQ [khfp,A

D;k oLr d n0;eku dk mldh pky ij dkb iHkko gkrk g\

mnkgj.k&2 % 20 m Åph ehukj dh pkVh l ,d iRFkj NkMk tkrk gA iFoh dh lrg ij igpu l igy mldk ox D;k gkxk\ iRFkj d iFoh ij igpu e yx le; dh x.kuk dhft,A 'g' dk eku $10 m/s^2$ fy;k tk,A

gy % ehukj dh Åpkb] $h = 20$ m

iRFkj dk çkjfEHkd ox] $u = 0$

$g = 10 m/s^2$

$s = ut + \frac{1}{2} gt^2$

$$20 = 0 \times t + \frac{1}{2} 10t^2$$

$5t^2 = 20$

$t^2 = 4$

$t = 2s$

vr% oLrq dk iFoh ij igpu e yxk le; 2 ld.M gA

(ii) iRFkj dk ox&

$v = u + gt$

$= u + 10 \times 2$ m/s $(u=0)$

$= 20$ m/s

vr% iFoh ij igpu l igy iRFkj dh pky] 20m/s gA

mnkgj.k&3 % Åèokèkj fn'kk e Åij dh vkj Qdh xb ,d xn 6 s e Qdu oky d ikl ykV vkrh gA crkvk&

1- xn fdl ox l Åij Qdh xb\

2- xn dh vfèkdre Åpkb D;k Fkh\

3- 4 ldM i'pkr xn dh fLFkfrA

gy %

1- xn dk çkjfEHkd ox] $u = ?$

xn dk vfre ox] $v = 0$ m/s

xn dk Åij tku e yxk le; $t = 3$ s

oLr iFke 3 sec e Åij tk,xh fQj vxy 3 sec e uhp vk,xh

vr% xn dk ijh njh r; dju d fy, yxk le; $= 3s + 3s = 6s$

xn dk ox

$v = u - gt$

$0 = u - 10 \times 3$ m/s ½x#Rokd"k.k cy d foijhr fn'kk e xfr d dkj.k _.k fy;k x;k½

$u = +30$m/s

2- xn dh vfèkdre Åpkb

$$s = ut - \frac{1}{2} g t^2$$

$= 30 \times 3 - \frac{1}{2} \times 10 \times 3^2 \text{ m}$

$= 90 - 45 \text{ m}$

$= 45 \text{ m}$

3- okil vkr le; 1 sec e oLr }kjk r; dh xb njh

$s = ut + \frac{1}{2} gt^2$

$= 0 + \frac{1}{2} \times 10 \times 1^2 \text{m}$

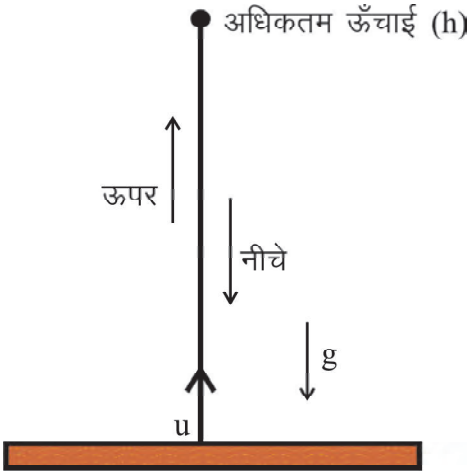
$= 5 \text{ m}$

vr% 4 sec i'pkr xn dh fLFkfr 45 m – 5 m = 40 m

i'u %

1- fdlh Hkh 'm' æ0;eku dh oLr dk iFoh dh lrg ij 'h' Åpkb l fLFkj voLFkk l fxjkr g] rk lrg ij igpu d Bhd io mldk ox D;k gkxk\

2- ,d xn dk fp=&4 e fn[kk, vulkj ÅËokèkj Åij dh vkj 5 m/s pky l Qd,A xn fdruh Åpkb r; djxh vkj fdru le; ckn iu% vkid gkFk e ykVdj vk,xh\ xn dh fdl voLFkk e pky lc l de gkxh vkj mldk eku D;k gkxk\



fp= Øekd&4 % xn dh xfr

11-4 æ0;eku ,o Hkkj (Mass and weight)

vki tkur g fd tMRo n0;eku ij fuHkj djrk gA **fdlh oLr e inkFk dh dy ek=k dk ge oLr dk n0;eku dgr gA** fdlh oLr e ;fn inkFk d dy ifjek.k e dkb ifjoru ugh fd;k x;k rk fdlh Hkh LFkku ij ml oLr dk n0;eku fLFkj jgxkA ge vDlj oLr dk n0;eku e ekir g] tl 2 kg pkoy] 1 kg nky] 3 kg 'kDdj vkfnA ;fn ge 2 kg n0;eku pkoy dk èkjrh l pæek ij ydj tk, rk pkoy dk n0;eku pæek ij Hkh 2 kg gh gkxkA SI i)fr e n0;eku dk ek=d fdykxke (kg) gA

fdlh oLr dk èkjrh ftl cy l viuh vkj vkdf"kr djrh g ml oLr dk Hkkj dgr gA SI i)fr e Hkkj dk ek=d U;Vu (newton) gA

lehdj.k ¼6½ l ge tkur g fd iFoh dh fdlh fuf'pr lrg ij 'm' kg n0;eku dh ,d oLr ij iFoh mg cy yxkrh gA vFkkr 'm' kg n0;eku dh oLr dk Hkkj iFoh dh ml fuf'pr lrg ij mg gA vkidk

D;k yxrk g fd iFoh dh lHkh lrg ij oLr dk Hkkj mruk gh g\ D;k fdlh oLr dk Hkkj iFoh] pæek vkj ljt dh lrg ij fLFkj jgxk\

i'u %

1- चंद्रमा का द्रव्यमान $M_{moon} = 7 \times 10^{22}$ kg] ,o f=T;k $R_{moon} = 1700$ km gA lehdj.k 7 dh lgk;rk l pæek dh lrg ij fdlh 'm' n0;eku dh oLr ij Roj.k dk eku Kkr djA ¼f=T;k dk ehVj e y½

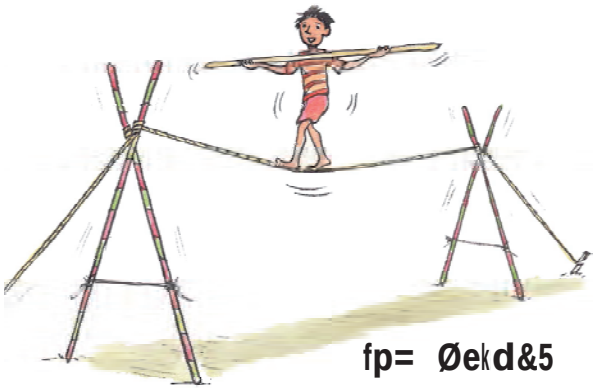
2- iFoh ,o pæek dh lrg ij 'm' n0;eku dh oLr d Hkkj dh ryuk djA

3- iFoh vkj pæek d dUæk d chp dh njh 3.84×10^5 km gA iFoh vkj pæek ,d nlj ij fdruk cy yxk,x\

fØ;kdyki&3

viuh d{kk d rhu nkLrk dk æ0;eku irk dhft ,A mu rhuk nkLrk ij iFoh }kjk yxu oky cy dh x.kuk rFkk ryuk dhft ,A pæek ij bu rhuk d Åij yxu oky cy e D;k ifjoru gkxk\

11-5 x#Roh; dn (Centre of gravity)



fp= Øekd&5

vkiu dHkh eyk e ;k viu ?kj d vkl&ikl fdlh cPp ;k cM 0;fDr dk ,d ekVh jLlh ij pyr n[kk gkxkA og viuk lryu ml jLlh ij dl cuk ikrk g\

jLlh ij pyr le; og viu nkuk gkFkk dk Qyk nrk g ;k dHkh&dHkh ,d lhèkh yEch ydMh dk lgkjk yrk gA D;k vkiu dHkh lkpk g fd og ,lk D;k djrk g\

fØ;kdyki&4

D;k vki fcuk >d mB ldr g

,d dlh ij fp= Øekd&6 e fn[kk, vulkj vkjke l cfB,A ml dlh l fcuk viu ij ekM mBu dk i;kl dhft ,A

- D;k ge ,lk dj ldr g\ ;fn ugh rk D;k\

fp= Øekd&6

fØ;kdyki&5

fdlh ckl dh yEch ydMh dk viuh gFkyh ij lrfyr dju dk i;kl dhft ,A

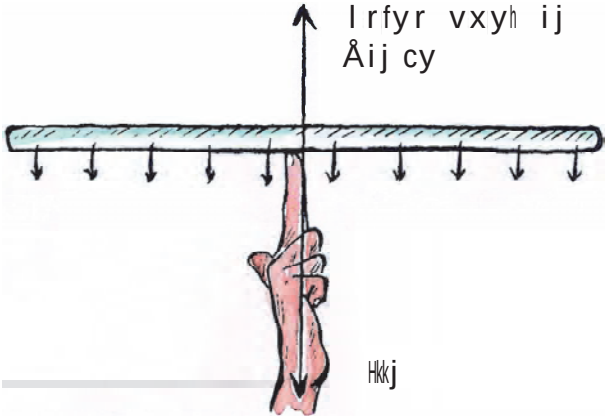
;g fdl fLFkfr e lHko gk jgk g\

Hkkj forj.k dh vkIr ;k lrfyr fLFkfr dk x#Roh; dn dgk tkrk gA og fcn tgk ij oLr dk dy Hkkj dfUnr gkrk gvk irhr gkrk g] x#Roh; dn dgykrk gA

fØ;kdyki&6

x#Roh; dn Kkr djuk

,d ehVj iekuk yhft,A viuh ,d vxyh ij bl fofHkUu fcnvk l bl lrfyr dju dk i;kl dhft,A vki D;k n[kr g\ D;k ieku d eè; fcn l ml lrfyr fd;k tk ldrk g\ ,lk D;k gvk\



fp= Øekd&7

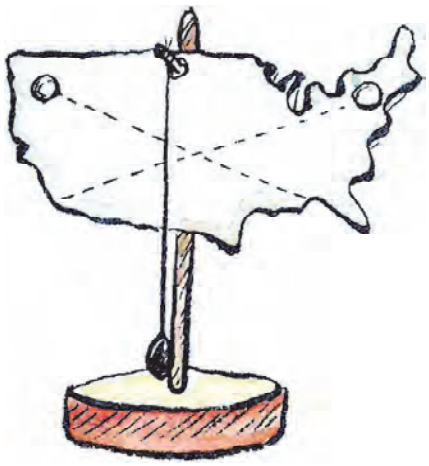
,d fu;fer vkdkj dh oLr tl ehVj ieku dk x#Roh; dn mld e/; fcn ij gkrk gA ml ieku dk li.k Hkkj ml fcn ij dfnr ekuk tk ldrk gA ml ,d fcn ij vkèkkj nu d dkj.k li.k ieku dk vkèkkj ikIr gkrk gA

fdlh oLr dk lrfyr dj mldk x#Roh; dn vklkuh l Kkr fd;k tk ldrk gA ehVj ieku d lkFk&lkFk db NkV rhj x#Roh; cy dk ifrfufèkRo djr gA bu lHkh dk ;kx x#Roh; dn ij ifj.kkeh cy gkxkA

ieku dk li.k Hkkj ml ,d fcn ij dfnr ekuk tk ldrk gA vr% bl fcn l xtjk gvk ,dy cy Åijh fn'kk e vkjkfir dju ij iekuk lrfyr fd;k tk ldrk gA

- fdlh oLr dk x#Roh; dn dl Kkr fd;k tk ldrk g\

Lor=rkiod yVdrh ¼fuyfcr½ oLr dk x#Ro dn fuycu fcn d Bhd uhp jgrk gA



fp= Øekd&8

;fn fuycu fcn l xtjrh gb ,d Åèokèkj j[kk [khph tk, rk ml j[kk d lkFk&lkFk dgh ij x#Roh; dn gkxkA mldh lgh fLFkfr tkuu d fy, ml oLr dk fdlh vU; fcn l fuyfcr dhft, rFkk nljh Åèokèkj j[kk ml fuycu fcn l [khfp,A bu nk j[kkvk dk ifrPNn fcn gh x#Roh; dn gA

blh idkj jLlh ij pyu oky 0;fDr dk x#Roh; dUn Hkh Bhd mld chp e gkrk gA lhèkh yEch ydMh dk lgkjk ydj og viu x#Roh; dUn dk uhp dh vkj ¼?kVu ;k ij ij½ dfUnr dju dk i;kl djrk g ftll og vklkuh l ml jLlh ij py ikrk gA

fØ;kdyki&7

,d oy; d x#Roh; dn dk Kkr djuk

nh xb fofèk e le>k;k x;k g fd dl x#Roh; dn ikIr fd;k tkrk gA blh d vkèkkj ij oy; dk x#Roh; dn Hkh Kkr fd;k tk ldrk gA

- ,d oy; dk x#Roh; dn dgk gkrk g\
- D;k fdlh oLr dk x#Roh; dn mld ckgj gk ldrk g\
- tgk oLr dk dkb n0;eku ugh g] D;k ogk ij x#Roh; dn gk ldrk g\

fLFkjrk

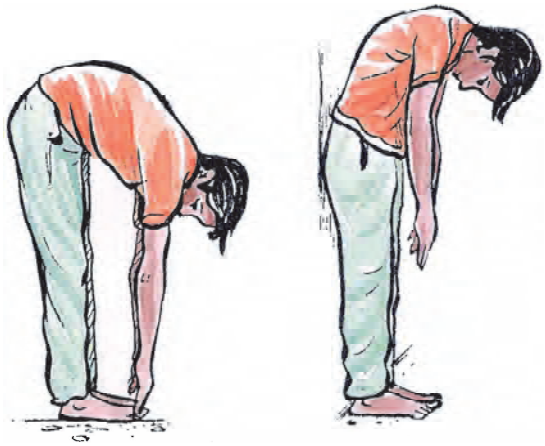
fLFkjrk d fy, x#Roh; dn dh txg Kkr djuk vko';d gA fdlh Hkh vkdkj dh oLr d x#Roh; dn l ,d j[kk uhp dh vkj [khfp, ;fn og oLr d vkèkkj d vrxr g rk oLr fLFkj jgxhA

;fn x#Roh; dn oLr d vkèkkj d ckgj gkrk g rk oLr vfLFkj gkrh gA

fØ;kdyki&8

x#Roh; dn dk ifjoru vkj mldk iHkko

tc vki lhèk [kM gkr g rk vkidk x#Ro dn dgk gkrk g\



¼v½ ¼c½

fp= Øekd&9

vxB dk Nu dk i;kl dhft,A nhokj d lkFk [kM jgdj bl iuh nkgjkb, tlk fd fp= Øekd&9 ¼c½ e n'kk;k x;k gA

- fp= Øekd&9 ¼c½ e n'kkb fLFkfr e D;k vki viu ij d vxB dk N ldr g\ ;fn ugh rk D;k\
- bu nkuk fLFkfr;k e vki viu 'kjhj d x#Ro dn e D;k ifjoru n[kr g\

lkfp, %

- ,d xky vkj ,d f=Hkktkdkj iVy dk x#Roh; dn dgk gkrk g\
- D;k fdlh oLr dk ,d l vfèkd x#Roh; dn gk ldrk g\
- ihlk dh >dh ehukj fxjrh D;k ugh g\
- viuh ihB ij Hkkjh otu mBkr le; vkidk lkeu D;k >duk iMrk g\

geu lh[kk

- cãkM dh lHkh oLr, n0;eku d dkj.k ,d nlj ij vkd"k.k cy yxkrh gA n0;eku d dkj.k vkdf"kr dju dk ;g x.k x#Rokd"k.k cy dgykrk gA ¼;g dUnhdr cy gA½
- lkof=d x#Rokd"k.k fu;rkd dk G l n'kk;k tkrk gA G dk eku $6.67 \times 10^{-11}\ \mathrm{Nm^2/kg^2}$
- x#Roh; Roj.k] g dk eku $9.81\ \mathrm{m/s^2}$ ekuk tkrk gA
- iFoh ij eä iru'khy oLr 'g' Roj.k l xfr'khy gkrh gA
- oLr dk n0;eku ,d fLFkj jkf'k gA exj fdlh oLr dk Hkkj oLr d Åij fØ;k'khy x#Roh; Roj.k ij fuHkj gA

e[; 'kCn (Keywords)

x#Rokd"k.k (gravitation)] lkof=d x#Rokd"k.k fu;rkd (universal gravitational constant)] x#Roh; Roj.k (gravitational acceleration)] æ0;eku (mass)] Hkkj (weight)] f=T;k (radius)] eDriru (freefall)] x#Roh; dn (centre of gravity)

vH;kl

1- cgfodYih; ç'u %&

(i) nk oLrvk d e/; yx jgk x#Rokd"k.k cy fuHkj ugh djrk&

¼v½ nkuk oLrvk d e/; dh njh ij

¼c½ nkuk oLrvk d n0;eku d x.kuQy ij

¼l½ nkuk oLrvk d n0;eku d ;kx ij

¼n½ x#Rokd"k.k fu;rkd ij

(ii) G dk eku g &

¼v½ $7.67 \times 10^{11} Nm^2/kg^2$ ¼c½ $6.67 \times 10^{11} Nm^2/kg$

¼l½ $6.67 \times 10^{-11} Nm^2/kg^2$ ¼n½ $5.67 \times 10^{11} Nm^2/kg^2$

(iii) iFoh dh lrg ij x#Roh; Roj.k dk eku gkrk g&

¼v½ $9.8\ m/s^2$ ¼c½ $8.8\ m/s^2$

¼l½ $4.8\ m/s^2$ ¼n½ $8.9\ m/s^2$

(iv) lkof=d x#Rokd"k.k fu;e l nk fi.Mk ftudk n0;eku m_1 vkj m_2 g vkj ftud chp dh njh R g d eè; yxu okyk cy cjkcj g&

¼v½ $F = G\frac{m_1 m_2}{R^2}$ ¼c½ $F = G\frac{m_1 m_2}{R^4}$

¼l½ $F = Gm_1 m_2/R$ ¼n½ $F = G\frac{M}{R}$

(v) x#Roh; cy d fo#) Åij dh vkj xfr dj jgh oLr dk mldh vfèkdre Åpkb ij vfre ox D;k gkxk\

¼v½ 0 ¼c½ $u^2/2g$

¼l½ h/t ¼n½ 2gh

2- fjä LFkku dh ifr dhft, &

(i) 10 kg n0;eku dh oLr dk iFoh ij Hkkj ---------- gkxkA

(ii) fojke voLFkk l eDr :i l iFoh dh vkj h Åpkb l fxjrh gb oLr dk ox ---------- gkxkA

(iii) lkof=d x#Rokd"k.k fu;rkd dk eku ---------- gkrk gA

(iv) x#Roh; Roj.k 'g' dk SI i)fr e ek=d ---------- gA

(v) nk fHkUu&fHkUu æ0;eku dh oLr, ;fn leku Åpkb l fxjkb tk, rk o ---------- le; e iFoh dh lrg ij igpxhA

3 iFoh rFkk mldh lrg ij j[kh fdl h 1 kg dh oLr d chp x#Roh; cy dk ifjek.k D;k gkxk\ ;gk iFoh dk n0;eku = 6×10^{24} kg vkj iFoh d dn l mldh lrg dh njh = 6400 km gA

4- nk oLrvk d chp yxu oky x#Rokd"k.k cy dk eku D;k gkxk ;fn&

(i) ,d oLr dk n0;eku nk xuk dj fn;k tk,A

(ii) oLrvk d chp dh njh rhu xuk dj nh tk,A

(iii) nkuk oLrvk d n0;eku nk xuk dj fn;k tk,A

5- ,d dkxt dh 'khV mlh idkj dh 'khV dk ekMdj cukb xb xn l èkheh D;k fxjrh g\

6- x#Rokd"k.k d lkof=d fu;e dk D;k egRo g\

7- ;fn pnek iFoh dk vkdf"kr djrk g] rk iFoh pnek dh vkj xfr D;k ugh djrh\

8- ,d xn mèokèkj fn'kk dh vkj 49 m/s d ox l Qdh tkrh gA ifjdyu dhft,&

(i) xn dh vfèkdre Åpkb

(ii) iFoh dh lrg rd okil ykVu e xn dk yxk dy le;A

9- fdlh oLr dk ;fn 10 m/s dh ox l Åèokèkj Qdk tk, rk og fdru le; i'pkr vkj fdru ox l okil vk;xh\ ½2 s, 10 m/s d½

10- nk oLrvk d chp yxu okyk x#Rokd"k.k cy F gA fdu&fdu ifjfLFkfr;k e nkuk oLrvk d chp yxu okyk x#Rokd"k.k cy 4F gkxk\

11- nk fofHkUu n0;eku okyh oLr, ,d lkFk iFoh ij D;k igprh g\ D;k nkuk oLrvk ij yxu okyk x#Rokd"k.k cy cjkcj g\

12- m n0;eku dh oLr e iFoh }kjk mRiUu Roj.k dk l=0;RiUu dhft, rFkk bld eku dh x.kuk djkA

UHPC5V

vè;k;&12

dk; ,o Åtk

(Work and Energy)

fiNy vè;k;k e ge foKku dh dN e[; voèkkj.kkvk t l& oLrvk dh xfr] cy d dkj.k xfr] xfr d fu;ek rFkk x#Rokd"k.k d ckj e ppk dj pd gA dk; ,o Åtk Hkh foKku dh egRoi.k voèkkj.kk, g tk ge vud ikdfrd ?kVukvk dk le>u vkj mudh 0;k[;k dju e enn djrh gA bl vè;k; e ge budk vè;;u djxA

ge viu nfud thou e ^dk;* rFkk ^Åtk* 'kCn dk i;kx vud lnHkk e djr gA t l og [kr e dk; djrk g] og cgr Åtkoku 0;fDr g vkfnA fdlh Hkh dk; dk dju d fy, Åtk dh vko';drk gkrh gA eu"; ,o e'khu Hkh dk; dju d fy, Åtk dk mi;kx djr g] t l& fo|kFkh ?kj l fo|ky; rd igpu d fy, lkbfdy pyku ;k iny pyu e viuh Åtk dk mi;kx djrk gA blh idkj fo|r cYc jk'kuh nu d fy, fo|r Åtk dk mi;kx djrk gA

lkp

- mi;kx e yh xb Åtk dgk tkrh g\
- D;k Åtk d mi;kx fd, fcuk dk; fd;k tk ldrk g\

bl vè;k; e ge bu i'uk dk le>u dk i;kl djxA

12-1 dk;

nfud thou e lkekU;r;k fdlh Hkh ykHknk;d 'kkjhfjd ,o ekufld ifjJe dk dk; le>k tkrk gA t l& fo|kFkh ijh{kk d le; vè;;u e cgr le; 0;rhr djrk gA iLrd i<rk g] i'u i=k dk gy djrk g] d{kk e fopkj&foe'k djrk gA lkekU; Hkk"kk e og dBkj ifjJe ;kfu dk; djrk gA blh idkj fdlh Hkh xhr dk xuxukuk] fe=k l ckrphr djuk] fo|ky; d fy, dk; ;ktuk cukuk] lkp&fopkj djuk vkfn lHkh dk dk; le>k tkrk gA

UHY87I

fdUr foKku e Hkkfrd dk; dh ifjHkk"kk vyx gkrh gA

foKku e dk; dju d fy, nk n'kkvk dk gkuk vko';d g&

- oLr ij dkb cy yxuk pkfg,A
- oLr foLFkkfir gkuh pkfg, ;k oLr dh fLFkfr e ifjoru gkuk pkfg,A

fp= Øekd&1

Hkkfrd dk; rHkh gkxk tc cy dh mifLFkfr e oLr e foLFkkiu gkA vU; lHkh dk; Hkkfrd dk; ugh gA blh idkj 0;fDr dk Åtkoku gkuk o fo|r Åtk vFkok Å"ek ;k xfrt Åtk vyx voèkkj.kk, gA bl vè;k; e ge Hkkfrd dk; o Hkkfrd Åtk dk vË;;u djxA

Hkkfrd dk; d mnkgj.k

,d iLrd dk mBk,] bld fy, vkidk cy yxkuk iMrk g vkj iLrd Åij dh vkj foLFkkfir gkrh g] blfy, ;g foKku e dk; ekuk tk,xkA iLrd Åij mBku e yxk cy x#Rokd"k.k cy d fo:) dk; djrk g o iLrd dh xfr e ifjoru gkrk gA

fp= Øekd&2

vkb,] nfud thou d mu mnkgj.kk ij fopkj djr g ftUg ge lkekU; Hkk"kk e dk; dgr gA fo|kFkh ijh{kk d le; dBkj dk; djrk gA pfd dk; dh oKkfud voèkkj.kk d vulkj ;gk cy ,o foLFkkiu dh n'kk, ugh gkrh gA vr% foKku e fo|kFkh d bl dBkj ifjJe dk dk; ugh dgk tk,xkA

blh idkj xhrk dk xuxukuk] fopkj&foe'k djuk vkfn Hkh foKku dh nf"V e dk; ugh gA mnkgj.k d fy, ;fn vki ,d dlh dk 10 feuV rd mBkdj j[k rk D;k vkiu dk; fd;k gkxk\ 'kk;n vkidh Fkdku l vkidk yx fd vkiu cgr dk; fd;k g ijUr Hkkfrd dk; dh ifjHkk"kk d vulkj dlh dk mBk, j[ku e vkiu dlh ij dkb dk; ugh fd;kA ;|fi dlh dk mBk, j[ku d fy, vkiu cy yxk;k ij dlh e foLFkkiu ugh gvkA pfd dlh e foLFkkiu ugh gvk blfy, vkid }kjk yxk, x, cy u dlh ij dkb dk; ugh fd;kA

tl fd dlh dk mBkr le;] dlh dh fLFkfr e dN ifjoru gvkA ml le; vkiu Hkkfrd dk; fd;kA mld ckn oLr dk mBk, j[ku ij dkb vfrfjDr dk; ugh gvkA

uhp dN ifjfLFkfr;k nh xb gA crkb, bue l fdl&fdl e dk; gk jgk g] fdle ugh vkj D;k\

fp= Øekd&3

fp= Øekd&4

1- vkiu ,d cgr cMh pVVku dk èkdyk ij og ugh fgyhA

2- vki lhf<;k ij p<dj bekjr dh nljh efty ij igpA

3- ;k=h LV'ku ij cx [kpdj dN njh rd y tkrk gA

4- ,d pyr g, lkbfdy dk jkdukA

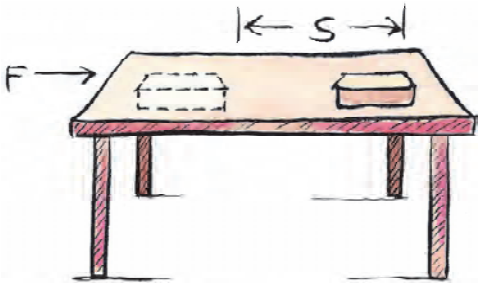
fØ;kdyki&1

- vkidh d{kk e dlh] Vcy] cp vkfn j[k gkxA bu lHkh dk ,d&,d dj ,d Åpkb rd mBkdj n[kA vc crkb,] bue l fdl oLr dk ,d gh Åpkb rd mBku e vkidk lcl T;knk dk; djuk iMxk vkj D;k\

,d fu;r cy }kjk fd;k x;k dk;

cy o foLFkkiu irk gku ij ge dk; dh x.kuk dj ldr gA

eku y fdlh oLr ij ,d fu;r cy F yxku ij oLr viuh fØ;k fcUn l S njh foLFkkfir gkrh gA tlk fd fp= Øekd&5 e n'kk;k x;k gA



fp= Øekd&5

dk; dh oKkfud ifjHkk"kk d vulkj fd, x, dk; dk eku cy rFkk oLr dk cy dh fn'kk e foLFkkiu d x.kuQy d cjkcj gkrk gA

vFkkr fd;k x;k dk; = cy × oLr dk cy dh fn'kk e foLFkkiu

$$W = FS$$

vr% dk; ,d vfn'k jkf'k gA

ge tkur g fd cy dh SI bdkb U;Vu (N) rFkk njh dh bdkb ehVj (m) gkrh gA vr% dk; dh bdkb ¼vFkok ek=d½ U;Vu × ehVj (Nm) gkxhA bl ty (J) Hkh dgk tkrk gA

lehdj.k $W = FS$ e

;fn $F = 1$ U;Vu (N)

$S = 1$ ehVj (m)

rk $W = FS$

$W = 1N \times 1m$

$= 1$ Nm (U;Vu ehVj½ ;k 1J gkxkA

vFkkr 1 ty (J) dk; dh og ek=k g tk 1 U;Vu cy yxku ij oLr dk cy dh fn'kk e 1m foLFkkfir djrh gA

mnkgj.k&1 % ,d yMdh Vcy ij j[kh gb fdrkc ij 4-5 N U;Vu dk cy yxkrh gA fdrkc cy dh fn'kk e 30 leh foLFkkfir gk tkrh gA oLr ij cy }kjk fd, x, dk;Z dh x.kuk dj\

gy % iLrd ij yxk;k x;k cy $F = 4\text{-}5$ U;Vu

cy dh fn'kk e iLrd dk foLFkkiu $S = 30$ leh

$$S = \frac{30}{100} \text{ehVj}$$

$$S = 0\text{-}3 \text{ ehVj}$$

fd;k x;k dk;Z $W = F \times S$

$$W = 4.5 \text{ N} \times 0.3 \text{ m}$$

$$W = 1.35 \text{ J}$$

mnkgj.k&2 % ,d 0;fDr 20 fdxk n0;eku dh oLr dk iFoh l 3 ehVj Åij mBkrk gA mld }kjk 0kLr ij fd, x, dk;Z dk ifjdyu djA ($g = 9.8 \text{ m/sec}^2$)

gy % oLr dk n0;eku $m = 20$ fdxk

foLFkkiu $S = 3$ ehVj

cy $F = mg$

$$= 20 \text{ kg} \times 9.8 \text{ m/sec}^2$$

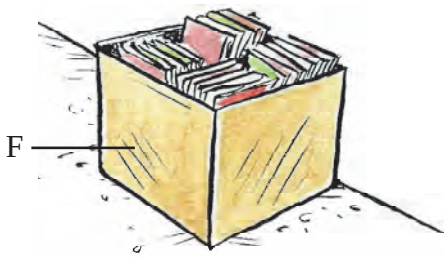
$$= 196 \text{ N}$$

fd;k x;k dk;Z $W = F \times S$

$$= 196 \text{ N} \times 3 \text{ m}$$

$$= 588 \text{ J}$$

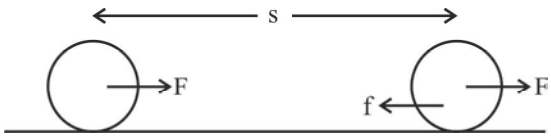
- iLrdk l Hkjk ,d ckDl nhokj l lVk gvk g vkj vkid dkQh i;klk d ckotn ckDl foLFkkfir ugh gkrk gA ¼fp= Øekd&6 e crk, vulkj½A dk;Z d lehdj.k W=FS dk è;ku e j[kdj ;gk dk;Z dh x.kuk djA
- ,lh vkj ifjfLFkfr;k d ckj e lkp tgk cy yxu ij Hkh oLr e foLFkkiu u gkA
- D;k dkb ,lh ifjfLFkfr Hkh lkph tk ldrh g tgk cy u yxu ij Hkh foLFkkiu gk\ viuh f'kf{kdk@f'k{kd l ppk djA



fp= Øekd&6

,d vU; fLFkfr ij fopkj dj&

eku yhft, vki ,d oLr ij (F) cy yxkr g vkj oLr (S) njh rd tkdj #d tkrh gA



fp= Øekd&7

1- tc vki oLr ij cy ¼F½ yxkr g rc oLr cy dh fn'kk e foLFkkfir gkrh gA ;gk cy }kjk fd;k x;k dk; èkukRed gkxk vFkkr W = FS

2- oLr ij mldh xfr dh fn'kk d foijhr fn'kk e ?k"k.k cy f dk; djrk g ftld dkj.k oLr S njh rd tkdj #d tkrh gA bl fLFkfr e ?k"k.k cy }kjk oLr ij fd;k x;k dk; _.kRed gkxkA ;gk ij nkuk d chp dk dk.k 180° gA

vFkkr W = –f S

vr% oLr ij yxk;k x;k cy rFkk oLr dk foLFkkiu leku fn'kk e gk rk cy }kjk fd;k x;k dk; èkukRed gkrk g vkj ;fn cy rFkk oLr dk foLFkkiu foijhr fn'kk e gk rk cy }kjk fd;k x;k dk; _.kRed gkrk gA

mnkgj.k&1 % ,d xkykdkj oLr dk y<dku ij og 4 ehVj dh njh rd foLFkkfir gkrh gA ml ij 15 U;Vu dk ?k"k.k cy yx jgk gA ?k"k.k cy }kjk fd, x, dk; dh x.kuk dj\

gy % oLr ij yxu okyk ?k"k.k cy F = 15 U;Vu

oLr dk foLFkkiu S = 4 ehVj

oLr dk foLFkkiu ,o oLr ij yxu okyk ?k"k.k cy dh fn'kk ,d nlj d foijhr g vr% ?k"k.k }kjk cy fd;k x;k dk;&

$$W = -(F \times S)$$

$$W = -(15N \times 4m)$$

$$W = -60\ J$$

mnkgj.k&2 % 60 fdyksxke n0;eku dh efgyk bekjr dh igyh efty rd igpu d fy, 20 lhf<;k p<rh gA ftle iR;d lh<h dh Åpkb 23 leh gA bl fØ;k e efgyk ij iFoh d x#Rokd"k.k cy }kjk fd, x, dk; dh x.kuk dj\

gy % efgyk dk n0;eku m = 60 kg

efgyk ij yx jgk x#Ro cy = $60kg \times 9.8\ Nm/sec^2$

iR;d lh<h dh Åpkbl $= \frac{23}{100}$ m

20 lh<h;k dh dy Åpkbl $h = 20 \times \frac{23}{100}$ m

x#Rokd"k.k cy }kjk fd;k x;k dk;Z

$$W = -mgh$$

$$= -60 \times 9.8 \times 20 \times \frac{23}{100}$$

$$= -2704.8 \text{ Nm}$$

$$= -2.70 \text{ KJ}$$

fØ;kdyki&2

vki ,d xn dk Åij dh vkj QdA bld fy, vkidk cy yxkuk iMrk gA Åij dh vkj xfr djrh gb xn ij yxkrkj x#Rokd"k.k cy dk; djrk g] tk mldh xfr dh fn'kk d foijhr gA lkp vkj crk,] fd&

1- Åij tkrh gb xn ij fdl cy }kjk èkukRed dk; fd;k x;kA

2- Åij tkrh gb xn ij fdl cy }kjk _.kRed dk; fd;k x;k\

3- viu mÙkj dk dkj.k ndj Li"V djA

1- ,d fo|kFkh m n0;eku dh ,d oLr dk mèokèkj fn'kk e h Åpkb rd mBkdj {kfr t fn'kk e ,d leku xfr l d njh rd pyrh g ¼fp= Øekd&8½A

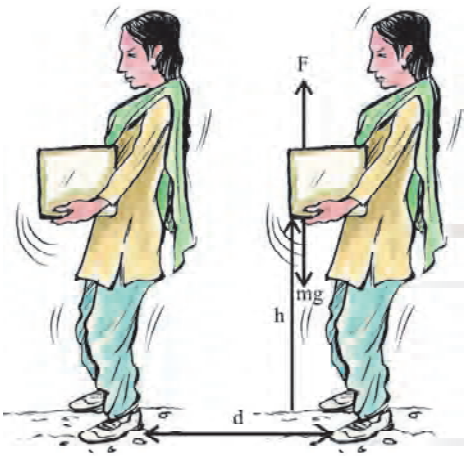
mijkDr fLFkfr e fo|kFkh }kjk fd;k x;k dk; fdruk gkxk\ vkb,] bl le>u dk i;kl djr g&

m n0;eku d ckDl dk h Åpkb rd mBku e fo|kFkh }kjk yxk, x, cy }kjk fd;k x;k dk;Z

w = mgh .....(i) ¼;gk cy rFkk foLFkkiu dh fn'kk leku gA½

tc fo|kFkh ckDl dk mBkdj {kfr t fn'kk e py jgh g vkj mld pyu dh xfr leku g rk ckDl dk Roj.k a 'kU; gA vr% bl fn'kk e ckDl ij yx jgk cy 'kU; gkxk vkj ckDl ij fo|kFkh }kjk fd;k x;k dk;Z

w = 0 .....(ii)



fp= Øekd&8 % fo|kFkh }kjk leku mBkr g,

V9CGN3

12.2 Åtk

vkiu n[kk gkxk fd fo|r cYc] V;cykbV] Vhoh] fo|r i[k vkfn dk pyku d fy, fo|r dh vko';drk gkrh gA jyxkMh] cl] dkj ekVjckbd vkfn dk pyku e iVky] Mhty vkfn dk mi;kx fd;k tkrk gA D;k vkiu dHkh lkpk g&

- fo|r cn gku ij fo|rh; midj.k D;k cn gk tkr g\
- fcuk iVky] Mhty vkfn d okgu D;k ugh pyr g\
- iM&ikèk l; d idk'k dh vuifLFkfr e viuk Hkktu D;k ugh cuk ikr g\
- Åtk vkj dk; e D;k lcèk g\

bu i'uk ij vkil e ppk djA

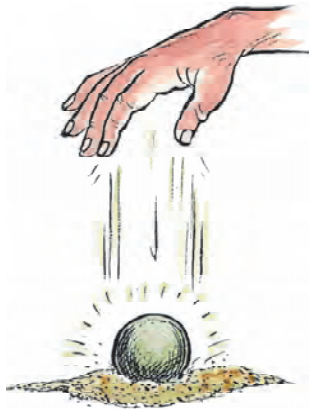
vkiu io d{kkvk e Åtk d ckj e i<k gA Åtk db :ik e ikb tkrh g& tl fo|r Åtk] idk'k Åtk] èofu Åtk] ;kf=d Åtk] ukfHkdh; Åtk] jklk;fud Åtk vkfnA fo|rh; midj.kk dk fo|r l Åtk iklr gkrh gA blh idkj okguk dk iVky ,o Mhty l Åtk iklr gkrh gA iM&ikèk l; d idk'k l Åtk iklr djd viuk Hkktu cukr gA

bl vè;k; e ge doy ;kf=d Åtk dk vè;;u djxA ;kf=d Åtk nk idkj dh gkrh gA

1- xfrt Åtk 2- fLFkfrt Åtk

12.2.1 xfrt Åtk (Kinetic energy)

fØ;kdyki&3



fp= Øekd&9

1- èkkr dh ,d Hkkjh xn yA
2- bl xhy jr l Hkjh V dh lrg ij 20 cm Åpkb l fxjk,A
3- jr ij cu xr ¼xï½ dh xgjkb ukiA
4- mDr fØ;kdyki e xn dk 40 cm, 70 cm rFkk 100 cm dh Åpkb l fxjkdj nkgjk,A
5- iR;d fØ;k e xï dh xgjkb ukV djA

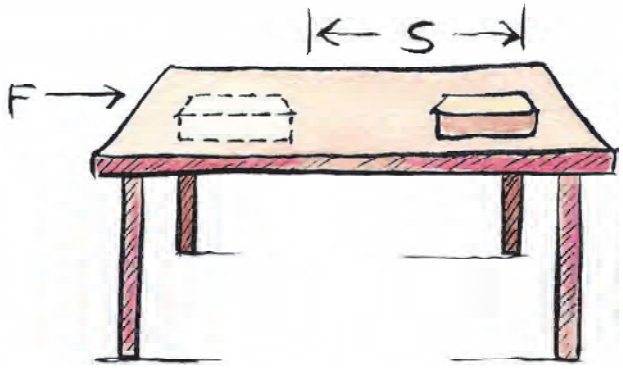
bl fØ;kdyki d vkèkkj ij fuEu i'uk d mÙkj nu dk i;kl djA

1- xn u fdl dkj.k l jr e xïk cuk;k\
2- xn dk fHkUu&fHkUu Åpkb;k l fxjku ij jr e cu xï dh xgjkb dk Øe e tekvkA D;k Åpkb;k d c<u ij xï dh xgjkb c<rh g\
3- fdl Åpkb l xn Qdu ij xïk lcl vfèkd xgjk cuk vkj D;k\

iR;d oLr e viuh xfr d dkj.k ,d Åtk fufgr gkrh g] ftl xfrt Åtk dgr gA fdlh oLr dh xfrt Åtk mldh pky d lkFk cnyrh gA leku n0;eku dh rt xfr djrh gb oLrvk e de ox l xfr djrh gb oLrvk dh vi{kk vfèkd xfrt Åtk gkrh gA blh dkj.k rho ox l xfr'khy xn fLFkj fodVk l Vdjkrh g rk fodV nj tk fxjrk gA tcfd èkj l vk dj Vdjkb xn fodV dk nj ugh Qd ikrhA

Xkfrt Åtk dh xf.krh; 0;k[;k

fdlh Hkh oLr dh xfrt Åtk fojkekoLFkk e 'kU; gkrh gA vFkkr xfr'khy oLr e xfr d dkj.k xfrt Åtk fufgr gkrh gA ge ;g dg ldr g fd xfr'khy oLr dh xfrt Åtk ml oLr ij bl ox dk ikIr dju d fy, fd, x, dk; d cjkcj gA



fp= Øekd&10 % xfr djrh g, oLr

xfrt Åtk o fd;k x;k dk;

Ekkuk fd n0;eku m dh ,d oLr] {kfrt ry ij j[kh x;h gA oLr ij ,d leku cy F yxku ij og 'S' njh rd foLFkkfir gk tkrh gA rc oLr ij fd;k x;k dk;&

$$W = FS \qquad \text{..... (i)}$$

oLr ij yxu oky cy d dkj.k ekuk mle mRiUu Roj.k a gkrk gA geu io vè;k; e xfr d lehdj.kk dk vè;;u fd;k gA ,d leku Roj.k a l xfr'khy fdlh oLr d ikjfEHkd ox u, vfUre ox v rFkk foLFkkiu s d chp fUkEu lEcUèk gkrk gA

$$v^2-u^2 = 2as \qquad \text{..... (ii)}$$

$$s = \frac{v^2 - u^2}{2a} \qquad \text{..... (iii)}$$

xfr d f}rh; lehdj.k l] ge Kkr g fd

$$F = ma \qquad \text{..... (iv)}$$

mijkDr Lkehdj.k Øekd (iii) o (iv) l s rFkk F dk eku lehdj.k (i) e j[ku ij ge fd, x, dk; dk fy[k ldr g &

$$w = ma \times \frac{v^2 - u^2}{2a}$$

$$w = \frac{1}{2}m\left(v^2 - u^2\right)$$

;fn oLr dh xfr fojke voLFkk l ikjEHk gkrh g] vFkkr u=0 rk

$$w = \frac{1}{2}mv^2$$

ekuk] fd;k x;k dk; oLr dh xfrt Åtk e ifjoru d cjkcj gA ;fn oLr fLFkj voLFkk l xfr djrh g rk fd;k x;k dk; xfrt Åtk d cjkcj gA

ge dg ldr g fd v ox l xfr'khy m n0;eku dh oLr dh xfrt Åtk dk eku&

$$E_k = \frac{1}{2}mv^2$$

Åtk dh SI bdkb ty gA

ppk dj

1- D;k oLr dh xfrt Åtk _.kRed gk ldrh g\

2- fdl Vd dk jkduk T;knk lgt gkxk&de leku l yn ;k vfèkd lkeku l yn dk\

3- dkj dh xfrt Åtk e dc vfèkd ifjoru gkxk\ tc dkj dk ox 10 m/s l 20 m/s gk tk, ;k tc dkj dk ox 20 m/s l 30 m/s gk tk,A

mnkgj.k&1 % 20 fdykxke n0;eku dh ,d oLr 5 m/s d leku ox l xfr'khy g] oLr dh xfrt Åtk fdruh gkxh\

gy % oLr dk n0;eku = 20kg

oLr dk ox = 5 m/s

xfrt Åtk $= \frac{1}{2}mv^2$

$= \frac{1}{2}\times 20\times 5^2$

= 250 J

oLr dh xfrt Åtk 250 ty gA

mnkgj.k&2 % ;fn fdlh dkj dk n0;eku 200kg g rk mlld ox dk 36 km/h l 72 km/h rd c<ku e fdruk dk; djuk iMxk\

gy % dkj dk n0;eku $m = 200$ fdykxke

dkj dk ikjfEHkd ox $u = 36$ fdeh@?k.Vk

¼lHkh jkf'k;k dk SI bdkb e cny½

$$u = \frac{(36\times1000)m}{(60\times60)s}$$

$$u = \frac{360}{36} = 10 m/\sec$$

blh idkj dkj dk vfUre ox &

$$v = \frac{(72\times1000)m}{(60\times60)s}$$

$$v = \frac{720}{36}\ \text{m/sec}$$

$$= 20\ \text{m/s}$$

dkj dh ikjfEHkd xfrt Åtk

$$E_{k1} = \frac{1}{2}mu^2$$

$$= \frac{1}{2}\times200\times(10)^2$$

$$= \frac{1}{2}\times200\times100$$

$$= 10000\ \text{J}$$

dkj dh vfUre xfrt Åtk

$$E_{k2} = \frac{1}{2}mv^2$$

$$E_{k2} = \frac{1}{2}mv^2$$

$$= \frac{1}{2}\times200\times(20)^2$$

$$= \frac{1}{2}\times200\times400$$

$$= 40000\ \text{J}$$

vr% fd;k x;k dk; = xfrt Åtk e ifjoru

$= E_{k2} - E_{k1}$

$= 40000 - 10000$

$= 30000\ J$

$= 30\ KJ$

ppk dj

1- fdlh oLr dh xfrt Åtk l D;k rkRi;; g\

2- v ox l xfr'khy fdlh m n0;eku dh oLr dh xfrt Åtk $\frac{1}{2}mv^2$ gA ;fn bld ox dk nkxuk dj fn;k tk, rk bldh xfrt Åtk fdruh gkxh\

3- ;fn ,d oLr dk n0;eku o ox] nljh oLr d n0;eku o ox dk nk xuk gk rk mudh xfrt Åtk dk vuikr D;k gkxk\

12-2-2 fLFkfrt Åtk (Potential energy)

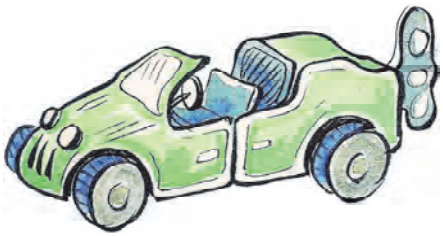
fØ;kdyki&4

1- ,d f[kyku okyh dkj yA

2- ble yxh pkch dk 2&3 ckj ?kek,A

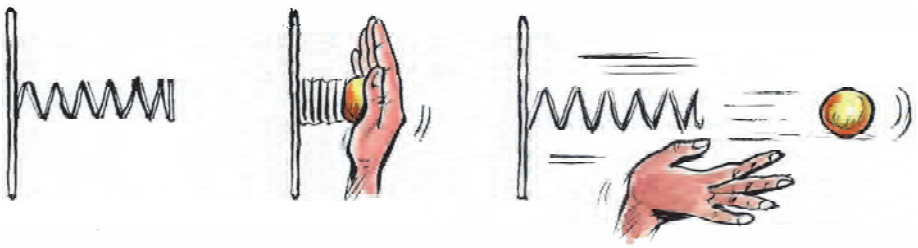
3- bl tehu ij j[kA

- D;k ;g pyu yxrh g\ ;fn gk rk D;k\
- ;fn pkch dk 4&5 ckj ?kek;k tk, rk D;k gkxk\



fp= Øekd&11

fp= e fn[kk, vulkj tc vki nhokj l yxh fLix ¼fp= Øekd&12 a½ ij xn j[kdj ml nckr g rk fLix ldfpr ¼fp= Øekd& 12 b½ gk tkrh g vkj t l gh vki viuk gkFk fLix l gVkr g] xn nj tkdj fxjrh gA ¼fp= Øekd&12 c½



(a) (b) (c)

fp= Øekd&12

fp= Øekd&13

dN ,lk gh fLix ryk e gkrk gA otu yVdku ij ryk f[kp tkrh g vkj NkMu ij okil vk tkrh gA

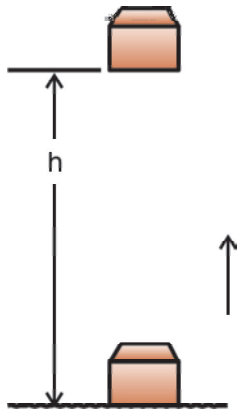
fp= Øekd&13 n[k] xyy dk [kkp dj NkMu ij xyy dh jcj Hkh nc fLix dh rjg gh okil fcuk ruko dh fLFkfr e vkuk pkgrh gA vr% iRFkj dk og nj rd Qd nrh gA

fdlh oLr ij fd, x, dk; d dkj.k mle Åtk lfpr gk tkrh gA ;g lfpr Åtk oLr dh fLFkfrt Åtk dgykrh g vFkkr iR;d oLr e viuh fLFkfr d dkj.k tk Åtk gkrh g ml fLFkfrt Åtk dgr gA ;g Åtk vU; :i e :ikUrfjr gkdj oLr dk dk; dju e l{ke cukrh gA tc vki fLix ij xn j[kdj nckr g rk vki fLix dh fLFkfr e ifjoru djr gA ;g Åtk mle fLFkfrt Åtk d :i e lfpr jgrh gA ;g xfrt Åtk e ifjofrr gkdj fLix dh xn dk nj rd xfr nu e l{ke cukrh gA

- D;k blh idkj jcj dh xyy l iRFkj Qdu dh fØ;k dk le>k ldr g\

x#Roh; fLFkfrt Åtk (Gravitational potential energy)

tc fdlh oLr dk iFoh l Åij mBk;k tkrk g rc ml dh Åtk e Hkh of) gkrh g oLr dk Åij mBku e iFoh d x#Rokd"k.k cy d fo:) dk; fd;k tkrk gA oLr dk fuf'pr Åpkb rd mBku e fd;k x;k dk; ml dh fLFkfrt Åtk d :Ik e lfpr jgrk gA x#Rokd"k.k cy d fo:) fd, x, dk; d dkj.k oLr e lfpr Åtk dk x#Roh; fLFkfrt Åtk dgr gA



fp= Øekd&14 % oLr dk iFoh dh lrg l Åij mBk;k x;k

;fn m n0;eku dh ,d oLr dk Åij mBku d fy, cy dh vko';drk gkrh gA bl d fy, U;ure cy oLr d Hkkj mg d cjkcj gkrk gA mBkb xb oLr e ml ij fd, x, dk; d cjkcj Åtk dh of) gkxhA eku y fd oLr dk h Åpkb rd mBku d fy, ml ij x#Roh; cy d fo:) fd;k x;k dk; w gA

Rkc fd;k x;k dk; $w = cy \times f0kLFkkiu$

$= mgh$

$= mgh$

D;kfd oLr ij fd;k x;k dk; mgh g vr% oLr dk feyh fLFkfrt Åtk Hkh mgh gkxhA ge bl fLFkfrt Åtk dk (Ep) dgxA

$Ep = mgh$

mnkgj.k&1 % 50 fdxk n0;eku dh ,d oLr dk iFoh l 8 ehVj dh Åpkb rd mBk;k x;k gA bl oLr e fo|eku Åtk dk ifjdyu djA ;gk $g = 9.8\ m/sec^2$

gy % oLr dk n0;eku $m = 50\ kg$

foLFkkiu Åpkb $h = 8m$

x#Roh; Roj.k g = 9.8 m/sec²

l= % fLFkfrt Åtk = mgh

= 50 × 9.8 × 8

= 3920 J

fLFkfrt Åtk 3920 ty gA

bl Hkh tku

oLr dh fLFkfrt Åtk Hkfe ry ;k vkid }kjk pu x, 'kU; ry ij fuHkj gA fdlh oLr d fy, ,d ry d lki{k fLFkfrt Åtk dk eku fdlh nlj ry d lki{k fLFkfrt Åtk d eku l Qd gkxkA

mnkgj.k&2% 5 fdxk n0;eku dh oLr iFoh l ,d fuf'pr Åpkb ij fLFkr g] ;fn oLr dh fLFkfrt Åtk 400 ty g] rk oLr dh iFoh d lki{k Åpkb Kkr djA g= 9.8 m/sec²A

gy % oLr dk n0;eku m = 5 kg

foLFkkiu Åpkb h = \

oLr dh fLFkfrt Åtk = mgh = 400 J

x#Roh; Roj.k g = 9.8 m/sec²

oLr dh fLFkfrt Åtk E_p = mgh = 400 J

$5 \times 9.8 \times h = 400$

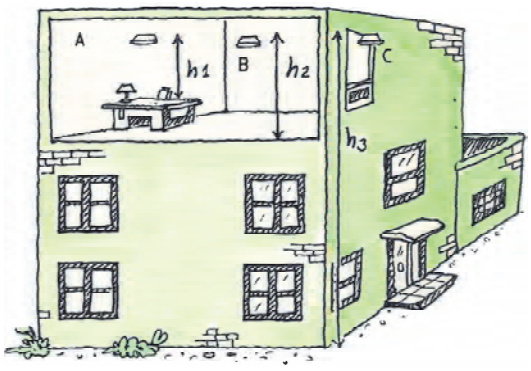
$h = \frac{400}{49}$

$h = 8.16\ m$

oLr 8.16 m Åpkb ij fLFkr gA

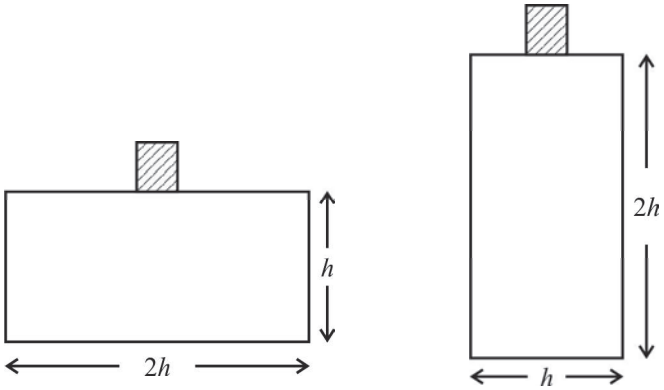
i'u

1- fp= Øekd&15 e fn[kkb xb rhu fLFkfr;k A, B rFkk C d fy, iLrd dh fLFkfrt Åtk Kkr dhft,A



fp= Øekd&15

2- fp= Øekd&16 e ,d vk;rkdkj ckDl fn[kk;k x;k g ft ldh yEckb ,o pkMkb Øe'k 2h ,o h gA nkuk fLFkfr;k e ckDl ij j[kh m n0;eku dh oLr dh fLFkfrt Åtk D;k gkxh\



fp= Øekd&16

ppk dj

1- èku"k&ck.k pyku dh fØ;k e rhj dk èku"k e yx rkj vFkok jcj ij j[kdj ihN dh vkj D;k [khpk tkrk g\

2- D;k oLr dh x#Roh; fLFkfrt Åtk _.kRed gk ldrh g\

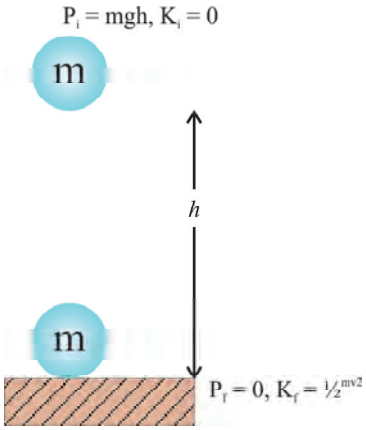
12-3 ;kf=d Åtk lj{k.k dk fu;e (Law of conservation of mechanical energy)

Ekkuk m n0;eku dh ,d oLr h Åpkb l Lor=rk iod fxjkb tkrh gA ikjEHk e oLr dh fLFkfrt Åtk mgh g vkj xfrt Åtk 'kU; g D;kfd bldk ikjfEHkd ox 'kU; gA

bl idkj oLr dh dy Åtk mgh gA

tc ;g oLr fxjrh g rk bldh fLFkfrt Åtk xfrt Åtk e ifjofrr gkrh gA ;fn fn, g, {k.k ij oLr dk ox v g rk xfrt Åtk $\frac{1}{2}mv^2$ gkxhA oLr tl&tl uhp fxjrh g bldh fLFkfrt Åtk de gkrh tkrh g rFkk xfrt Åtk c<rh tkrh gA tc oLr èkjrh ij igpu okyh gkrh g rk bl voLFkk e oLr dk vfUre ox v vfèkdre gk tk,xkA blfy, vc xfrt Åtk vfèkdre rFkk fLFkfrt Åtk U;ure gkxhA ge tkur g fd lHkh fcUnvk ij oLr dh fLFkfrt Åtk rFkk xfrt Åtk dk ;kx leku jgrk g vFkkr

fLFkfrt Åtk $ xfrt Åtk = fu;r



fp= Øekd&17 % fxjrh gb oLr

;k $mgh + \frac{1}{2}mv^2 = fu;r$

fdlh oLr dh xfrt Åtk rFkk fLFkfrt Åtk dk ;kx mldh dy ;kf=d Åtk gA ge n[kr g fdlh fi.M d eDr :Ik l fxjr le; bld iFk e fdlh fcUn ij fLFkfrt Åtk e ftruh deh gkrh g xfrt Åtk e mruh gh of) gkrh gA

cgr l ,l vU; mnkgj.kk] voykduk vkj rdk d vkèkkj ij ge ;g dg ldr g fd Åtk dk u gh UK"V fd;k tk ldrk g vkj u gh mRiUu fd;k tk ldrk gA bl doy ,d :Ik l nlj :Ik e ifjoru fd;k tk ldrk gA vFkkr cãk.M dh dy Åtk fu;r jgrh gA ;gh Åtk lj{k.k dk fu;e gA

vkb,] fØ;kdyki }kjk bl vkj le>u dk i;kl djr g&

fØ;kdyki&5

30 fdxk dk dkb fi.M 5 ehVj dh Åpkb l eDRk :Ik l fxjk;k tkrk gA fuEufyf[kr lkj.kh d vulkj iR;d fLFkfr e fLFkfrt Åtk ,o xfrt Åtk dh x.kuk djd lkj.kh Hkj&

$g = 9.8\ m/sec^2$

¼xfr d lehdj.k dh lgk;rk l fHkUu&fHkUu Åpkb;k ij ox Kkr dj½

fi.M dh Åpkb EkhVj	oLr dk ox fofHkUu Åpkb;k e	fLFkfrt Åtk E= mgh	Xkfrt Åtk $E_K = \frac{1}{2}mv^2$	dy Åtk $E_p + E_K$
5				
4				
3				
2				

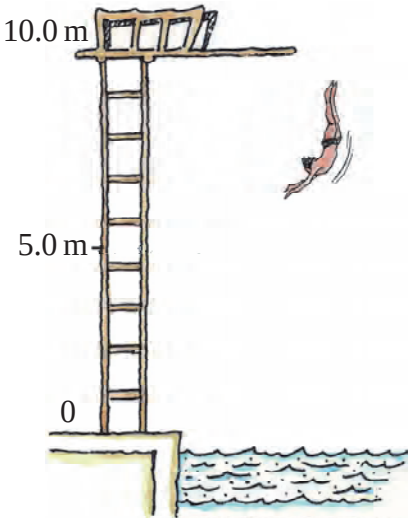
;fn Åij fn, x, fØ;kdyki d fu"d"kk dk è;ku l n[k rk vki ik,x fd iR;d fLFkfr e fiM dh dy ;kf=d Åtk fu;r jgrh gA

fopkj foe'k dj

;fn idfr e Åtk :iUrj.k lEHko ugh gkrk rk D;k gkrk\ ,d er d vulkj Åtk :iUrj.k d fcuk thou lEHko ugh gk ikrk] D;k vki bll lger g\

leg e dj

m n0;eku dk ,d 0;fDr 10 ehVj dh Åpkb l ikuh e dnrk gA ¼fp= Øekd&18½ ;kf=d Åtk lj{k.k fu;e dk mi;kx dj 0;fDr dk ox Kkr dj tc og ikuh dh lrg l 5 ehVj dh Åpkb ij gkA



fp= Øekd&18

V9V8RD

12-4 'kfDr (Power)

je'k ,o jk[kh d ?kj ij ikuh dh Vdh leku vkdfr vkj Åpkb dh gA nkuk gh viuh Vdh e ikuh p<ku d fy, fo|r ekVj dk i;kx djr gA jk[kh d ?kj dh ikuh dh Vdh je'k dh ikuh dh Vdh l tYnh Hkj tkrh gA bld ihN D;k dkj.k gk ldrk g\

dHkh&dHkh ge n[kr g fd gekj ?kj d xkbUMj ¼pDdh½ e 1 fdxk nky dk ihlu e iMkIh d xkbUMj l T;knk le; yxrk gA ,lk D;k\

D;k bue dy fd;k x;k dk; vyx&vyx g ;k ekVj o xkbMj dh dk; dju dh {kerk vyx&vyx g\

leku dk; dk dju e vyx&vyx e'khuk dk yxu oky le; e vUrj gk ldrk g vFkkr bud dk; dju dh nj vyx gA dk; dju dh nj dk 'kfDr dgr gA ge ekVjckbd] ekVjdkj] fo|r iEi] fo|r cYc] V;c ykbV] vkjk e'khu] pkjk dkVu dh e'khu] VDVj tlh e'khuk dh 'kfDr d ckj e ckr djr gA budh 'kfDr ;g n'kkrh g fd ; fdruh rth l Åtk e ifjoru vFkkr dk; djr gA

dk; dju dh nj ;k Åtk : ikUrj.k dh nj dk 'kfDr dgr gA bl xf.krh; : i e ,l fy[kx] ;fn dkb 0;fDr t le; e w dk; djrk g rk

'kfDr= dk;@le;

P= w / t

'kfDr dh bdkb ¼ek=d½ okV (W) gA ;fn dkb 0;fDr 1 ld.M e 1 ty dk; djrk g rk Åtk mi;kx dh nj 1 J/s gkxh rFkk 'kfDr 1 W gkxhA

vFkkr 1 okV = 1 J/s

;k 1 W = 1 J/s

T;knk 'kfDr gk rk ml ge fdyokV e ukir gA

1 fdyokV = 1000 okV

1 KW = 1000 W ;k 1000 J/s

;fn ge irk djuk gk fd fdlh e'khu e fdruh Åtk [kp gb rk ge n[kuk gkxk fd mldh 'kfDr fdruh gkxh vkj og fdru le; rd dk; dj jgh gA

mi;kx dh xb Åtk P = w / t l

w = p × t

;fn P = 1 KW rFkk t = 1h gk rk mi;kx e yh xb Åtk 1KWh gkxhA

vFkkr 1 KWh ¼,d fdyokV ?kVk½ Åtk dh og ek=k g tk 1 KW d fdlh lkr dk 1 ?kV rd mi;kx dju e 0;; gkxhA ?kjk e] m|kxk e rFkk 0;kolkf;d lLFkkuk e 0;; gku okyh Åtk dk ik;% fdyk okV ?kVk (KWh) e 0;Dr djr gA mnkgj.k d fy, ,d eghu e mi;kx dh xb fo|r Åtk dk ;fuV d :i e 0;Dr djr gA ;gk 1 ;fuV dk vFk g 1 KWh

1KWh = 1KW×1h = 1000W×3600 Sec

=3600000J

=3.6×10⁶J

mnkgj.k&1 % ,d efgyk 300 ty dk; dk 5 ld.M e ijk djrh g rk crkvk mlu fdruh 'kfDr 0;; fd;k\

gy % efgyk d }kjk fd;k x;k dk; W = 300 J

dk; dju e yxk le; t = 5s

vr% efgyk }kjk 0;; dh xb 'kfDr p = w/t

= 300/5

= 60 W

mnkgj.k&2 % 50 kg n0;eku dk ,d yMdk 30 lhf<;k 10 ld.M e p<rk gA ;fn iR;d lh<h dh Åpkb 15 leh gk rk mldh 'kfDr dk ifjdyu djA g = 10 eh-@l²

gy % yMd dk n0;eku m = 50 kg

mg = 50 × 10

= 500 kg m/s²

30 lhf<;k dh dy Åpkb h = (30 × 15)/100

= 4.50 m

Pk<u e yxk le; t = 10s

'kfDr p = fd;k x;k dk;@le;

= mgh / t

p = (500 × 4.50) / 10

= 225 W

yMd dh 'kfDr 225 W gA

i'u

- 'kfDr fdls dgr g\
- 1 okV 'kfDr dk ifjHkkf"kr djA
- ;fn ,d cYc 990 ty fo|r Åtk 10 ld.M e 0;; djrk g rk bldh 'kfDr fdruh g\

mnkgj.k&3 % 60 okV dk ,d cYc ifrfnu 10 ?kV mi;kx fd;k tkrk gA cYck }kjk ,d fnu e [kp dh xb Åtk dh ;fuVk dk ifjdyu djA

gy % fo|r cYc dh 'kfDr = 60 okV ¾ 0-06 kW

mi;kx fd;k x;k le; = 10 ?kVk

vr% cYc dh [kp dh xb Åtk = 'kfDr × fy;k x;k le;

= 0-06 kw × 10h

= 0.60 kWh

= 0.60 ;fuV

CkYc }kjk ,d fnu e 0-60 ;fuV Åtk dh [kir gkxhA

fØ;kdyki&6

- viu ?kj d fo|r ifjiFk e yx fo|r ehVj dk ckjhdh l i{k.k dj rFkk ifrfnu ikr% 7-00 ct ehVj dk ikB;kd ukV djA
  - iR;d fnu fdruh ;fuV 0;; gkrh g\
  - iR;d fnu i{k.kk dk ,d ekg rd lkj.kh c) djA
  - viu i{k.kk dh rqyuk fo|r d ekfld fcy e fn, x, fooj.kk l djA

geu lh[kk

1- fdlh oLr ij fd;k x;k dk;] ml ij yxk, x, cy d ifjek.k rFkk oLr dk cy dh fn'kk e foLFkkiu d x.kuQy d cjkcj gkrk gA dk; dk ek=d ty (J) gA

2- oLr ij yxk;k x;k cy ,o mld foLFkkiu dh fn'kk leku gk rk cy }kjk fd;k x;k dk; èkukRed gkxk rFkk oLr ij yxk;k x;k cy ,o mld foLFkkiu dh fn'kk vleku gk rk cy }kjk fd;k x;k dk; _.kkRed gkxkA

3- Åtk] oLr dk dk; dju dh {kerk nrk gA Åtk dk ek=d Hkh ty gA

4- fdlh oLr e mldh xfr d dkj.k fufgr Åtk mldh xfrt Åtk dgykrh gA v ox l xfr djrh gb m æ0;eku dh oLr dh xfrt Åtk $\frac{1}{2}mv^2$ gkxhA

5- oLr }kjk mldh fLFkfr vFkok vk—fr e ifjoru d dkj.k lfpr Åtk dk oLr dh fLFkfrt Åtk dgr gA iFoh ry l h Åpkb rd mBkb xb m æ0;eku dh oLr dh x#Roh; fLFkfrt Åtk mgh gkxhA

6- Åtk lj{k.k fu;e d vulkj Åtk dk u gh u"V fd;k tk ldrk g u gh mRiUuA bl doy ,d :i l nlj :i e :ikrfjr fd;k tk ldrk gA :ikUrj.k d io rFkk :ikUrj.k d i'pkr dy Åtk lno fu;r jgrh gA

7- dk; dju dh nj ;k Åtk :ikUrj.k dh nj dk 'kfDr dgr gA 'kfDr dk SI ek=d okV (W) gA

8- 1kWh Åtk dh og ek=k g tk 1kW d fdlh lkr dk 1 ?kV rd mi;kx dju e 0;; gkrh gA

e[; 'kCn % (Keywords)

dk; (work)] Åtk (energy)] xfrt Åtk (kinetic energy)] fLFkfrt Åtk (potential energy)] Åtk lj{k.k (energy conservation)] 'kfDr (power)

vH;kl

1- mfpr fodYi pudj fy[k&

(i) oLr ij 10 N dk cy yxku ij ;fn oLr cy dh fn'kk e 2 m rd foLFkkfir gk] oLr ij cy }kjk fd;k x;k dk; gkxk&

¼v½ 15 J ¼c½ 20 J ¼l½ .20 J ¼n½ 5 J

(ii) 5 kg n0;eku dh ,d oLrq 2 eh@lsd.M d ,d leku ox esa xfr'khy gA oLrq dh xfrt Åtk fdruh gksxhA

¼v½ 10 ty ¼c½ 15 ty ¼l½ 5 ty ¼n½ 20 ty

(iii) 12 kg n0;eku dh ,d oLrq èkjrh ls ,d fuf'pr ÅpkbZ ij fLFkr g ;fn oLrq dh fLFkfrt Åtk 480 J g rk oLrq dh èkjrh d lkis{k ÅpkbZ gksxhA ¼g =10 m/s²½

¼v½ 6 eh@lsd ¼c½ 9 eh@lsd ¼l½ 5 eh@lsd ¼n½ 4 eh@lsd

(iv) vki viu ?kj e 100 W dk ,d fo|qr cYc ifrfnu 5 ?k.V rd tykrs gA cYc }kjk ,d fnu e [kp dh xbZ Åtk dh ;fuV fdruh gksxh\

¼v½ 0-4 ;fuV ¼c½ 0-5 ;fuV ¼l½ 0-05 ;fuV ¼n½ 0-01 ;fuV

2- fjDr LFkku dh ifr dj&

(i) dk; dk SI ek=d ---------- gA

(ii) 1 fdyksokV ?k.Vk ---------- ty d rqY; gA

(iii) fdlh oLrq dh dy Åtk ---------- jgrh gA

(iv) oLrq ij yxk, cy ,o mld foLFkkiu dh fn'kk foijhr gk rk fd;k x;k dk; ---------- gksxkA

(v) m n0;eku dh oLrq iFoh ls h/2 ÅpkbZ ij fLFkr gk rk oLrq dh fLFkfrt Åtk ---------- gksxhA

3- xfrt Åtk ls vki D;k le>rs g\ fdlh xfreku oLrq d fy, xfrt Åtk dk l= LFkkfir djsA

4- fdlh ?kj e ,d eghu e fo|qr Åtk dk 250 ;fuV 0;; gksrk g ;g Åtk ty e fdruh gksxh\

$[900 \times 10^6 J]$

5- (a) Åtk lj{k.k fu;e D;k g\ le>k,A

(b) eDr :i ls fxjr ,d fi.M dh fLFkfrt Åtk yxkrkj de gksrh tkrh g D;k ;g Åtk lj{k.k fu;e dk mYY?ku djrh g\ dkj.k d lkFk Li"V djsA

6- fLFkfrt Åtk dk le>kr g, l= dh LFkkiuk djsA

7- (a) ;fn d.k d ox dk nxuk dj fn;k tk, rks] bldh xfrt Åtk D;k gksxh\

(b) d.k ij fd, x, dk; dk ifjek.k 'kU; gk rk bldk ox D;k gksxk\

8- v ox ls xfr djrh gb dkj e cd yxku d i'pkr og d njh rd tkdj #drh gA x.kuk dj] ;fn dkj dk ox 2 v gk rk cd yxku d i'pkr og fdruh njh rd tkdj #dxh\

9- dkbZ eu"; pkoy d ,d xëj dk viuh flj ij 30 feuV rd j[krk g vkj Fkd tkrk gA D;k mlu dN dk; fd;k g\ viu mÙkj dk rd ndj le>k,A

10- fdlh fi.M ij 8 U;Vu dk cy vkjkfir dju ij og cy dh fn'kk e 4 ehVj foLFkkfir gk tkrk gA bl fØ;k e fd, x, dk; dh x.kuk djA ¼mŸkj& 32 ty½

11- 10 fdykxke n0;eku dh oLr dk iFoh d x#Rokd"k.k cy d fo:) 10 ehVj Åij mBku e fdruk dk; djuk iMxk\ ¼mŸkj& 980 ty½

12- nk fi.M ftudk n0;eku Øe'kh 10 kg rFkk 15 kg gA bUg iFoh l Øe'kh 5 m rFkk 2 m dh Åpkb rd mBk;k tkrk gA nkuk fiMk dh fLFkfrt Åtk e ifjoru dh x.kuk djA ¼mŸkj& 196 ty½

13- ,d 0;fDr ;fn 6 ld.M e 15 N dk cy yxkdj ckDl dk 8 eh- nj rd foLFkkfir djrk g rk mldh 'kfDr dh x.kuk djA (P = 20W)

14- 0-5 fdykxke dh fdlh oLr dh Åtk e 1 ty dk ifjoru dju d fy, ml fdruh Åpkb rd mBkuk gkxk\ ($g = 10\ m/s^2$) ¼mŸkj& 0-2 ehVj½

vè;k;&13

gekjk LokLF;

(Our Health)

13-1 LokLF; dk vfHkik; (Meaning of Health)

D;k vkid lkFk dHkh ,slk gvk g fd pkg dj Hkh rfc;r Bhd ugh gku d dkj.k vki viuk euiln dk; ugh dj ik, gkA tSl& ep [kyu tkuk] fQYe n[ku tkuk] eyk n[ku tkuk ;k fo|ky; d fdlh dk;Øe e Hkkx y ikukA

ge tku&vutku LokLF; 'kCn dk i;kx db ckj djr g tSl fd vkt ejk LokLF; Bhd ugh g] ejk eu fdlh dke e ugh yx jgk gA

vkb,] ge lHkh feydj LokLF; D;k g] bl le>u dk i;kl djr gA

fp= Øekd&1

- viu lkfFk;k d lkFk ppk dj rFkk mu fLFkfr;k dh lph cuk,] tc vki LoLFk egll ugh djr gA

vkerkj ij ge **LoLFk jgu** dk vFk **vPNk egll dju** l yxkr gA tc ge] viu jktejk d dke dk Bhd rjhd l dj ik jg gkr g rk dgr g fd ge LoLFk g vFkkr LokLF; og fLFkfr g ftle 'kkjhfjd] ekufld rFkk dk'ky ;Dr dk; viuh {kerk ,o n{krk d lkFk ijk fd;k tk ldA

13.2 LokLF;] vLoLFkrk vkj jkx (Health and disease)

vyx&vyx ykxk d fy, LoLFk jgu dk vFk vyx&vyx gkxk tl& urd d fy, LoLFk jgu dk vFk g fd og gj ifjfLFkfr e vPN uR; dk in'ku dj ld] ckljhoknd d fy, bldk vFk g fd og yck 'okl y ld] ftll fd og ckljh d Loj dk fu;f=r dj ldA ,d f[kykMh d fy, bldk vFk g fd og fo"ke ifjfLFkfr;k e Hkh d'kyrkiod viu [ky dk in'ku dj ldA

db ckj fcuk fdlh fo'k"k jkx d Hkh ge vLoLFk gk tkr gA tl& mi;Dr mnkgj.kk e fd, tku oky dk;k dk lcfèkr 0;fDr lgt :i l inf'kr dju e vleFk gkrk g rk ge dgr g fd og vLoLFk gA

ge LoLFk jgu dk gh LokLF; le>r g rk jkx D;k g\ jkx dk vxth d 'kCn Disease l n'kk;k tkrk gA ;g nk Hkkxk e ckVk tk ldrk g& Dis + ease bldk 'kkfCnd vFk n[k rk Dis dk vFk ckèkk ;k ckfèkr gkuk (Disturbed) ease dk vFk vkjke (Rest)A jkx dk nljk vFk g vlfoèkk vFkkr jkx gku dk vFk g fd gedk 'kkjhfjd vlfoèkk gA ge jkx d fo"k; e rc ckr djr g tc ge vlfoèkk d fof'k"V y{k.k dk irk gkrk gA tl& 0;fDr dk ckj&ckj d ,o nLr gk jg g rc ;g dg ldr g fd og 0;fDr fdlh jkx l xflr gA ;g jkx Mk;fj;k gk ldrk gA

- LoLFk jgu ,o vLoLFkrk e vrj Li"V djA

13.3 LokLF; dk iHkkfor dju oky dkjd (Factors that affect health)

gekjk LokLF; gekj ?kj] ikl&iMkl vkj vkl&ikl d thok ,o ifjfLFkfr;k ij fuHkj jgrk gA

- D;k vkid ekgYy@dkykuh e lHkh ?kjk dk LoPN ty ikIr gk jgk g\
- vkid ?kj dk dpjk dgk Qdk tkrk g\
- vkid ekgYy e mRiUu dpj dk fuiVkjk dku vkj dl djrk g\
- vkid ekgYy dh lMdk o ukfy;k dh lQkb ,d llrkg e fdruh ckj gkrh g\

ge lHkh dk gekj vkl&ikl dh LoPNrk dh vkj Hkh è;ku nuk vko';d gA tjk lkfp,! ;fn ukfy;k lkQ u gk rk D;k gkxk\ tc dpjk o dMk&djdV lMdk o xfy;k e Qyk jg rk D;k gkxk\ tc [kyh ukfy;k dk xnk ikuh lMdk ij cg jgk gk rk D;k gkxk\ bl idkj dh ifjfLFkfr;k e gekj LokLF; d fcxMu dh lHkkouk, c< tkrh gA

blh idkj ty] ok; ,o Hkk tu e mifLFkr gkfudkjd thok tLk& thok.k] fo"kk.k] dod] ikVk tkvk] gyfeFkl ueVkMl vkfn d dkj.k gekjk LokLF; fcxM ldrk gA fofHkUu i;koj.kh; ifjfLFkfr;k tl& ck<] Hkdi o l[kk vkfn Hkh gekj LokLF; dk iHkkfor djr gA

13-4 jkx dh vfHk0;fDr y{k.kk d vkèkkj ij

vkb,] jkx d fo"k; e vkj vfèkd lkpA igy ;g fd ge dl irk yxrk g fd ge dkb jkx g\ geu ^^cgdkf'kdh; ljpuk ¼ Ård** vè;k; e i<k g fd gekj 'kjhj e vud Ård gkr gA ; Ård gekj 'kjhj d vxr=k dk cukr g tk 'kjhj d fofHkUu dk;k dk likfnr djr gA iR;d vxr= e fo'k"k vx gkr g ftud fof'k"V dk; gkr g] tl ikpu r= e vkek'k; rFkk vkr gkr g] tk gekj }kjk [kk, x, Hkk tu dk ipkr gA if'k;k rFkk vfLFk;k l cuk i'kh&ddky r= gekj 'kjhj dk lHkkyrk g vkj 'kjhj dh xfr e lgk;rk djrk gA

tc dkb jkx gkrk g rc 'kjhj d ,d vFkok vud vxk ,o r=k d dk; dju e vFkok ljpuk e ^[kjkch* ifjyf{kr gku yxrh gA ; cnyko ¼ifjoru½ jkx d y{k.k n'kkr gA jkx d y{k.k ge ^[kjkch* dk ldr nr gA bl idkj fljnn] [kklh] nLr] fdlh ?kko e il ¼eokn½ vkuk] ; lHkh y{k.k gA bu y{k.kk l fdlh&u&fdlh jkx dk irk yxrk gA yfdu bul ;g ugh irk pyrk fd dku&lk jkx g\ mnkgj.k d fy,] fljnn dk dkj.k vk[kk dk detkj gkuk] ijh{kk dk Hk; vFkok ntuk fofHkUu chekfj;k e l ,d gk ldrk gA

jkx d fpà o g ftUg fpfdRld y{k.kk d vkèkkj ij n[kr gA y{k.k fdlh fo'k"k jkx d ckj e lfuf'pr ldr nr gA fpfdRld jkx d lgh dkj.k dk tkuu d fy, i;kx'kkyk e dN tkp Hkh djokr gA

13-5 jkx dk i"Vhdj.k

;fn fdlh 0;fDr dk LokLF; vPNk ugh g rk mldh vfHk0;fDr y{k.kk d }kjk gkrh gA tl& fdlh 0;fDr dk detkjh o gkFk&ij e nn dh f'kdk;r gk rk bu y{k.kk d vkèkkj ij ;g ugh dgk tk ldrk g fd ml dkb jkx g ;k ughA jkx dh if"V tkp d }kjk dh tk ldrh gA oreku e fpfdRlk {k= e fofHkUu idkj dh tkp lfoèkk, miyC;k g] ftul 'kjhj dh tkp dN gh le; e djd jkx d dkj.kk dh if"V dj yh tkrh gA bl idkj dh tkp e jDr] dQ o ey&e= vkfn dh tkp dh tkrh gA

- fdlh fpfdRld l irk dj] fd mi;Dr tkpk l D;k&D;k tkudkjh feyrh g\

,d jkx d cgr lkj y{k.k

gekj 'kjhj d vxk e [kjkch ifjyf{kr gku ij db y{k.k fn[kkb nr g tl& tdke] [kklh] c[kkj] nLr] fljnn] iV&nn] gkFk&ij e nn vkfnA bu y{k.kk l fdlh u fdlh jkx dk gkuk irk yxrk g] fdr

;g irk ugh yxrk g fd dku&lk jkx gA mnkgj.k d fy, {k; jkx ¼Vh-ch-½ d db y{k.k g tl fd lnh] [kklh] fljnn] c[kkj] otu de gkuk] lkl Qyuk vkfnA vFkkr ,d gh jkx d cgr lkj y{k.k gk ldr gA

,d y{k.k cgr lkj jkxk e

cgr lkj jkxk e ,d gh y{k.k gk ldrk g tl& ge fljnn gk jgk g rc gk ldrk g fd fljnn dk dkj.k ekbxu ;k tdke gkA

fØ;kdyki&1

viu ekgYy e irk yxk,&

- vHkh fdru ykxk dk dkb jkx g\ ¼mud uke rFkk MkDVj }kjk crk, x, jkxk d uke dh lph cuk,½
- bu jkxk d y{k.kk dh lph cuk,A ¼mijkDr lph e tkM½
- ,d gh y{k.k oky 0;fDr;k e dku&dku l jkx g\

13-6 jkxk dk legh dj.k&vofèkdky d vkèkkj ij

db ckj ge pkV yxrh g vkj ?kko dN gh fnuk e Bhd gk tkrk g tl& lkbfdy l fxju ;k [kyr le; fxju l pkV yxuk vkfnA ijr dN chekfj;k ,lh gkrh g ftUg Bhd gku e cgr yck le; yxrk gA vr% ge jkxk dk vofèkdky d vkèkkj ij fuEu idkj l legh—r dj ldr g&

13-6-1 rho jkx (Acute diseases)

,l jkx tk cgr de le; d fy, gkr g ;k mipkj dju ij dN le; e gh Bhd gk tkr g rFkk mul lkekU; :i l LokLF; ij cgr vfèkd iHkko ugh iMrk g tl& tdke] lkekU; c[kkj gkuk vkfnA

13-6-2 nh?kdkfyd jkx (Chronic diseases)

,l jkx tk mipkj yr jgu d ckotn Hkh cgr yc le; rd cu jgr gA tl& {k; jkx ¼Vh-ch-½A bl jkx l yc le; rd xflr gku d dkj.k 0;fDr dk otu de gkuk] lkl Qyuk] Fkdku egl l djuk vkfn y{k.k fn[kkb nr gA

;fn jkx dk lgh rjhd o lgh le; ij tkp o mipkj ugh gk rc rho jkx Hkh nh?kdkfyd jkx e cny ldrk gA mnkgj.k d fy, tdke o [kklh dk lgh le; ij mipkj u gk rFkk ;g yc le; rd cuk jg rk 0;fDr dk nek gk ldrk gA

13-7 jkx d dkjd

vkidk irk g fd jkx d db dkj.k gk ldr g bUg ge ¼1½ rkRdkfyd dkj.k o ¼2½ lgk;d dkj.k d vrxr le> ldr gA

;fn fdlh bykd e dkb NkVk cPpk iry nLr l xLr g] rk ge dg ldr g fd bldk dkj.k nf"kr ty e mifLFkr fo"kk.k gk ldr gA bl fLFkfr e jkx dk rkRdkfyd dkj.k fo"kk.k gkxkA yfdu bykd d vU; cPpk u Hkh ogh nf"kr ty fi;k g rc bldk D;k dkj.k g fd ,d cPp dk gh nLr yx vkj nljk dk ugh\

bldk dkj.k ;g gk ldrk g fd ml cPp e ifrjks/kd {kerk de gkA ifj.kkeLo:i cPpk fo"kk.k d lid e vkrk g rk og iry nLr l xLr gk tkrk g tcfd vU; cPp ughA

vc i'u mBrk g fd cPp dh ifrjks/kd {kerk de D;k g\ 'kk;n cPp dk i;kIr Hkk tu u feyk gk] ftll mld 'kjhj e ik"kd vo;ok dk vHkko gk x;kA

;g Hkh lHko g fd ml cPp e ih<h nj ih<h LFkkukrfjr gku oky x.kk e fofHkUurk gk] rc og cPpk fo"kk.k d lid e vku ij iry nLr l xflr gk tkrk gA bl fLFkfr e fofHkUurk ;k ik"kd vo;ok dk vHkko Hkh fcuk fo"kk.k d nLr mRiUu ugh djr] yfdu o jkx d lgk;d dkj.k cur gA

cPp dk LoPN ty miyC/k ugh gvkA bld ihN vU; db dkj.k gk ldr gA bue l ,d dkj.k ;g Hkh gk ldrk g fd tgk ml cPp dk ifjokj jgrk g lkQ&lQkb dh deh d dkj.k ogk dk ty nf"kr gk x;k gkA

- D;k vkidk ;k vkid ifjokj d lnL;k dk dHkh nLr g, g\
- nLr gku dk dkj.k D;k Fkk\ lph cuk,A
- bu fLFkfr;k e rkRdkfyd ,o lgk;d dkj.kk dk vyx&vyx djA

13-7-1 lØked jkx ,o dkjd (Infectious/Communicable disease and its agents)

vofèkdky d vykok jkxk dk mud Qyu d rjhdk d vkèkkj ij Hkh legh dr fd;k tk ldrk gA bld vUrxr lØked o vlØked jkx vkr gA cgèkk vkidk ;g fgnk;r nh tkrh gkxh fd jkxh 0;fDr;k l nj jgA ftll vki Hkh ml chekjh l xflr u gk tk,A

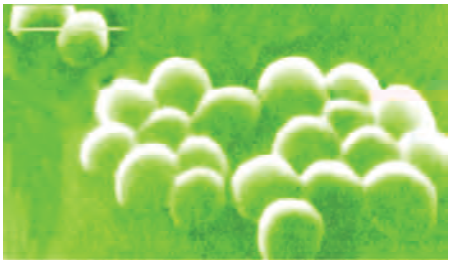
cPp dk nLr yxu oky mnkgj.k e geu i<k fd nLr yxu dk rkRdkfyd dkj.k fo"kk.k gk ldrk gA fo"kk.k dh rjg gh vU; tho tl& thok.k] dod] dfe] ikVk tkvk vkfn Hkh jkx Qyku oky rkRdkfyd dkj.k gA bu dkjdk l xflr jkxh d lid e vku ij LoLFk 0;fDr Hkh jkx xflr gk tkr gA vr% bUg

lØked dkjd dgk tkrk gA bul mRiUu gku oky jkxk dk lØked jkx dgr gA tdke] Vh-ch-] gtk] lyx] Ropk lcèkh jkx vkfn lØked jkxk d mnkgj.k gA

- MkDVj@ul@LokLF; depkjh vU; 0;fDr;k dh vi{kk jkfx;k d lid e vfèkd jgr gA irk djk fd o viu vkidk lØfer gku l dl cpkr gkx\

y'ekfu;k&;g dkyktkj 0;kf/k dkjd ikVktkvk gA ;g tho vMkdkj gkrk g rFkk iR;d e ,d pkcduek ljpuk gkrh gA foHkkftr gkr tho dk rhj }kjk n'kk;k x;k gA

fVluk lkek&;g funky 0;kf/k dkjd ikVktkvk gA bl r'rjhuek yky jDr df.kdk d lkFk inf'kr fd;k x;k g ftll vkidk mld vkdkj dk irk py ldA



LVQkbykdkdkb cDVhfj;k tk egkl dk dkjd gA 5 ekbØkehVj eki dh j[kk dk n'kkr g,A

xky dfe¼,Ldfjl ychdk;fMl½&;g NkVh vkr e ik;k tkrk gA 4 leh- d Ldy dh eki ,d o;Ld xky dfe d vkdkj d vueku d fy, gA

fp= Øekd&2% fofHkUu lØked dkjd

13-7-2 vlØked jkx ,o dkjd (Uninfectious/Non communicable disease and its agents)

dN jkx ,l gkr g tk lØked dkjdk }kjk ugh gkr mud dkjd fHkUu&fHkUu gk ldr gA bUg vlØked jkxk dh J.kh e j[kk tkrk gA mnkgj.k d fy, gfl;kdkj dkf'kdk vjDrrk ¼fldy ly ,uhfe;k½ dN idkj d dlj] vkuokf'kd vlkekU;rk d dkj.k gk ldr gA blh idkj mPp jDrpki dk dkj.k vfèkd otu gkuk rFkk 0;k;ke u djuk gk ldrk gA bl idkj d jkx e jkxh 0;fDr l lid e vku ij LoLFk 0;fDr;k ij jkx dk dkb iHkko ugh iMrk gA blh dkj.k bUg vlØked jkx dgr gA

- D;k jkxh 0;fDr l ge'kk njh cuk, j[kuk mfpr g\ vkil e ppk djA
- eu";k e vlØked jkx dl gk tkr g\

D;k vki tkur g

iflVd o.k ¼iflVd vYlj½ rFkk ukcy ijLdkj

db o"kk l ge ;gh lkpr Fk fd iflVd o.k tk vkek'k; rFkk xg.kh e vEyh;rk lcfèkr nn rFkk jDr lko djrk g ftl dk dkj.k jgu&lgu dk <x gA iR;d 0;fDr lkprk Fkk fd ij'kkuh Hkj thou l vkek'k; e vEy dk lko gkrk g] ftl dkj.k iflVd o.k gk tkrk gA

nk vkLVfy;kb oKkfudk u irk yxk;k fd ,d thok.k&gyhdkcDVj ik;ykjh iflVd o.k dk dkj.k gA iFk] vkLVfy;k d jkx foKkuh jkfcu okju ¼tUe lu 1937½ u bu NkV&NkV oØkdkj thok.kvk dk vud jkfx;k d vkek'k; d fupy Hkkx e n[kkA cjh ek'ky ¼tUe lu 1951½ ,d fpfdRld u okju dh [kkt e fnypLih yh vkj mUgku bu lkrk l thok.k dk loèku dju e lgk;rk ikIr dhA

viu mipkj vè;;u e ek'ky rFkk okju u irk yxk;k fd jkxh d iflVd o.k dk mipkj rHkh gk ldrk g tc dkjd thok.kvk dk vkek'k; e gh ekj fn;k tk,A bUgku iflVd o.k ifrtfod r;kj fd;k rFkk bld mipkj l iflVd o.k Bhd gk tkrk gA bl [kkt d fy, ek'ky rFkk okju dk ¼fp= e n[k½ 'kjhj fØ;k foKku rFkk vk"kfèk d fy, lu 2005 e l;Dr :i l ukcy ijLdkj inku fd;k x;kA

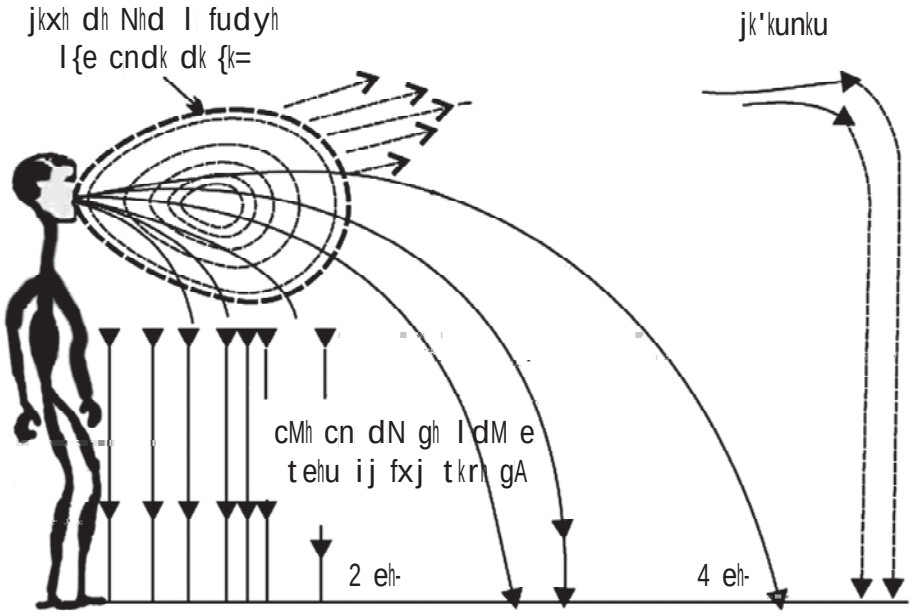
13-8 jkx Qyu d lkèku

geu i<k fd lØfer 0;fDr d lid e vku ij nlj 0;fDr;k dk Hkh jkx xLr gku dh lHkkouk c< tkrh gA

- jkxh 0;fDr d lid e vku ij vU; 0;fDr;k dk og jkx dl gk ldrk g\

lØked jkx d tho ,d 0;fDr l nlj 0;fDr;k rd fofHkUu ekè;ek }kjk vklkuh l Qyr g tl&ok;] ty] Hkktu] yfxd lid vkfnA

U;ekfu;k rFkk rifnd tl jkx ok; d ekè;e l Qyr gA tc jkxh 0;fDr Nhdrk ;k [kklrk g rk mldh ykj d NhVk d lkFk 'kjhj e mifLFkr jkx d thok.k ;k fo"kk.k ckgj vkr g rFkk vkl&ikl mifLFkr LoLFk 0;fDr dk lØfer dj nr g ftl LoLFk 0;fDr Hkh jkx l xflr gk tkrk gA



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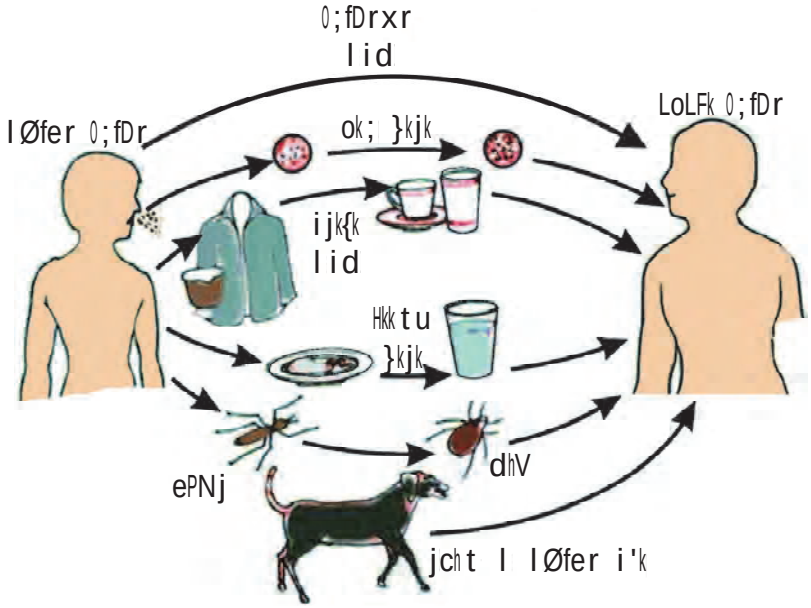
jkxh d ikl [kM 0;fDr dk ok; d ek/;e l ¼okfgr½ jkxk dk lØe.k gku dh lHkkouk c< tkrh gA vfèkd HkhM oky ,o de jk'kunku oky ?kjk e Hkh ok; okfgr jkx gku dh lHkkouk vfèkd gkrh gA¼fp=&3½

nf"kr o vèkid ekl o vU; HkkT; lkexh dk Hkk tu d :i e fy;k tk,] rc bll Hkh db idkj d lØked jkx Qyr gA dod ¼Qxl½ yxk HkkT; inkFk xg.k dju l [kk| fo"kDrrk gku dk [krjk jgrk gA



fp= Øekd&4 % jkx lØe.k d lkekU; rjhd

bld vykok dN vU; jkx yfxd lid d dkj.k Hkh Qyr g tl& flQfyl] ,Ml (AIDS) vkfnA ,Ml yfxd lid d vykok jDr vkèkku ¼jDr p<kuk½] lØfer btD'ku] xflr ekrk }kjk cPp dk nXèkiku djku ,o xflr ekrk l xHk d f'k'k e Hkh Qyrk gA

- eu";k e vlØked jkx dl gk tkr g\

13-9 vx fof'k"V rFkk Ård fof'k"V vfHk0;fDr (Organ specific and tissue specific manifestation)

geu ckr dh g fd fofHkUu lkèkuk tl& ty] ok;] Hkk tu }kjk jkx mRiUu dju oky l{etho 'kjhj e io'k djr gA fQj ; dgk tkr g\ ; 'kjhj e dgh Hkh tk ldr gA tl& gok l io'k dju oky l{etho ukd d ekè;e l QQMk e igpr g vkj {k;jkx mRiUu djr gA ; thok.k tc vfLFk ij lØe.k djr g rk mUg Hkxj djr rFkk detkj cuk nr g tl vfLFk dk {k; jkxA eg d }kjk io'k dju oky l{etho vkgkjuky e tkdj Vk;QkbM tl jkx mRiUu djr gA giVkbfVl fo"kk.k ;dr e igpdj ihfy;k jkx mRiUu djr gA

,p-vkb-oh- (HIV) tk ,d fo"kk.k g] 'kjhj e io'k dj ylhdk xfFk;k e Qyrk gA eyfj;k mRiUu dju oky l{e tho ePNj d dkVu l 'kjhj e io'k djr gA ; ;dr e tkr g] mld ckn yky #fèkj dkf'kdkvk }kjk 'kjhj d vU; vxk dk Hkh iHkkfor djr gA ;fn ge ;g tkur gk] fd dku l Ård vFkok vx ij vkØe.k gvk g vkj ml Ård ;k vx dk D;k dk; g rk ge lØe.k d fpgu rFkk y{k.k dk vueku yxk ldr gA

lØked jkxk d Ård fof'k"V iHkko d vfrfjDr mud vU; lkekU; iHkko Hkh gkr gA vfèkdk'k lkekU; iHkko bl ij fuHkj djr g fd lØe.k l 'kjhj dk ifrj{kk r= fØ;k'khy gk tk,A bl idkj lfØ; ifrj{kk r= iHkkfor Ård d pkjk vkj jkx mRiUu dju oky l{e thok dk ekju d fy, vud dkf'kdk, cuk nrk gA bl iØe dk 'kkFk (inflammation) dgr g rFkk bl iØe e LFkkuh; iHkko tl& iHkkfor vx dk Qyuk rFkk nn gkuk vkj lkekU; iHkko tl& c[kkj] ltu vkfn gkr gA

D;k vki tkur g

ifrj{kk r= (Immune system)

ifrj{kk i.kkyh fdlh tho d 'kjhj d Hkhrj fof'k"V dkf'kdkvk dk ,d leg g] tk jkxtudk vkj vokNuh; dkf'kdkvk dk igpku dj mUg u"V djrh g rFkk jkxk l j{kk djrh gA ;g i.kkyh fo"kk.kvk l ydj ijthoh dfe;k tl& fofHkUu idkj d jkx dkjdk dk igpkuu e l{ke gkrh gA fdr ;g thok dh LoLFk dkf'kdkvk ij dkb ifrfØ;k ugh djrh g] ftl 'kkjhfjd i.kkyh lpk: :i l dk; djrh jgrh gA

dN ekeyk e lØe.k d fof'k"V Ård vfr lkekU; iHkko dk yf{kr djr gA mnkgj.k ,p-vkb-oh-lØe.k e fo"kk.k ifrj{kk r= dk u"V dj nr g ft ll jkxh dk 'kjhj ifrfnu gku oky NkV&NkV lØe.kk dk edkcyk ugh dj ikrk gA gYd [kklh tdke l Hkh fuekfu;k gk ldrk gA blh idkj vkgkjuky d lØe.k l #fèkj;Dr iokfgdk gk ldrh gA vrr% ; vU; lØe.k gh ,Ml d jkxh dh eR; d dkj.k cur gA

ge ;g Hkh Lej.k j[kuk vko';d g fd jkx dh rhork dh vfHk0;fDr 'kjhj e fLFkr gkfudkjd thok dh l[;k ij fuHkj djrh gA ;fn budh l[;k cgr de g rk jkx dh vfHk0;fDr Hkh de gkxhA ;fn budh l[;k vfèkd gkxh rk jkx dh vfHk0;fDr bruh rho gkxh fd thou dk Hkh [krjk gk ldrk gA vr% gekj 'kjhj dk ifrj{kk r= gh budh l[;k dk fuèkkfjr djrk g rFkk ge jkxk l cpkrk gA

- Þifrj{kk r= dh jkx d cpko e egRoi.k Hkfedk jgrh gAÞ ,Ml d lnHk e bl dFku dk le>k,A

ge ,l i;koj.k e jgr g ft le gekj vfrfjDr vU; tho Hkh jgr gA blfy, dN jkx vU; trvk }kjk Hkh lpkfjr gkr jgr gA ; tUr jkxk.kvk ¼lØe.k dju oky dkjd½ dk jkxh l ydj vU; u, ik"kh rd igpk nr gA vr% ; e/;LFk dk dke djr g] ftUg jkxokgd ¼Vector½ dgr gA lkekU; jkxokgd dk ePNj ,d mnkgj.k gA ePNj dh cgr lh ,lh itkfr;k g ftUg vR;fèkd ik"k.k dh vko';drk gkrh g ft ll fd o ifjiDo vM mRiUu dj ldA ePNj vud lerkih ikf.k;k ¼ft le eu"; Hkh 'kkfey½ ij fuokg djrk gA bl idkj o ,d eu"; l nlj eu"; e jkx dk Qykr gA

13-10 jkdFkke ,o mipkj (Prevention and treatment)

vc rd dh tkudkjh d vkèkkj ij ;g le> curh g fd lØked jkx d mipkj d nk mik; gk ldr g&

¼1½ jkx d iHkko dk de djdA ¼2½ jkx d dkjd dk u"V djdA

mipkj dk igyk rjhdk ;g g fd jkx d tk y{k.k fn[kkb nr g mu y{k.kk d vkèkkj ij nok nh tkrh gA nok yu d i'pkr jkxh dk vkjke dju dh lykg nh tkrh gA ft ll 'kjhj dh Åtk ljf{kr gk tk,] tk LoLFk gku e lgk;d gA ijr bl y{k.k vkèkkfjr mipkj l doy y{k.k nc tkr g vkj lHkkouk jgrh g fd dN le; i'pkr iu% ge jkx d y{k.k fn[kkb nA tl& fdlh lØe.k l ge c[kkj vk jgk g] c[kkj dh dkb nok yu l c[kkj rk Bhd gk tkrk g ijr lØked jkx dk dkjd l{etho u"V ugh gk ikrk vkj dN fnuk d vrjky e iu% c[kkj vk tkrk gA

nlj rjhd d dkjdk ¼thok.k] fo"kk.k] dod vkfn½ dk dl igpku bld fy, tkp dh vko';drk iMrh gA budh igpku dj yu d i'pkr mi;Dr nok dk i;kx fd;k tkrk gA tl& jDr dh tkp d i'pkr Kkr gkrk g fd eyfj;k c[kkj g rk eyfj;k d fy, nok fu;fer :i l rFkk fuf'pr vofèk rd vFkkr ijk Mkt yuk pkfg,] ft ll eyfj;k d dkjd u"V gk tk,A

13-11 jkxk l cpko (Prevention of diseases)

LoLFk thou thu d fy, vko';d g fd ge ,l i;kl dj ft l l fd ge jkx gku dh lHkkouk, de l de gkA

- dN ,l i;kl k d ckj e crk, ft l l fd ge jkxxLr u gkA

LoLFk jgu dh 'k#vkr LoPN okrkoj.k l dh tk ldrh gA ;fn ge viu vkl&ikl d okrkoj.k dk xnxheDr j[k rk ge jkx Qyu d db dkj.kk dk fu;f=r dj ldr gA blh d lkFk&lkFk Hkktu dh i;kIr ek=k o 0;k;ke d }kjk Hkh ge jkxk l nj jg ldr gA

blh vè;k; e geu i<k g fd jkxk l cpko dk lhèkk lcèk gekj ifrj{kk r= l gkrk gA vxj gekjk ifrj{kk r= etcr gkxk rk yc le; rd ge LoLFk cu jg ldr gA vktdy ifrj{kk r= dk etcr cuku d fy, db i;kl fd, tkr g rkfd jkx gku l igy gh 'kjhj e jkx l cpu d fy, ln< 0;oLFkk cu tk,A vkiu ^Vhdkdj.k* d ckj e rk luk gkxk] ;g ,d ,lh gh ifØ;k gA

D;k vki tkur g

ifrj{kk (Immunity)

ijijk d vulkj Hkkjrh; rFkk phuh fpfdRldh; r= e dHkh&dHkh tkuc>dj ppd l ihfMr 0;fDr rFkk LoLFk 0;fDr dh Ropk dk vkil e jxMr FkA mUg bll ,lh vk'kk Fkh fd bld dkj.k ppd d en jkxk.k LoLFk 0;fDr d 'kjhj e jkx d ifr ifrjkèkd {kerk mRiUu dj nxA nk lk o"k io ,d bfXy'k fpfdRld] ftudk uke ,MoM tuj Fkk] u irk yxk;k fd Xoky ftUg xk&ppd gb g mUg egkekjh d le; Hkh ppd ugh gbA tuj u tkuc>dj ykxk dk xk&ppd fn;kA bll mUgku ik;k fd vc o ykx ppd d ifrjkèkh gA bldk dkj.k ;g g fd ppd dk fo"kk.k xk&ppd d fo"kk.k dk fudV lcèkh gA yfVu e Cow ¼xk;½ dk vFk g okDdk rFkk cowpox ¼xk&ppd½ dk vFk g oDlhfu;kA bl vkèkkj ij oDlhu vFkkr Vhdk 'kCn vk;k g] ft ldk ge vktdy mi;kx djr gA

- D;k vkidk dHkh ^Vhdk* yxk g\ viu vfHkHkkodk l irk dj fd vkidk dku&dku l Vhd yx g\

Vhdkdj.k og mik; g ft ld }kjk fdlh jkx fof'k"V d ifr 'kjhj e jkx ifrjkèkd {kerk mRiUu dh tkrh gA Vhdkdj.k dh ifØ;k }kjk 'kjhj e thok.kvk ,o fo"kk.kvk dh fu;f=r ek=k io'k djkb tkrh gA ft l l jkx dk gYdk vkØe.k gkrk gA bll gekj 'kjhj e iuk blh idkj dk vkØe.k gku ij jkx l yMu dh {kerk c< tkrh gA

fp= Øekd&5 % ikfy;k Mki }kjk Vhdkdj.k

e[; 'kCn (Keywords)

lØked jkx (communicable disease)] vlØked jkx (non-communicable disease)] okgd (vector)] ifrj{kk r= (immune system)] thok.k (bacteria)] fo"kk.k (virus)] 'kFk (inflammation)] Vhdkdj.k (vaccination)] ,p-vkbZ-oh- (human immuno deficiency virus), ,Ml (aquired human immuno deficiency syndrome)] nh?kdkfyd jkx (chronic disease)] rho jkx (acute disease)

geu lh[kk

- LokLF; og fLFkfr g ftle 'kkjhfjd] ekufld vkj dk'ky ;Dr dk; viuh {kerk ,o n{krk d lkFk ijk fd;k tk ldA
- jkx 'kCn dk vxth 'kCn Disease l n'kk;k tkrk gA ftldk vFk vkjke e ckèkk gkuk gA
- 0;fDrxr LokLF; d fy, lkotfud LoPNrk egRoi.k gA
- rho jkx mipkj dju ij dN le; e gh Bhd gk tkr g tl pkV yxu d dkj.k c[kkjA nh?kdkfyd jkx ych vofèk rd cuk jgrk g tl& Vh-chA
- nf"kr ty] vkgkj e ik"kd vo;ok dk vHkko vkfn jkxk d mRiUu gku d lgk;d dkj.k gk ldr gA
- lØked dkjdk }kjk mRiUu gku oky jkx ^^lØked jkx** dgykr gA mnkgj.k& g tk] Vk;Qk;M] ,Ml ,o {k; jkx vkfnA
- ,Ml d jkxh d ifrj{kk r= dk detkj gkuk mldh eR; dk dkj.k gkrk gA
- thok e ifrj{kk r= jkxtudk vkj vokNuh; dkf'kdkvk dk igpku dj bUg u"V djd jkxk l tho dh j{kk djrk gA
- fo"kk.kvk l mRiUu jkx tl& fVVul] fMIFkhfj;k] ddj[kklh] [kljk] ikfy;k vkfn dk lkeuk dju d fy, ifrjkèkd {kerk fodflr dh tkrh gA
- Vhdkdj.k }kjk lØked jkxk dk fuokj.k fd;k tk ldrk gA

vH;kl

1- lgh fodYi pu&

(i) dku&lk jkx lØked g&

¼v½ jrkèkh ¼c½ eèkeg

¼l½ mPp jDr nkc ¼n½ gtk

(ii) ,Ml fdld }kjk gkrk g&

¼v½ fo"kk.k ¼c½ thok.k

¼l½ dod ¼n½ dfe

(iii) dku&lk jkx lØked ugh g&

¼v½ Vk;Qk;M ¼c½ d"B

¼l½ NkVh ekrk ¼n½ jDr dlj

2- vPN LokLF; dh nk vko';d fLFkfr;k crk,A

3- jkx gku d fdUgh nk ie[k dkjdk dk fy[kA

4- fiNy ,d o"k e vki fdruh ckj chekj g,\ chekjh D;k Fkh\

¼v½ bu chekfj;k dk gVku d fy, vki viuh fnup;k e D;k ifjoru djx\

¼c½ bu chekfj;k l cpu d fy, vki viu ikl&iMkl e D;k ifjoru djuk pkgx\

5- ,d cPpk viuh chekjh d fo"k; e ugh crk ik jgk gA ge dl irk djx fd&

¼v½ cPpk chekj g\ ¼c½ ml dku&lh chekjh g\

6- lØked rFkk vlØked jkxk d chp D;k fHkUurk gkrh g\ iR;d jkx dk ,d mnkgj.k nA

7- fuEufyf[kr e l fdu ifjfLFkfr;k e vkid chekj gku dh lHkkouk, vfèkd g\ D;k\

¼v½ tc vkidh ijh{kk dk le; g\

¼c½ tc vki cl rFkk jyxkMh e nk fnu rd ;k=k dj pd g\

¼l½ tc vki dk fe= [kljk l ihfMr gA

8- jkx ifrjkèkd {kerk fdl dgr gA ;g gekj LokLF; dk dl iHkkfor djrh g\ ,d mnkgj.k l le>k,A

9- jkx dh jkdFkke mld mipkj l cgrj gA bl dFku dh lkFkdrk crku d fy, dkb ,d mnkgj.k nA

ifjf'k"V

LokLF; lcèkh prkouh

èkeiku l gkfu;k& èkeiku l QQMk ij diHkko iMrk gA rEckd e fo"kyk inkFk fudkfVu ik;k tkrk gA ;g QQMk dk gkfu igpkrk gA èkeiku l dfidkvk dh vkrfjd f>Yyh QV tkrh gA èkeiku dju l dkcu MkbvkDlkbM xl eklif'k;k] efLr"d vkj jDr d fy, miyC èk vkDlhtu dh ek=k de dj nrh g] ftll xlk dh vnyk cnyh dk {k= de gk tkrk gA vfèkd vkDlhtu xg.k dju d fy, ân; dk vfèkd dk; djuk iMrk g ftll ân;k?kkr dh lHkkouk c< tkrh gA

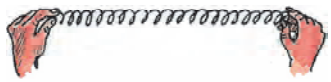
rEckd fudkfV;k Vcde dh ifÙk;k d fd.ou }kjk cukb tkrh gA bld lou l gkB] thHk] e[kxgk dh f>Yyh] xfldk d dlj gku dh lHkkouk gkrh gA

'kjkc l udlku& vR;fèkd 'kjkc ihu d ckn eNk gkrh gA ,dkxrk dh deh] efLr"d dk udlku] mPp jDr nkc] xn dh foQyrk vkfn y{k.k fn[kkb nr g lkFk gh lkFk ihfy;k] ;dr dk dlj vkj giVkbfVl vkfn jkx gku dh lHkkouk gkrh gA

bud vfrfjDr u'khy inkFk tl& dkdhu] vQhe] xktk dk lou dju ij ; ekufld mRrtuk] lEekgu iHkko] foHke] prukghurk] vkfn mRiUu djr gA budk lou vktdy ,d xHkhj leL;k curh tk jgh gA

vè;k;&14
èofu

(Sound)



nfud thou e ge fofHkUu idkj dh èofu;k lur g t l i'k&if{k;k dh èofu] e'khu&xkfM;k dh èofu] Vh-oh-&VyhQku dh èofu vkfnA dN èofu;k ,lh gkrh g] ft l ge ugh lu ikr yfdu dN i'k&i{kh ml lu ldr gA

èofu l lcfèkr db i'u g t l&

1- èofu D;k g\ ;g dl mRiUu gkrh g\

2- èofu fdlh lkr l gekj dku rd dl igprh g\

3- cn dkj] cn cl ;k cn dej d Hkhrj fdlh 0;fDr dh vkokt ckgj [kM 0;fDr dk lukb ugh nrh ;k cgr de lukb nrh gA exj tc vki dkj d 'kh'k ;k njokt dk [kV[kVkr g rc nkuk vkj vkokt lukb nrh gA ,lk D;k\

bl vè;k; e ge bu lHkh i'uk d mÙkj [kktu dk i;kl djxA lkFk gh bll lcfèkr fØ;kdyki ,o i;kx Hkh djxA

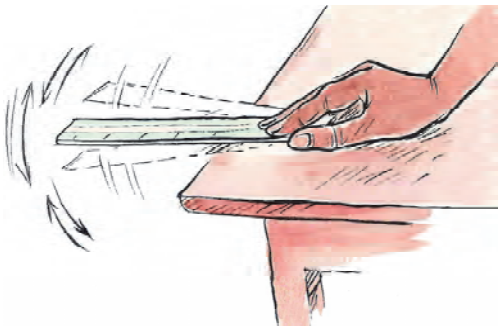
14-1 èofu dk mRiUu gkuk

fØ;kdyki&1

1- ,d ehVj Ldy yA

2- bld ,d flj dk 40 cm rd et d fdukj ij dl dj nck, j[kA ¼fp=&1½

3- Ldy d nlj flj dk uhp dh vkj nckdj NkM nA geu n[kk fd Ldy diu dju yxrk g vkj èofu mRiUu gkrh gA bl fØ;kdyki e Ldy dk 30 cm, 20 cm rFkk 10 cm rd j[kdj nkgjk,A vkiu D;k vuHko fd;k\ D;k Ldy dh yEckb dk èofu ij iHkko iMk\



fp= Øekd&1 % ehVj Ldy e diu

fØ;kdyki&2

1- fp=&2 e fn[kk, vulkj ekkr d rkj dk nk gd d chp e dl dj ckfèk,A ¼è;ku n fd rkj e ekM u gk½

fp= Øekd&2 % ekkr d rkj dk gd l cèkk gkuk

2- viuh mxyh l Ndj ml dfir djk,A

D;k vkidk èofu lukb nh\ ;fn gk rk D;k ;g èofu fØ;kdyki&1 e mRiUu gb èofu l vyx Fkh\

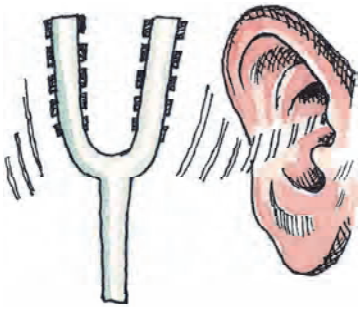
fØ;kdyki&3

1- ,d Lofj= f}Hkt yA

2- bldh Hktk dk jcj iM ij ekjdj dfir djkb,A

3- dfir Lofj= f}Hkt dk dku d lehi yk,A

D;k vkidk èofu lukb nrh g\ dfir Lofj= f}Hkt dh Hktk dk viuh mxyh l Li'k djA vkiu D;k vuHko fd;k\ fe=k l ppk djA



fp= Øekd&3 %
dfir [kfj= f}Hkt dh èofu luuk

mDr lHkh fØ;kdykik e vkiu n[kk fd èofu fdlh oLr e diu l mRiUu gkrh gA fHkUu&fHkUu inkFkk ¼oLrvk½ e diu l fHkUu&fHkUu idkj dh èofu;k mRiUu gkrh gA èofu inkFk dh iR;kLFkrk ij fuHkj djrh gA **iR;kLFkrk inkFk dk og x.k g ftll og viu vkdkj ;k vkdfr e ifjoru dk fojkèk djrk gA** vFkkr tc fdlh inkFk ij cy yxkdj mldh vkdfr ;k vkdkj e ifjoru fd;k tkrk g vFkok ifjoru dk i;kl fd;k tkrk g rc og iR;kLFkrk d dkj.k ml ifjoru dk fojkèk djr g, iu% viuh io fLFkfr e vku dk i;kl djrh gA

tk inkFk ftruk T;knk iR;kLFk gkxk] og mruh gh 'kh?krk l viuh io fLFkfr e vku dk i;kl djxk tl& èkkr l cu inkFk jcj dh vi{kk vfèkd iR;kLFk gkr gA blh dkj.k mUg ekMuk ;k [kpuk jcj dh vi{kk T;knk dfBu gkrk gA inkFk dk ;gh x.k mul mRiUu gku okyh èofu;k dk iHkkfor djrk gA

dfir oLr dh yEckb Hkh èofu dk iHkkfor djrh gA ,d lhek l de yEckb ij dfir oLr dh Ëofu lukb ugh nrh gA

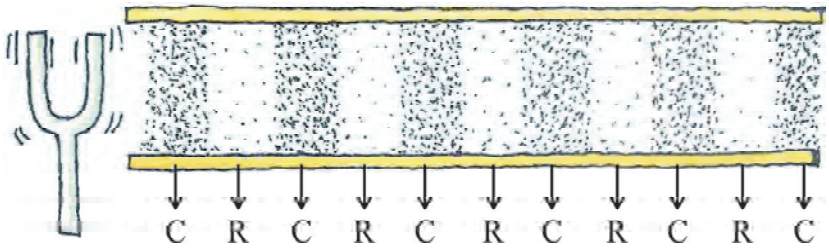
14-2 èofu dk ge rd igpuk

geu n[kk fd èofu diu djrh gb oLrvk l mRiUu gkrh gA tc dkb oLr diu djrh g rk og viu lEid d ekè;e d d.kk ij cy vkjkfir djrh g ftll ekè;e d d.k viuh lrfyr ;k fojke voLFkk l foLFkkfir gk tkr g vkj viu lehi d vU; d.kk ij leku cy vkjkfir djr gA ; foLFkkfir d.k iu% viu lehi d d.kk ij cy vkjkfir dj mUg foLFkkfir dj nr gA lehi d d.kk dk foLFkkfir dju d i'pkr ikjfEHkd d.k viuh ey voLFkk e ykV vkr gA bl idkj Åtk dk ,d d.k l nlj d.k e LFkkukUrj.k gkrk g vkj èofu vkx c<rh gA ekè;e e ;g ifØ;k rc rd pyrh jgrh g tc rd èofu vkid dkuk rd ugh igp tkrhA

D;k èofu rjx dk gh ,d :i g

vkb,] bl io e fd, fØ;kdyki&3 d vkèkkj ij le>u dk i;kl dj&

fØ;kdyki&3 e tc vki Lofj= f}Hkt dk dfir djkr g rk dfir Lofj= f}Hkt dh Hktk viu Øe'k nkb vkj ckb vkj diu ¼nkyu½ dju yxrh gA tc og viu nk;h vkj diu djrh g rk viu lEid dh ok; d d.kk dk èkDdk ndj mPp nkc dk {k= mRiUu djrh gA bl {k= dk lihMu dgr gA tc ;g iuk ihN dh vkj diu djr g, okil vkrh g rk ,d fuEu nkc dk {k= mRiUu djrh g ftl fojyu dgr gA ¼fp=&4½



fp= Øekd&4 % dfir Lofj= f=Hkt e Øe'k lihMu rFkk fojyu dh Ük[kyk ¼;gk C lihMu rFkk R fojyu dk n'kkrk gA½

tc Lofj= f}Hkt yxkrkj diu djrk g rk ok; e lihMu vkj fojyu dh ,d J.kh cu tkrh gA ;gh lihMu vkj fojyu ,d rjx cukr g tk ekè;e l gkdj lpfjr gkrh gA

pfd èofu lpj.k e ekè;e d ,d d.k l nlj d.k e Åtk dk LFkkukUrj.k gkrk gA bl dkj.k èofu dk ;kf=d rjx dgk tkrk gA

D;k èofu lpj.k ¼xeu½ Bkl] no ;k xl rhuk ekè;ek e leku gkrk g\

fØ;kdyki&4

1- ydMh dh et d ,d flj d ikl viuk dku yxk, ¼fp=&5½A

fp= Øekd&5 % Bkl ekè;e e èofu dk lukb nuk

2- viu fe= dk et d nlj flj ij èkhj l Bkdu ;k [kV[kVku dk dgA
D;k vkidk èofu lukb nh\
èofu vki rd fdl ekè;e l igph\

3- vc viuk dku et l Åij mBkb, vkj fe= dk iuh et dk Bkdu dk dgA
bl fLFkfr e èofu fdl ekè;e l vki rd igph\
nkuk fLFkfr;k e lukb nh xb èofu;k e D;k vrj Fkk\ viu fe=k l ppk djA

ppk dj&

1- unh ;k rkykc e py jgh ekVj uko dh èofu ikuh dh lrg l T;knk ikuh d Hkhrj lukb nrh gA ,lk D;k\

èofu dk lpj.k ekè;e d d.kk d ?kuRo ij fuHkj djrk gA ?kuRo ftruk vfèkd gkxk diu d dkj.k ekè;e e nkc Hkh mruk vfèkd gkxk vkj èofu dk lpj.k Hkh rhork l gkxkA Bkl rFkk no ekè;e d d.k xl dh ryuk e ikl&ikl gkr gA vFkkr budk ?kuRo xl d d.kk l vfèkd gkrk g] ftl oLr d diu d dkj.k d.kk e foLFkkiu rhork l gkrk g vkj Åtk LFkkukUrj.k d le; Åtk gkl Hkh de gkrh gA blh dkj.k xl ¼ok;½ dh vi{kk Bkl rFkk no e èofu rth l xfr djrh gA blh rjg no dh vi{kk Bkl e Ëofu lpj.k rhork l rFkk de Åtk gkl l ¼no dh ryuk e½ gkrk g vkj ge èofu lkQ lukb nrh gA

iR;kLFkrk d vkèkkj ij n[ku ij] ,l inkFk ftue mifLFkr d.kk d eè; vkd"k.k cy vfèkd gkrk g] o vfèkd iR;kLFk gkr g D;kfd mudh fLFkfr e ifjoru djuk T;knk dfBu gkrk gA ,l d.kk e fo{kkHk mRiUu dju ij og 'kh?krk l viuh io fLFkfr e vku dk i;kl djr g rFkk o d.k tk 'kh?krk l viuh io fLFkfr e vk tkr g] iuh xfr dju dk r;kj gkr g vkj bl idkj o rho xfr l dEiu ¼nkyu½ djr gA ,l ekè;e ftldh iR;kLFkrk vfèkd gkrh g ¼tl& LVhy½ e èofu lpj.k de iR;kLFkrk oky ekè;e ¼tl& jcj½ dh vi{kk rth@'kh?krk l gkrk gA ;gh dkj.k g fd Bkl] no rFkk xl ¼ok;½ e èofu lpj.k dh xfr Bkl e lcl vfèkd vkj xl ¼ok;½ e lcl de gkrh gA

ppk dj&

1- iFoh dh lrg l Åij dh vkj tku ij èofu ij D;k iHkko iMxk\

2- D;k vUrfj{k e Hkh èofu lukb nxh\ dkj.k nA

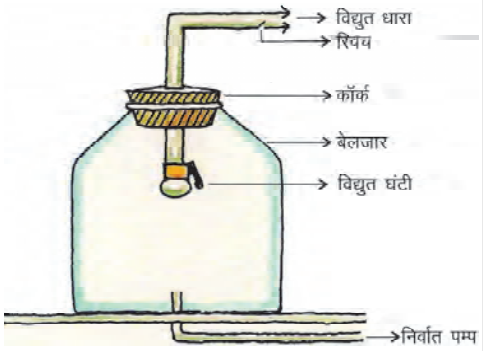
3- ckfj'k d ekle e fctyh dMdMku ij ge jk'kuh igy fn[kkb nrh g vkj dMdMku dh èofu dN {k.k ckn lukb nrh gA D;k\

èofu vkj ekè;e

vc rd geu i<k fd èofu lpj.k ekè;ek d ?kuRo ij fuHkj djrk gA lkpk] ;fn ekË;e gh u gk rk D;k èofu ge rd igpxh\ ;g tkpu d fy, fuEu i;kx fd;k x;kA

i;kx

i;kx ¼fp= Øekd&6½ e ,d fo|r ?kVh vkj dkp dk ,d cytkj fy;k x;kA ?kVh dk cytkj e yVdk dj] cytkj dk fuokr ii l tkMk x;kA ?kVh d fLop dk ncku ij mldh vkokt lukb nhA tc fuokr ii l cytkj dh ok; dk èkhj&èkhj ckgj fudkyk x;k rc ?kVh dh èofu èkheh iMu yxh] ;|fi mle igy tl gh fo|r Ëkkjk iokfgr gk jgh FkhA tc cytkj dh leLr ok; fudky nh xb rk ?kVh dh èofu cn gk xbA



fp= Øekd&6 ¼ cytkj dk i;kx

bl i;kx l ;g fu"d"k fudkyk x;k fd fuokr e èofu lpfjr ugh gkrh vFkkr èofu dk luu d fy, ekè;e dh vko';drk gkrh gA

èofu rjx fuokr e lpfjr ugh gkrh D;kfd fuokr e lihMu rFkk fojyu d fy, d.k mifLFkr ugh gkrA

lkp

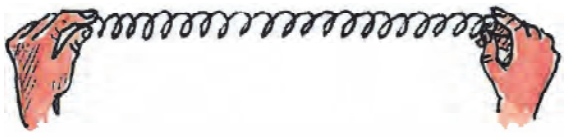
pUnek ij ok;e.My u gku ij D;k ogk vUrfj{k ;k=h ckr dj ik,x\ dkj.k nhft ,A

14-3 rjxk d idkj ¼diu dh fn'kk d vkèkkj ij½

ge tkur g fd tc rjx lpj.k gkrk g rk ekè;e d d.kk dk LFkkukUrj.k ugh gkrk vfir og viuh ey fLFkfr d lki{k diu ;k nkyu djr gA rjx lpj.k dh fn'kk d lki{k ekè;e d d.kk d nkyu dh fn'kk d vkèkkj ij rjx nk idkj dh gkrh g&

1- vunè; rjx (Longitudinal waves)

2- vuiLFk rjx (Transverse waves)



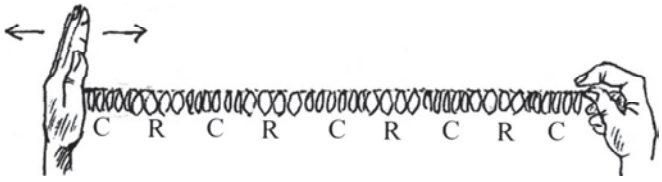
fØ;kdyki&5

¼v½ vunè; rjxk dk cuuk

1- ,d fLydh ¼fLixuek lykfLVd½ yA

2- fLydh d nkuk flj dk idMdj vkx&ihN ckjh&ckjh l [khp vkj èkDdk nA

3- vc fLydh ij fu'kku yxk n vkj mDr fØ;k dk iuh nkgjk, vkj bl è;kuiod n[kA



fp= Øekd&7 ¼ fLydh e vun?; rjxk dk cuuk ¼;gk C lihMu rFkk R fojyu dk n'kkrk gA½

bl fØ;kdyki e vkiu n[kk fd vkx&ihN èkDdk nu vkj [khpu ij fLydh e yxk fpUg Hkh foLFkkiu d lpj.k dh fn'kk d lekukrj fn'kk e xfr djrk gA bl idkj dh rjx vunè; rjx dgykrh gA

vFkkr **o rjx ftle ekè;e d d.kk dk diu ½nkyu½ rjx lpj.k dh fn'kk d lekUrj gkrk g] mUg vunè; rjx dgr gA èofu rjxk dk lpj.k Hkh blh idkj gkrk gA vr% èofu rjx Hkh vunè; rjx gA**

fØ;kdyki&6

½c½ vuiLFk rjxk dk cuukA

1- ,d fLydh ½fLixuek lykfLVd½ yA

2- fLydh d ,d flj dk fLFkj j[kdj nlj flj dk Åij&uhp fgyk,A

fp= Øekd&8 ¼
fLydh e vuiLFk rjxk dk cuuk

bl fØ;k e cuh rjx D;k vunè; rjxk l vyx g\

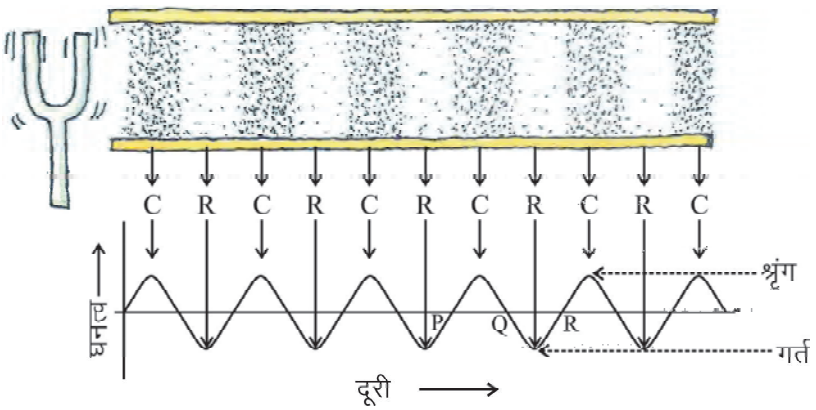
fLydh dk Åij uhp fgyku ij d.kk dk diu rjx lpj.k dh fn'kk e ycor gkrk gA bl fØ;k e cuh rjxk dk vuiLFk rjx dgr gA

vFkkr **og rjx ftle ekè;e d d.k viuh ekè; fLFkfr;k ij rjx lpj.k dh fn'kk e ycor nkyu ;k diu djr g] vuiLFk rjx dgykr gA**

14-4 èofu rjx d vfHky{k.k

rjx d Lo:i dk pkj jkf'k;k d vkèkkj ij ifjHkkf"kr fd;k tkrk gA ; pkj jkf'k;k g& rjx dh rjxnè;] vkofÙk] vk;ke rFkk oxA

uhp Lofj= f}Hkt d diu l mRiUu èofu rjx n'kkb xb gA



fp= Øekd&9

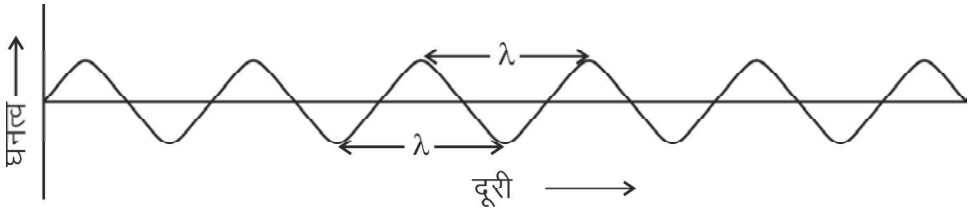
ge tkur g fd èofu rjxk e Øe'k lihMu rFkk fojyu gkrk gA lihMu d {k= e ok; d.kk dk ?kuRo vfèkdre rFkk fojyu d {k= e ok; d.kk dk ?kuRo U;ure gkrk gA

;g xkQ vun/; rjx d fy, ekè;e d d.kk d ?kuRo rFkk rjx dh njh e cuk;k x;k gA xkQ e PQ okyk Hkkx lihMu dk rFkk QR okyk Hkkx fojyu dk n'kkrk gA mlh idkj vuiLFk rjx d fy, xkQ e mHkj Hkkx dk Ükx rFkk uhp dh [kkb oky Hkkx dk xr dgr gA

rjx l lcfèkr fofHkUu ikfjHkkf"kd 'kCn fuEufyf[kr g&

1· rjx nè; (Wave length)

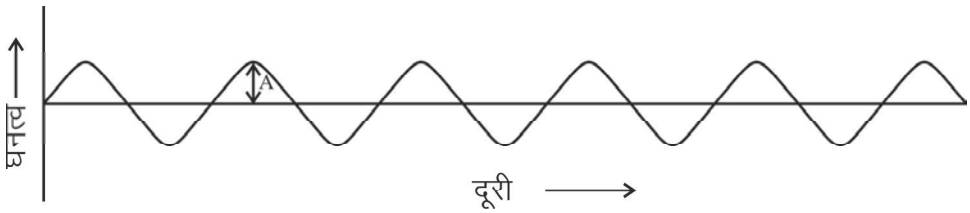
nk Øekxr lihMuk ¼Ükxk½ vFkok fojyuk ¼xrk½ d chp dh njh dk rjxnè; dgr gA bldk SI ek=d ehVj gA bl λ ¼yeMk½ l inf'kr fd;k tkrk gA



fp= Øekd&10 ¼ ?kuRo&njh xkQ e rjx nè;

2· vk;ke (Amplitude)

tc èofu rjx ok; e xeu djrh g rc ok; d d.k nkyk;eku gkr g ftl lihMu vkj fojyu {k= curk g] ifj.kkeLo:Ik fdlh {k= dk ok; ?kuRo lkekU; l vfèkd gkdj mPpre Lrj ,o fuEure Lrj rd ?kVrk&c<rk gA /ofu rjx d dkj.k ek/;e d ?kuRo e ey fLFkfr e mrkj&p<ko dk eku rjx dk vk;ke dgykrk gA ftruh Åph ;k rho /ofu gk mruk vf/kd ek/;e d ?kuRo e mrkj&p<ko gkrk gA vFkkr mruk vf/kd rjx dk vk;ke gkrk gA bl v{kj A l fu:fir fd;k tkrk gA



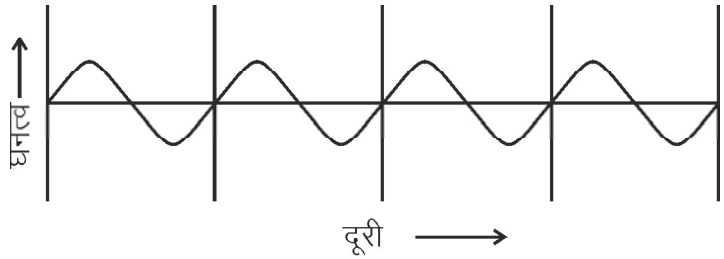
fp= Øekd&11 ¼ ?kuRo&njh xkQ e rjx dk vk;ke

3· vkordky (Time period)

nk Øekxr lihMuk ;k nk Øekxr fojyuk }kjk fdlh fuf'pr fcUn l xtju e yx le; dk rjx dk vkordky dgr gA nlj 'kCnk e] fdlh ekè;e e ?kuRo d ,d lEi.k nkyu e fy;k x;k le; èofu rjx dk vkordky dgykrk gA bl v{kj T l fu:fir fd;k tkrk gA bldk SI ek=d ld.M gA

4. vkofÙk (Frequency)

ge tkur g fd tc èofu fdlh ekè;e e lpfjr gkrh g rk ekè;e dk ?kuRo fdlh vfèkdre rFkk U;ure eku d chp cnyrk gA ?kuRo dk vfèkdre eku l U;ure eku rd vkdj iuk vfèkdre eku rd igpu ij ,d nkyu ijk gkrk gA



1 सेकंड में दोलन की संख्या = 4

fp= Øekd&12

,dkd le; e bu nkyuk dh dy l[;k èofu rjx dh vkofÙk dgykrh gA

;fn ge ifr ,dkd le; e rjx d ,d fcn l xtju oky lihMuk ;k fojyuk dh l[;k dh x.kuk dj rk ge èofu rjx dh vkofÙk Kkr dj ldr gA bl lekU; r% v{kj 'n' l inf'kr fd;k tkrk gA bldk SI i)fr e ek=d ifr ld.M ;k Hz ¼**gVt**½ gA èofu dh rh{.krk ¼rkjRo½ mldh vkofÙk ij fuHkj djrh gA

vkofÙk rFkk vkordky d chp fuEu lcèk gkrk g&

$$T = \frac{1}{n} \quad ;k \quad n = \frac{1}{T}$$

mnkgj.k&1 % 500 gVt oky rjx dk vkordky Kkr dj\

gy % i'ukulkj vkofÙk n = 500 Hz

pfd ge tkur g fd vkordky T = 1/n

= 1/500

= 0.002 second

5. èofu rjxk dh pky (Speed of sound waves)

,d lihMu ;k ,d fojyu }kjk ,dkd le; e r; dh xb njh dk rjx dh pky dgr gA

ge tkur g fd pky = njh@le;

,d nkyu i.k dju e rjx }kjk pyh xb njh dk eku rjxnè; (λ) d cjkcj ,o le; vkordky (T) d cjkcj gkrk gA

vr% v = λ/T

∵ n = 1/T

vr% pky = n λ

vFkkr pky = vkofÙk × rjxnè;

è;ku jg èofu rjxk dh pky doy ekè;e dh idfr ij fuHkj djrh gu fd mld rjxnè; ;k vkofÙk ijA

mnkgj.k&2% fdlh xl ekè;e l lkr }kjk 40000 lihMu ,o 40000 fojyu ifr ld.M fufer gkrh gA ;fn igyk lihMu] lkr l 1 leh dh njh ij gk rk rjx dk ox Kkr dj\

gy % ge tkur g fd vkofÙk 1 ldM e gku oky lihMuk ,o fojyuk dh l[;k d cjkcj gkrh gA

vr% vkofÙk n = 40000 Hz

rjxnè; λ = nk lihMuk vFkok fojyuk d chp dh njh

=1 leh = 1/100 ehVj

pfd rjx dk ox v = n λ

= 40000 x1/100

= 400 ehVj@ld.M

14-5 J0;rk ijkl (Hearing range)

eu";k e èofu dh J0;rk d vkèkkj ij bl rhu Hkkxk e ckVk x;k g& 1- J0; èofu] 2- voJ0; Ëofu] 3- ijkJ0; èofuA

J0; èofu (audible sound)- ge LkHkh vkofÙk dh èofu;k dk ugh lu ldr gA eu";k e èofu dh J0;rk dk ijkl vFkkr ftl ge lu ldr g] yxHkx 20 Hz l 20 gtkj Hz ½20 KHz½ rd gkrk gA ikp o"k l de vk; d cPp rFkk dN tr tl dRr 25 KHz rd dh èofu lu ldr gA

voJ0; èofu (infrasound)- 20 Hz l de vkofÙk dh èofu;k dk voJ0; èofu (infrasound) dgr gA tl& Hkdi d le; iFoh d Hkhrj dh rjx] jkl;fud rFkk ukfHkdh; fo[kMu e mRiUu èofu;k vkfnA ;fn ge voJ0; èofu dk lu ikr rk ge fdlh ykyd d diuk dk mlh idkj lu ikr tl fd ge fdlh Hkkj d i[kk d diuk dk lu ikr gA

ijkJ0; èofu ;k ijkèofu (ultrasound)- 20 KHz l vfèkd vkofÙk dh èofu;k dk ijkJ0; èofu ;k ijkËofu (ultrasound) dgr gA MkfYQu] pexknM tl dN trvk d }kjk ijkèofu mRiUu dh tkrh gA 'kyHkk ;k dhV&irxk (moths) d Jo.k bfUn;k vR;r lxkgh gkrh gA ; pexknMk }kjk mRiUu mPp vkofÙk dh phph dh èofu dk lu ldr gA mUg viu vkl&ikl mMr g, pexknM d ckj e tkudkjh fey tkrh g vkj bl idkj Lo; dk idM tku l cPkk ikr gA

14.6 ijkJ0; èofu dk vui;kx

ijkèofu;k mPp vkofÙk;k dh rjx gA ; èofu;k vojkèkk dh mifLFkfr e Hkh ,d fuf'pr iFk ij xeu dj ldrh gA m|kxk rFkk fpfdRlk d {k=k e ijkèofu;k dk ogn :Ik l mi;kx fd;k tkrk gA

• ijkèofu ik;¼ mu Hkkxk dk lkQ dju e mi;kx dh tkrh g ftu rd lkekU; fofèk l igpuk dfBu gkrk g tl fo"ke vkdkj d it] byDVkfud midj.k vkfnA ftu oLrvk dk lkQ djuk gkrk g mUg lkQ dju oky foy;u e j[kr g vkj bl foy;u e ijkèofu rjx Hkth tkrh gA mPp vkofÙk d dkj.k Ëky] fpdukb rFkk xnxh d d.k vyx gkdj uhp fxj tkr gA bl idkj oLr i.kr;k lkQ gk tkrh gA

ijkèofu dk mi;kx èkkfRod fiMk e Nih njkjk rFkk mld vU; nk"kk dk irk yxku d fy, Hkh fd;k tkrk gA bdkdkfM;kxkQh (Echocardiography) d :Ik e Hkh ijkèofu dk mi;kx fd;k tkrk gA bl rduhd e ijkèofu (ultrasound) rjxk dk ân; d fofHkUu Hkkxk l ijkofrr djkdj ân; d diu dk ifrfcEc cuk;k tkrk gA

vYVk lkukxkQh (ultrasonography)

ijkèofu (ultrasound) llpd ;k vYVk lkukxkQh ,d ,lk ;=g tk ijkèofu rjxk dk mi;kx djd ekuo 'kjhj d vkrfjd vxk dk ifrfcEc ikIr dju d fy, mi;kx e yk;k tkrk gA bl llpd l jkxh d vxk tl ;dr] fiÙkk'k;] xHkk'k;] xn vkfn dk ifrfcEc ikIr fd;k tk ldrk g rFkk iFkjh o fofHkUu vxk e vcn ¼V;ej½ dk irk yxku e lgk;rk djrk gA bl rduhd e ijkèofu rjx 'kjhj d Årdk e xeu djrh g rFkk ml LFkku l ijkofrr gk tkrh g tgk Ård d ?kUkRo e ifjoru gkrk gA bld Ik'pkr bu rjxk dk fo|r ldrk e ifjofrr dj ml vx dk ifrfcEc cuk fy;k tkrk gA

bu ifrfcEck dk ekfuVj ij inf'kr fd;k tkrk g ;k fQYe ij vfdr dj fy;k tkrk gA

bldk mi;kx xHkdky e Hk.k dh tkp] mld tUetkr nk"kk rFkk mldh of) dh vfu;ferrkvk dk irk yxku e fd;k tkrk gA ijkèofu dk mi;kx xn dh NkVh iFkjh dk ckjhd d.kk e rkMu d fy, Hkh fd;k tkrk gA

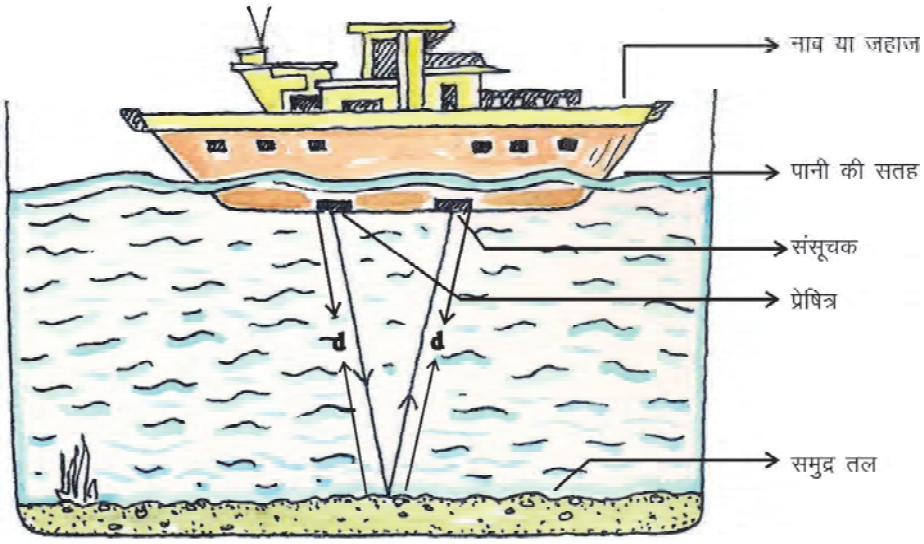
Lkkukj (Sound navigation and ranging - SONAR)

;g ,d ,lh ;fDr g ftle ty e fLFkr fi.Mk dh njh] fn'kk rFkk pky ekiu d fy, ijkèofu rjxk dk mi;kx fd;k tkrk gA bl ;=e ,d if"k= (transmitter) ,o ,d llpd (reciever) gkrk g vkj bl fdlh uko ;k tgkt e ¼fp=&13½ d vulkj yxk;k tkrk gA if"k= ijkèofu rjx mRiUu djrk g vkj ml if"kr djrk gA ; rjx ty e xeu djrh g rFkk len rYk e fi.M l Vdjku d i'pkr ijkofrr gkdj llpd }kjk xg.k dj fo|r ldrk e ifjofrr dj nh tkrh gA i"k.k vkj llpu d chp le; vrjky Kkr dj fi.M dh njh dh x.kuk dh tk ldrh gA ekuk fd ijkèofu ldr d i"k.k rFkk vfHkxg.k e yxk le; vrjky t g rFkk lenh ty e èofu dh pky v gA vr¼ ldr }kjk r; dh xb dy njh 2d gkxh ¼d njh tkuk ,o d njh vkuk½A

le; = njh@pky

$$t = \frac{2d}{v}$$

vr% xgjkb d ¾ $\frac{vt}{2}$



fp= Øekd&13 % Lkkukj (SONAR)

mnkgj.k&2% ,d vuqèkku Vhe }kjk len dh xgjkb e lkukj llpd l flXuy if"kr fd;k tkrk gA flXuy 6s e okil ikIr gk tkrh gA ;fn lenh ty e èofu dh pky 1500 m/s gk rk len dh xgjkb Kkr dj\

eku y len dh xgjkb d eh- gA

vr% flXuy }kjk r; dh xb njh = 2 d

,o yxk le; = 6 s

èofu dh pky = 1500 m/s

pfd pky = njh@le;

vr% njh = pky × le;

2d = 1500 × 6

d = 1500 × 6/2

vr% len dh xgjkb d = 4500 m = 4500/1000 km = 4.5 km

geu lh[kk

- lkr d diu l èofu mRiUUk gkrh gA
- èofu fdlh ekè;e e vunè; rjxk d :Ik e Øe'k lihMu ,o fojyu d :Ik e lpfjr gkrh gA
- èofu lpj.k e ekè;e d d.k vkx ugh c<r] doy fo{kkHk gh lpfjr gkrk gA
- èofu lpj.k d fy, ekè;e dh vko';drk gkrh gA
- nk Øekxr lihMu rFkk fojyu d chp dh njh dk rjxnè; dgr gA
- rjx }kjk ekè;e d ?kuRo d ,d li.k nkyu e fy, x, le; dk vkor dky dgr gA
- ,dkd le; e nkyuk dh dy l[;k dk vkofÙk dgr gA
- èofu dh pky = vkofÙk × rjxnè; (v = nλ)
- ekuo e èofu dh J0;rk dh vkofÙk;k dk vklr ijkl 20 Hz l 20 kHz rd gkrk gA
- J0;rk ijkl l de vkofÙk dh èofu dk voJ0; rFkk vfèkd vkofÙk dh èofu dk ijkèofu dgr gA bl fpfdRlk rFkk ik|kfxd {k=k e mi;kx e fy;k tkrk gA
- lkukj rduhd dk mi;kx len d Hkhrj fNih oLrvk dk irk yxku e fd;k tkrk gA

e[; fcUn (Keywords)

fo{kke (disturbance)] rjx (wave)] rjxnè; (wavelength)] J0;rk ijkl (hearing range)] vk;ke (amplitude)] vkofÙk (frequency)] vkordky (time period), lihMu (compression), fojyu (rarefaction)

vH;kl

1- lgh fodYi pudj fyf[k,&

(i) tc èofu rjx ekè;e e lpfjr gkrh g rc ,d LFkku l nlj LFkku ij&

¼v½ ekè;e d d.kk dk LFkkukrj.k gkrk gA

¼c½ Åtk dk ,d d.k l nlj d.k e LFkkukrj.k gkrk gA

¼l½ Åtk dk ifjoru gkrk gA

¼n½ bue l dkb ughA

(ii) 20 Hz l de vkofÙk okyh èofu dgykrh g&

¼v½ J0; ¼c½ voJ0;

¼l½ ijkJ0; ¼n½ ble l dkb ugh

(iii) nk Øekxr lihMuk ;k fojyuk d chp dh njh dgykrh g&

¼v½ vk;ke ¼c½ vkofr

¼l½ rjx dh pky ¼n½ rjx nè;

(iv) lpfjr rjx d ox (v), vkofÙk (n) rFkk rjxnè; (λ) e lcèk gkrk g&

¼v½ $v = \frac{n}{\lambda}$ ¼c½ $v = n\lambda$

¼l½ $v = \frac{\lambda}{n}$ ¼n½ bue l dkb ugh

(v) èofu rjx lpfjr ugh gkrh g&

¼v½ Bkl e ¼c½ no e

¼l½ ok; e ¼n½ fuokr e

(vi) diu djrh gb oLr dk vkordky 0.05 s gk rk mRiUu rjxk dh vkofÙk gkxh&

¼v½ 5 Hz ¼c½ 20 Hz

¼l½ 200 Hz ¼n½ 2 Hz

2- fjDr LFkkuk dh ifr dj &

(i) ekuo e èofu dh J0;rk ijkl ---------- l ---------- gkrh gA

(ii) rjxnè; dk sl ek=d ---------- gA

(iii) Øekxr lihMu rFkk fojyu d eè; dh njh ---------- gkrh gA

(iv) èofu dh pky ---------- ij fuHkj djrh gA

3- ;fn èofu rjx dh vkofÙk dk nxuk dj fn;k tk, rk ekè;e e mldh pky fdruh gkxh\

4- lkr A l mRiUu èofu dh vkofÙk lkr B l mRiUu èofu dh vkofÙk dh nxuh gA nkuk lkrk d rjxnè; dh ryuk djA

5- èofu d dku l vfHky{k.k l vki fdlh dej e CkB vkid fe= dh vkokt dk igpku yr g\

6- nk èkkrvk dh VDdj l Øe'kh ok; ,o ty e èofu mRiUUk dh tkrh gA crk, leku njh ij fdle èofu rho gkxh\

7- èofu D;k g vkj ;g dl mRiUu gkrh g\

8- lihMu ,o fojyu dk lfPk= le>k,A

9- èofu lpj.k d fy, ekè;e dh vko'drk gkrh gA i;kx }kjk le>k,A

10- le>k, fd èofu rjx vunè; rjx g\

11- fVli.kh fyf[k,& 1- bdkdkfM;kxkQh 2- vYVkIkukxkQh 3- lkukj

12- rjx d ox] vkofÙk rFkk rjxnè; dk lfp= ifjHkkf"kr dj bue lcèk 0;RiUu djA

13- ,d èofu rjx 339 m/s dh pky l pyrh gA ;fn bldk rjxnè; 1-5 l-eh- gk rk rjx dh vkofÙk fdruh gkxh\ D;k ; J0; gkxh\ [22.6kHz, ijkJ0;]

14- fdlh rki ij ok; e èofu dh pky 340 m/s ,o rjxnè; 0-017 m gA mlh èofu lkr dk ty e Mky fn;k tk, rk rjxnè; ij D;k iHkko iMxkA ;fn ty e èofu dh pky 1480 m/s g] x.kuk dj crk,A

[rjxnè; & 0-074 eh-]

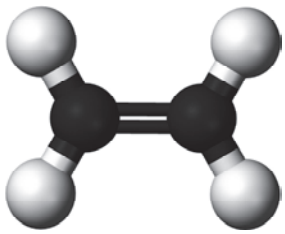
15- flrkj dh èofu dh rh{.krk dk de dju d fy, vki dku&dku l mik; djx\

16- ,d vunè; rjx ftldh rjxnè; 1 cm g] ok; e 330 m/s pky l lpfjr gkrh gA rjx dh vkofÙk dh x.kuk dhft,A D;k ;g rjx lkekU; eu"; }kjk luh tk ldrh g\ [33 kHz]

vè;k;&15

gkbMkdkcu

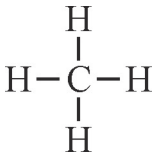
(Hydrocarbons)



vè;k; ^jklk;fud vkcèku* e geu gkbMktu vkj vU; rRok tl&ukbVktu] vkDlhtu vkj dkcu d lgl;kth ;kfxdk d ckj e i<k gA vekfu;k] gkbMktu vkj ukbVktu l cuk rFkk ikuh] gkbMktu vkj vkDlhtu l cuk lgl;kth ;kfxd gA D;k vki crk ldr g fd dkcu vkj gkbMktu l cu lgl;kth ;kfxd dku&dku l g vkj ; D;k dgykr g\ bue l dN eFku] ,Fku] ,Fkhu] ,Fkkbu vkfn gA dkcu vkj gkbMktu d ;kfxdk dk gkbMkdkcu dgr gA dkcu] gkbMktu d lkFk lcl vfèkd ;kfxd cukrk g tcfd ukbVktu] vkDlhtu bR;kfn gkbMktu d lkFk ,d ;k nk ;kfxd gh cukr gA vkb,] ge tkuu dk i;kl dj fd vkf[kj dkcu bru vfèkd ;kfxd D;k cukrk gA

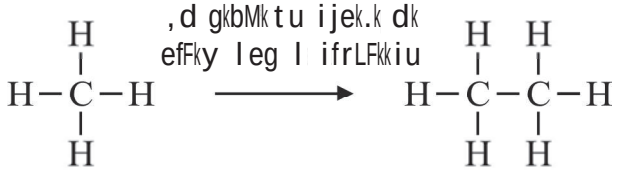
15-1 Ük[kyu ¼Catenation½

eFku dkcu dk ljyre ;kfxd g] bldk v.kl= CH_4 g rFkk ljpuk l= bl idkj g&



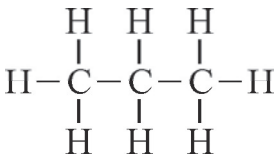
fp= Øekd&1 % eFku dh ljpuk

;gk dkcu d ,d ijek.k u gkbMktu d pkj ijek.kvk l vkcèk cuk;k gA ;fn ge eFku l gkbMktu dk ,d ijek.k gVk n rk ge $-CH_3$ ikIr gkxkA $-CH_3$ dk efFky leg dgk tkrk gA eFku d ,d gkbMktu dk efFky $(-CH_3)$ leg l ifrLFkkfir dju ij D;k gkxk\ ge fp= Øekd 2 e n'kk;k v.k ikIr gkxkA



fp= Øekd&2 % ,Fku dh ljpuk

;g ,Fku g ftldk v.kl= C_2H_6 gA ,Fku l Hkh ge ,d gkbMkt u dk efFky leg }kjk ifrLFkkfir dj ldr gA ,lk dju ij ge tk v.k feyrk g mle rhu dkcu ijek.kvk dh Ük[yk gA



fp= Øekd&3 % rhu dkcu ijek.k okyh Ük[yk

bl idkj ge Ük[yk e dkcu ijek.kvk dh l[;k c<kdj ml vkj yck dj ldr gA rRok dk ;g x.k] ftld }kjk mld ijek.k vkil e vkcèk cukdj ych Ük[yk cukr g] Ük[yu dgykrk gA dN lhek rd lYQj rFkk flfydu Hkh Ük[yu n'kkr g] fdr budh Ük[yk NkVh gkrh gA doy dkcu gh ych Ük[yk cuku e l{ke gA dkcu e Ük[yu dk ,d dkj.k ;g g fd og vU; rRok d ijek.kvk d lkFk gh ugh] cfYd vU; dkcu ijek.kvk d lkFk Hkh icy vkcèk cukrk gA Ük[yu d bl x.k d dkj.k dkcu d ;kfxdk dh l[;k cgr vfèkd gkrh gA

15-2 gkbMkdkcu dk l?kfur fu:i.k

vc rd gkbMkdkcu dh ljpuk n'kku d fy, geu ljpuk l= dk mi;kx fd;k g] ftle nk dkcu ijek.kvk d eè; ,dy cèk dk ,d j[kk (–) ¼fp= Øekd 1] 2] 3½ f}cèk dk nk lekrj j[kkvk (=) ¼fp= Øekd 4 d½ vkj f=cèk dk rhu lekrj j[kkvk (≡) ¼fp= Øekd 4 [k½ }kjk n'kk;k tkrk gA

¼d½ ,Fkhu ¼[k½ ,Fkkbu

fp= Øekd&4 % d vkj [k

,lh ljpuk dk ckj&ckj cukuk lfoèkktud ugh gkrk vkj ,l fp= LFkku Hkh cgr ?kjr gA vr% bUg inf'kr dju d fy, l?kfur ljpuk l= dk i;kx fd;k tkrk g tk ,d ljy rjhdk gA bl idkj dh ljpuk e nk ijek.kvk d chp d ,dy vkcèk dk ugh n'kk;k tkrk tl ,Fku dk l?kfur ljpuk l= CH_3CH_3 gA ;fn v.k e nk ;k vfèkd ijek.k d leku leg g rk ge l= dk vkj lf{kIr dj ldr g tl $CH_3CH_2CH_2CH_2CH_2CH_3$ dk ge $CH_3(CH_2)_4CH_3$ fy[k ldr gA ftl ijek.k leg dh iujkofÙk gkrh g ml dk"Bd e fy[kdj] mldh l[;k dk dk"Bd d ckgj iknkd d :i e fy[kk tkrk g] tk ;g n'kkrk g fd v.k e og ijek.k leg fdruh ckj vkrk gA ,Fkhu rFkk ,Fkkbu dk l?kfur l= Øe'k% $H_2C=CH_2$ o HC≡CH gkrk gA

15-3 ,Ydu ¼Alkane½

ge tkur g fd lcl ljy gkbMkdkcu eFku gA bl Ük[kyk e ;fn Øe'kh ,d&,d dkcu tkMr tk, rk ge ych l ych lrr Ük[kyk ikIr dj ldr gA

lkj.kh Øekd&1 % ,Yduk dh l?kfur ljpuk] v.kl= ,o mud uke

dkcu ijek.kvk dh l[;k n	l?kfur ljpuk	v.kl=	uke					
			ey Hkkx $ vuyXu ¾ uke					
n=1	CH_4	CH_4	Meth	+	ane	=	Methane	eFku
n=2	CH_3CH_3	C_2H_6	Eth	+	ane	=	Ethane	,Fku
n=3	$CH_3CH_2CH_3$	C_3H_8	Prop	+	ane	=	Propane	ikiu
n=4	$CH_3(CH_2)_2CH_3$	C_4H_{10}	But	+	ane	=	Butane	C;Vu
n=5	$CH_3(CH_2)_3CH_3$	C_5H_{12}	Pent	+	ane	=	Pentane	iVu
n=6	$CH_3(CH_2)_4CH_3$	C_6H_{14}	Hex	+	ane	=	Hexane	gDlu

Lkkj.kh Øekd&1 e nh xb ljpukvk d v.kl= è;ku l n[kA D;k vki dkcu ijek.kvk dh l[;k n rFkk v.kl= e dkb lcèk n[k jg g\ ge n[kr g fd lkj.kh e fn, lHkh gkbMkdkcuk dk lkekU; l= C_nH_{2n+2} d }kjk inf'kr fd;k tk ldrk g] bUg ,Ydu dgr gA ,Ydu doy dkcu vkj gkbMktu d ;kfxd gkr g ftue ijek.k ,d&nlj l doy ,dy cèk }kjk tM jgr g] bue f} ;k f=cèk ugh ik;k tkrkA

15-4 lrr Ük[kyk oky ,Yduk dk ukedj.k

fdlh Hkh ,Ydu ¼okLro e fdlh Hkh gkbMkdkcu½ dk uke mle mifLFkr dkcu ijek.kvk dh l[;k d vkèkkj ij j[kk tkrk gA fdlh Hkh lrRk Ük[kyk oky ,Ydu d uke dk nk Hkkxk e ckVk tk ldrk gA igyk Hkkx ey ;k tud Hkkx tk n'kkrk g fd bl gkbMkdkcu dh lcl ych lrr dkcu Ük[kyk e fdru dkcu gA nljk Hkkx vuyXu ftll ge irk pyrk g fd gkbMkdkcu d dkcu ijek.kvk d chp fdl idkj dk vkcèku gA vkb,] dN mnkgj.k ydj bu fu;ek dk le>u dk i;kl djr g ¼lkj.kh Øekd&1½A

,Ydu d fy, ;fn n=1 gk vFkkr dkcu ijek.k dh l[;k 1 gk rc ey Hkkx Meth }kjk n'kk;k tkrk g rFkk vuyXu ane gkrk g vr % ,Ydu dk uke Meth + ane = Methane ¼eFku½ gkrk gA ;fn n = 2, 3, 4, 5 ;k 6 gk rc ey Hkkx Øe'kh ,Fk] iki] C;V] iV ;k gDl (Eth, Prop, But, Pent ;k Hex) }kjk inf'kr fd;k tkrk g rFkk vuyXu ,u (ane) gkrk gA

i'u %

1- ,d ,l ,Ydu dk uke rFkk ljpuk l= cuk, ftle n=3 gkA

2- $CH_3\,CH_2\,CH_2\,CH_2\,CH_3$ dk l?kfur ljpuk l= fyf[k,A

3- C_7H_{16} dk glVu dgr g] bl uke dk ey Hkkx vkj vuyXu e vyx dhft,A

eFku (CH_4) vkj ,Fku (C_2H_6) d v.kl= dk è;ku l n[kA bue $-CH_2-$ bdkb dk vrj gA vc ,Fku (CH_3CH_3) vkj ikiu $(CH_3CH_2CH_3)$ dh ljpuk n[kA ;g Li"V g fd bu nkuk e Hkh doy $-CH_2-$ bdkb dk vrj gA ,Ydu Ük[kyk e] ge bl idkj vud fudVre tkM ¼vxy ;k fiNy lnL; d lkFk½ cukdj mud v.kl= dh tkp dj ldr g] tl ikiu vkj C;Vu dk tkMk ;k C;Vu vkj iVu ;k iVu vkj gDluA iR;d ckj ge n[kr g fd tkMk e doy $-CH_2-$ dk vrj gA ;kfxdk dh og Ük[kyk ftue fudVre lnL;k d tkMk e ,lk lcèk gk] ml Ük[kyk dk ltkrh; J.kh dgr gA lHkh ,Yduk dk lkekU; l= C_nH_{2n+2} g ¼;gk n dkcu d ijek.kvk dh l[;k g½ vkj bl ifjokj d fudVre ¼Øekxr½ lnL;k d chp $-CH_2-$ bdkb dk vrj gA blfy, ge dg ldr g fd ,Ydu ifjokj ,d ltkrh; J.kh gA

eFku vkj ,Fku d v.kHkkjk dh x.kuk dhft, rFkk nkuk lnL;k d v.kHkkj e vrj fudkfy,A blh idkj ,Fku&ikiu] ikiu&C;Vu] C;Vu&iVu vkj iVu&gDlu tkMk d v.kHkkjk d vrjk dh x.kuk dhft,A D;k vkidk bl ltkrh; J.kh d lnL;k d v.kHkkjk e dkb lcèk fn[kkb nrk g\

15-5 Hkkfrd x.kèkek e Øfedrk

geu n[kk fd ltkrh; J.kh d fudVre lnL;k d v.kHkkj e 14 u dk vrj gA D;k bldk Hkkfrd x.kèkek ij dkb iHkko iMrk g\ vkb,] dN ,Yduk d DoFkukd n[k&

lkj.kh Øekd&2 % iFke 6 ,Yduk d DoFkukd

,Yduk d uke	DoFkukd °C
eFku	–162
,Fku	–89
ikiu	–42
C;Vu	–0.5
iVu	36
gDlu	69

lkj.kh Øekd&2 l Li"V g fd tl&tl ,Ydu e dkcu ijek.kvk dh l[;k c<rh tkrh g] ol&ol mud DoFkukd Hkh c<r gA ge dg ldr g fd ych] lrr Ük[kyk oky ,Yduk dk DoFkukd NkVh Ük[kyk oky ,Ydu d DoFkukd l vfèkd gkrk g vFkkr ,Ydu dk DoFkukd mld v.kHkkj ij fuHkj djrk gA lkèkkj.kr% ltkrh; lnL;k d Hkkfrd x.kèkek e Øfed vkj fu;fer ifjoru ik;k tkrk gA

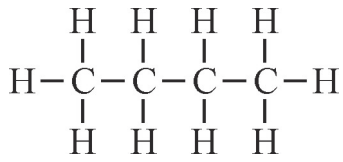
i'u %

1- ltkrh; J.kh fdl dgr g\ mnkgj.k }kjk le>kb,A

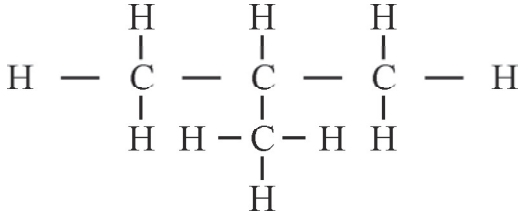
2- C;Vu] ikiu vkj iVu e l fdldk DoFkukd lcl vfèkd gkxk vkj D;k\

15-6 'kkf[kr Ük[kyk vkj leko;ork

vc rd dkcu Ük[kyk c<ku d fy, geu vfre flj d dkcu l tM gkbMktu dk efFky leg l ifrLFkkfir fd;kA bl idkj l ge lrr Ük[kyk oky gkbMkdkcu fey ij ge ,Yduk e 'kk[kk, Hkh cuk ldr gA ;fn fdlh ,Ydu e dkb dkcu nk l vfèkd dkcu l cèk cukrk g rk ge dgr g fd Ük[kyk e ml LFkku ij 'kk[kk gA vkb,] fQj l ikiu ($CH_3CH_2CH_3$) dk mnkgj.k n[kr gA ble rhu dkcu ijek.k g] nk dkcu Ük[kyk d fljk ij vkj ,d chp eA fljk ij fLFkr nkuk dkcu jklk;fud nf"V l leku gA Ük[kyk c<ku d fy, ge nk LFkkuk ij gkbMktu dk ifrLFkkfir dj ldr gA ;fn vfre LFkku d dkcu l tM gkbMktu dk ifrLFkkfir fd;k tk,] fp= Øekd&5 d leku ljpuk feyrh g] fdr ;fn ge chp d dkcu l tM gkbMktu dk ifrLFkkfir dj rc ge fp= Øekd&6 d leku ljpuk feyrh gA



fp= Øekd&5 % ¼C;Vu½



fp= Øekd&6 % ½2&efFkyikiu½

nkuk ljpukvk dk v.kl= C_4H_{10} g vFkkr bue ijek.kvk dh l[;k vkj idkj ,d leku gA ij budh ljpuk fHkUUk&fHkUu g blfy, ; vyx&vyx ;kfxd gA vr% ,l ;kfxd ftud v.kl= leku fdr ljpukRed l= fHkUu&fHkUu gk] ,d nlj d leko;oh gkr g rFkk ;g x.k leko;ork dgykrk gA geu n[kk fd C_4H_{10} v.kl= oky nk ,Ydu lHko gA

bue l ,d dk ge C;Vu ¼fp= Øekd&5½ dgr gA vkb,] n[k fd nlj ;kfxd ¼fp= Øekd&6½ dk uke D;k gkxk\

ukedj.k d fy, lcl igy ge dkcu dh lcl ych lrr Ük[kyk <<r gA ;g vko';d ugh dh Ük[kyk n[ku e lhèkh gkA fp= Øekd&7 e n'kk, ljpuk l= e lcl ych Ük[kyk e rhu dkcu gA ; nkuk Ük[kyk, n[ku e vyx&vyx irhr gkrh g ijr okLro e bue dkb vrj ugh gA

fp= Øekd&7

ge n[kr g fd lcl ych Ük[kyk ftl ey ;k tud Ük[kyk dgr g] e rhu dkcu gA blfy, ;kfxd d uke dk ey Hkkx iki& gkxkA vc ge ml dkcu dk irk yxkr g tgk 'kk[kk gA bll tM ,fYdy leg dk uke nhft,A mi;Dr mnkgj.k e ,fYdy leg efFky gA vc ge Ük[kyk d dkcu ijek.kvk dk Øe l ,l vd nx fd 'kkf[kr dkcu dk y?kre ¼de½ vd feyA bl mnkgj.k e ;g egRo ugh j[krk fd fdl dkcu l ge fxuuk 'k: djr g D;kfd gj fLFkfr e 'kkf[kr dkcu dk nk vd gh feyxkA bl rjg ,fYdy leg dk LFkku 2 g ¼fp= Øekd&8½A

fp= Øekd&8 % ¼2&efFkyikiu½

vc ge ;kfxd dk uke fy[kr gA uke fy[kr le; lcl igy ifrLFkkih leg dh LFkku l[;k] mld ckn y?k j[kk ¼&½ fy[kh tkrh gA y?k j[kk d ckn ifrLFkkih leg dk uke vkj mld ckn ey Hkkx dk uke tkMk tkrk g vkj vr e gkbMkdkcu vuyXu fy[kk tkrk g vr% ;kfxd dk uke g 2&efFkyikiu gA

geu n[kk fd ftu ;kfxdk dk v.kl= leku] ij ljpuk l= fHkUu gk] ,d nlj d ljpukRed leko;oh dgykr gA ljpukRed leko;ork db idkj dh gkrh gA C;Vu rFkk 2&efFkyikiu e n[kh xb ljpukRed leko;ork dk Ük[kyk leko;ork dgk tkrk g D;kfd og dkcu Ük[kyk e fHkUurk d dkj.k mRiUu gkrh gA

i'u %

1- C_5H_{12} d Ük[kyk leko;oh cukb,A ¼ldr % rhu leko;oh lHko g½

blh idkj gDlu d 5 leko;oh gkr gA fdlh v.kl= d fy, lHko leko;fo;k dh l[;k mle mifLFkr dkcu ijek.k l[;k d c<u l c<rh gA

15-7 ,Ydhu vkj ,Ydkbu ¼Alkene and alkyne½

vHkh geu ,Ydu ltkrh; J.kh le>hA vkb,] tkuu dh dkf'k'k dj fd f}c/k vFkok f=cèk oky gkbMkdkcu Hkh D;k ltkrh; J.kh cukr g\ f}cèk okyk lcl ljy gkbMkdkcu ,Fkhu g ¼ftl vke Hkk"kk e ,fFkyhu dgr g½A ,Fkhu dk ljpuk l=

CH_2=CH_2 rFkk v.kl= C_2H_4 gA vxth e fy[ku ij bld uke dk ey Hkkx ,Fk (eth) vkj vuyXu bu (-ene) g] ;gk ,Fk n'kkrk g fd v.k e nk dkcu gA ge ,Fkhu d fdlh Hkh dkcu l tM ,d gkbMktu dk efFky leg l ifrLFkkfir dj ldr gA ,lk dju ij ge $CH_3CH=CH_2$ ikIr gkxkA bl ikihu dgr g vkj bldk vk.kfod l= C_3H_6 gA ,l gkbMkdkcu ftue nk dkcu d eè; f}cèk ik;k tkrk g] ,Ydhu dgykr gA

;g Li"V g fd ,Fkhu vkj ikihu e doy –CH_2– leg dk vrj gA ,Ydu dh rjg] ,Ydhu leg e Hkh dkcu Ük[kyk dh of) d fy, ge vfre dkcu l tM gkbMktu dk &CH_3 ¼efFky½ leg l ifrLFkkfir djr gA

Lkkj.kh Øekd& 3 % ,Ydhuk dh l?kfur ljpuk] v.kl= ,o mud uke

dkcu ijek.kvk dh l[;k] n	l?kfur ljpuk	v.kl=	uke				
			ey Hkkx	$	vuyXu	¾	uke
n=2	$H_2C = CH_2$	C_2H_4	Eth	+	ene	=	Ethene ,Fkhu
n=3	$H_2C = CH\ CH_3$	C_3H_6	Prop	+	ene	=	Propene ikihu
n=4	$H_2C = CH\ CH_2\ CH_3$	C_4H_8	But	+	ene	=	Butene C;Vhu
n=5	$H_2C = CH\ (CH_2)_2\ CH_3$	C_5H_{10}	Pent	+	ene	=	Pentene iVhu
n=6	$H_2C = CH\ (CH_2)_3\ CH_3$	C_6H_{12}	?				

Lkkj.kh Øekd&3 l Li"V gkrk g fd ,Ydhu ifjokj d lnL;k dk lkekU; l= C_nH_{2n} gA bue fudVre lnL;k e doy –CH_2– dk vrj g blfy, ;g Hkh ltkrh; J.kh gA

,Ydhu dk uke nu d fy, Hkh ge ey&vuyXu fu;e dk ikyu djr gA ey uke l ge ,Ydhu dh tud Ük[kyk e mifLFkr dkcu ijek.k dh l[;k n'kkr g vkj bu (ene) vuyXu tkMr gA bl rjg C;Vhu dk vFk g pkj dkcu ¼C;V½ okyk ,YdhuA D;k vki N% dkcu ijek.k oky ,Ydhu dk uke crk ldr g\

,lk gh dN ge ,Fkkbu ¼,lhfVyhu½ d lkFk Hkh dj ldr gA ,Fkkbu f=cèk okyk ljyre gkbMkdkcu gA o gkbMkdkcu ftue dkcu&dkcu ijek.kvk d chp f=cèk gk] ,Ydkbu dgykr gA bud ukedj.k d fy, Hkh ge ey&vuyXu fu;e dk ikyu djr g] ;gk ey uke l ge ,Ydkbu dh tud Ük[kyk e mifLFkr dkcu ijek.k dh l[;k n'kkr g rFkk vkbu (yne) vuyXu tkMr gA bl rjg ikikbu dk vFk g rhu dkcu okyk ,YdkbuA

nh xb lkj.kh Øekd&4 e ,Ydkbu ifjokj d iFke rhu lnL;k d uke fn, x, g] bl lkj.kh e fjDr LFkkuk dk Hkfj,A

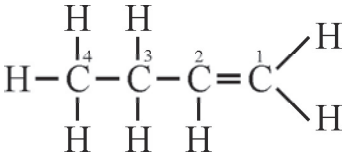
lkj.kh Øekd&4 % ,Ydkbuk dh l?kfur ljpuk] v.kl= ,o mud uke

dkcu ijek.kvk dh l[;k n	l?kfur ljpuk	v.kl=	uke
			eyHkkx $ vuyXu ¾ uke
n=2	HC ≡ CH	C_2H_2	Eth + yne = Ethyne ,Fkkbu
n=3	$CH_3C \equiv CH$	C_3H_4	Prop + yne = Propyne ikikbu
n=4	$CH_3\ CH_2\ C \equiv CH$	C_4H_6	But + yne = Butyne C;Vkbu
n=5	?	?	?
n=6	?	C_6H_{10}	?

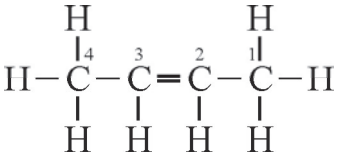
Lkkj.kh Øekd&4 l Li"V g fd ,Ydkbuk dk lkekU; l= C_nH_{2n-2} gA ,Ydkbu ifjokj d fudVre lnL;k e doy –CH_2– leg dk vrj g blfy, o Hkh l tkrh; J.kh cukr gA

15-8 ,Ydhu vkj ,Ydkbu e leko;ork ¼Isomerism in alkenes and alkynes½

C_4H_8 dh ljpuk cuku dk i;kl dhft,A bl ljpuk e vki dku l dkcu ijek.kvk d chp f}cèk cuk,x\ f}cèk] tud Ük[kyk e nk LFkkuk ij lHko g& igy vkj nlj dkcu ijek.kvk d chp ¼fp= Øekd&9 d½ vFkok nlj vkj rhlj dkcu d chp ¼fp= Øekd&9 [k½A



¼d½ C;V&1&bu



¼[k½ C;V&2&bu

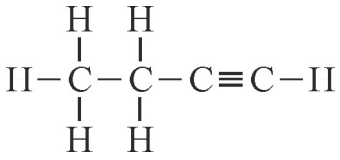
fp= Øekd&9 % d vkj [k

nkuk ljpuk, ,Ydhu n'kk jgh g vkj nkuk dk l= C_4H_8 gA

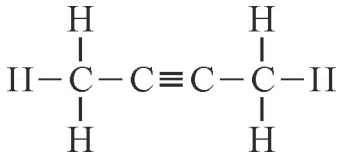
nkuk ;kfxdk d f}cèk dh fLFkfr e fHkUurk d dkj.k ;g leko;ork mRiUu gb g blfy, bl fLFkfr leko;ork dgr gA fLFkfr leko;ork Hkh Ük[kyk leko;rk d leku ,d idkj dh ljpukRed leko;ork gA ;gk nkuk ;kfxdk dk vk.kfod l= ,d gh g fdr ljpuk e vrj d dkj.k mud x.k vyx&vyx g vkj mud uke Hkh fHkUu gA

fp= Øekd 9 ¼d½ dk ge C;V&1&bu (but-1-ene) dgr gA bl uke e igyk Hkkx lhèkh ey Ük[kyk e mifLFkr dkcu n'kkrk gA bld ckn ,d vd fy[kk x;k g] tk v.k e f}cèk dk LFkku n'kkrk g rFkk bu (ene) ;g n'kkrk g fd ;g ,Ydhu ifjokj dk lnL; gA 'kCnk vkj vdk d e/; y?k j[kk ¼&½ gkrh gA blh idkj fp= Øekd 9 ¼[k½ dk C;V&2&bu (but-2-ene) dgr gA

fLFkfr leko;rk ,Ydkbuk }kjk Hkh inf'kr dh tkrh g mnkgj.k d fy, C_4H_6 ¼fp= Øekd&10 d ,o [k½ dh nk lhèkh Ük[kyk ljpuk, curh gA



¼d½ C;V&1&vkbu



¼[k½ C;V&2&vkbu

fp= Øekd&10 % d ,o [k

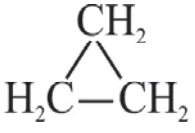
Åij n'kkb xb nkuk ljpuk, fLFkfr leko;oh gA mud ukek e igyk Hkkx] C;V n'kkrk g fd v.k e pkj dkcu g vkj vkbu n'kkrk g fd ; ,Ydkbu leg d lnL; g rFkk chp dk vd] f=cèk dk LFkku n'kkrk gA

fdlh Hkh ,Ydkbu vFkok ,Ydhu ftle dkcu l[;k pkj ;k vfèkd gk] mue fLFkfr leko;ork lHko gA

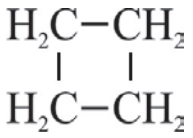
15-9 vkcèku d vkèkkj ij gkbMkdkcu d idkj

vc rd geu rhu idkj d gkbMkdkcu] ,Ydu] ,Ydhu vkj ,Ydkbu n[k gA ,Ydhuk e dkcu&dkcu d eè; f}cèk vkj ,Ydkbu e f=cèk gkrk gA f}c/kk rFkk f=cèkk dh l[;k ,d l vfèkd gk ldrh gA bld foijhr ,Ydu e lHkh ijek.kvk d chp doy ,dy cèk gkr g] pkg og dkcu&dkcu cèk gk vFkok dkcu&gkbMk tuA vkcèk e bl vrj d vkèkkj ij Hkh gkbMkdkcu dk oxhdj.k lHko gA cgcèk ¼f}c/k ;k f=cèk½ oky gkbMkdkcu dk vlrlr gkbMkdkcu rFkk ,dy cèk oky gkbMkdkcu dk lrlr gkbMkdkcu dgk tkrk gA bl rjg] ,Ydhu vkj ,Ydkbu vlrlr gkbMkdkcu g tcfd ,Ydu lrlr gkbMkdkcu gA

vc rd ftu gkbMkdkcu ljpukvk dk geu n[kk o ;k rk lhèkh vFkok 'kkf[kr Ük[kyk FkhA ij ;g Hkh lHko g fd dkcu ijek.k ,d&nlj l tM dj oy; cuk,A ,l cu lcl NkV oy; e rhu dkcu gkr g ¼fp= Øekd&11½A



lkbDykikiu
fp= Øekd&11



lkbDykC;Vu
fp= Øekd&12

bl v.k e] iR;d dkcu nk vU; dkcu vkj nk gkbMk tu ijek.kvk l tMk g] bldk vk.kfod l= C_3H_6 gA D;k ;g fdlh ,Ydhu dk l= Hkh g\ pkj dkcu okyk oy; Hkh lHko g] bldk l= C_4H_8 ¼fp= Øekd&12½ gA

nkuk mnkgj.kk e dkcu d ijek.k oy; vkdkj e 0;ofLFkr gA bue lHkh ijek.kvk d chp doy ,dy cèk g] budk lkekU; l= C_nH_{2n} gA bu gkbMkdkcu dk pØh; (cyclo) ,Ydu dgr gA C_3H_6 dk lkbDykikiu rFkk C_4H_8 dk lkbDykC;Vu dgr gA ;kn jg] lkbDyk,Ydu vkj dN ,Ydhu dk l= leku g vr% uke fy[ku l igy ljpuk tkuuk vko';d g] bl idkj db vU; pØh; gkbMkdkcu lHko gA

i'u%

1- C_5H_8 v.kl= d fdru fLFkfr leko;oh lHko g\ mudh ljpuk cukb,A

2- fuEufyf[kr e lrlr rFkk vlrlr gkbMkdkcu iFkd dhft,&

$CH{\equiv}CH$, $CH_3CH_2CH_3$, $CH_3HC{=}CH_2$, $CH_2{=}CH_2$, CH_3CH_3

e[; 'kCn (Keywords)

gkbMkdkcu (hydrocarbon)] Ük[kyu (catenation)] cèk (bond)] ,Ydu (alkane)] ,Ydhu (alkene)] ,Ydkbu (alkyne)] leko;ork (isomerism)] lrlr (saturated)] vlrlr (unsaturated)] ltkrh; J.kh (homologous series)] Ük[kyk leko;ork (chain isomerism)] LFkku leko;ork (position isomerism)] y?k j[kk ¼&½ (hyphen)] vuqyXu (suffix)] ljpuk l= (structural formula)] ey ;k tud Ük[kyk (parent chain)] l?kfur l= (condensed formula)

geu lh[kk

- dkcu rFkk gkbMkdkcu l cu lgl;kth ;kfxd gkbMkdkcu dgykr gA
- dkcu dh l;ktdrk pkj g vkj vU; ijek.kvk d lkFk ;g lgl;kth cèk }kjk tMrk g blfy, leLr dkcfud ;kfxdk dk 0;ogkj vkil e feyrk tyrk gA
- rRok dk og x.k] ftld }kjk mld ijek.k vkil e vkcèk cukdj ych Ük[kyk cukr g] Ük[kyu dgykrk gA
- Lkeku fØ;kRed leg ;Dr dkcfud ;kfxdk dh ,lh J.kh ¼ifjokj½ ftud nk Øfed lnL;k d l=k e $-CH_2-$ dk vrj gkrk g vkj budk lkekU; l= ,d leku gkrk g rFkk Hkkfrd x.kk e Øfed ifjoru gkrk g] ltkrh; J.kh dgykrk g rFkk ;kfxd ,d nlj d ltkr dgykr gA

- ,l ;kfxd ftud v.kl= leku fdr ljpukRed l= fHkUu&fHkUu gk ,d nlj d leko;oh rFkk ;g x.k leko;ork dgykrk gA
- dkcu ijek.kvk dh Ük[kyk e fHkUurk d dkj.k mRiUu gb leko;ork Ük[kyk leko;ork dgykrh gA
- dkcu Ük[kyk e ifrLFkkih ;k fØ;kRed leg ;k f}c/k ;k f=c/k dh fLFkfr e vrj d dkj.k mRiUu gb leko;ork fLFkfr leko;ork dgykrh gA
- ,Ydu e C-C o C-H cèk ,dy cèk gkr g] budk lkekU; l= C_nH_{2n+2} gkrk gA
- ,Ydhu e C=C lkk;k tkrk g budk lkekU; l= C_nH_{2n} gA
- ,Ydkbu e C≡C ik;k tkrk g budk lkekU; l= C_nH_{2n-2} gA
- lkbDyk,Ydu e dkcu d ijek.k oy; vkdkj e jgr g] budk lkekU; l= C_nH_{2n} gA

vH;kl

1- uhp fn, x, fooj.kk gr lgh fodYi dk p;u dhft,&

½LFkku leko;ork] ltkrh; J.kh] ,Ydu] leko;oh] Ük[kyk leko;oh] Ük[kyu½

(i) bl gkbMkdkcu e doy ,dy cèk gkr gA

(ii) dkcu db rRok d lkFk icy cèk cuku dh {kerk j[krk gA ij fo'k"k ckr ;g g fd og vU; dkcu ijek.kvk l tMdj ych Ük[kyk cukrk gA

(iii) o v.k ftue ijek.kvk dh l[;k leku fdr ljpuk l= fHkUu gkA

(iv) C;Vu rFkk 2&efFkyikiu fdl idkj d leko;oh gA

(v) og ljpukRed leko;ork tk ,Ydhu vkj ,Ydkbu e lHko g ij ,Ydu e ughA

(vi) bl J.kh d lnL; Hkkfrd x.kèkek e fu;fer vrj fn[kkr gA

2- fjDr LFkku dh ifr dhft,&

(i) gDl&1&bu vkj gDl&2&bu ---------- leko;oh gA

(ii) C;Vu dk DoFkukd ikiu l ---------- gA

(iii) 2&efFkyikiu dh tud Ük[kyk e dkcu ijek.kvk dh l[;k ---------- gA

(iv) lkbDykC;Vu e gkbMktu ijek.kvk dh l[;k ---------- gA

(v) C_2H_6, C_3H_8, C_4H_{10} ---------- ltkrh; J.kh d lnL; gA

3- fuEufyf[kr d ljpuk l= cukb,&
2&efFkyhu] iki&1&vkbu] iV&2&bu

4- ,Ydu ltkrh; J.kh d rhu x.k fyf[k,A

5- LFkku rFkk Ük[kyk leko;rk e mnkgj.k lfgr vrj fyf[k,A

6- lrr Ük[kyk ,Yduk d DoFkukd vkj mudh dkcu l[;k e D;k lcèk g\ le>kb,A

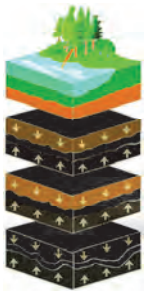
7- o ,Ydu] ,Ydhu vkj ,Ydkbu ftue rhu ;k de dkcu ijek.k g] ljpuk leko;rk ugh n'kkr] le>kb,A

8- C_4H_8 v.kl= d fdru leko;oh cux\ mud l= cukb,A ¼ldr& rhu leko;oh lHko g½

v/;k;&16

dk;yk] iVkfy;e ,o iVkjlk;u

(Coal, Petroleum and Petrochemicals)

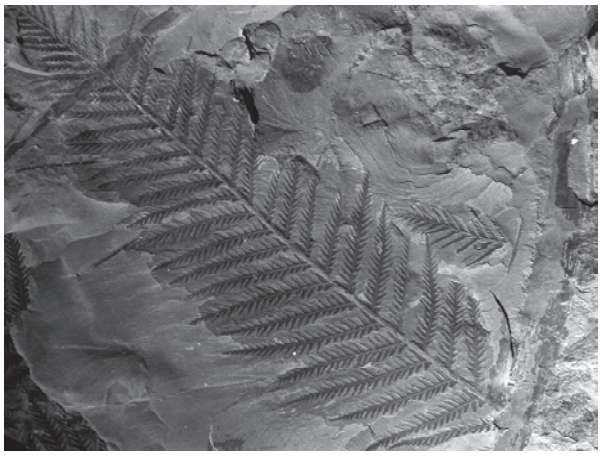


fofHkUu dk;k dk dju d fy, ge Åtk dh vko';drk gkrh gA Åtk ge fofHkUu lkrk l ikIr gkrh gA dkj[kkuk dk pyku d fy, fo|r] okguk dk pyku d fy, bèku ¼Mhty] iVky ,o lh-,u-th-½ dh vko';drk gkrh gA ge Hkkrtu cuku d fy, fofHkUu idkj d bèku tl& ydMh] feêh dk ry] ,y-ih-th] dk;yk vkfn dk mi;kx djr gA

vkiu dHkh lkpk g fd vkf[kj ; bèku fo'k"k :i l dk;yk] iVky vkj Mhty ge feyr dgk l g\ D;k bu bèkuk dk fuek.k fdlh i;kx'kkyk ;k dkj[kku e gkrk g\ ; dl vkj dgk cur g\ ; bèku djkMk o"kk rd iFoh dh lrg d uhp xgjkb e nc g, tho&trvk vkj ouLifr;k d vo'k"kk dk :ikrj.k g rFkk ; thok'e bèku ¼dk;yk vkj iVkfy;e½ dgykr gA

16-1 dk;yk vkj iVkfy;e dh mRifÙk ¼Origin of coal and petroleum½

yxHkx 36 l 28 djkM o"k io dkckfuQjl dky e ouLifr;k ¼iM&ikèkk½ ,o trvk d er 'kjhj iFoh d Hkhrj nc x,A èkhj&èkhj mu ij feêh dh ijr terh xbA Hk&xHk e mPp rki ,o nkc ij vkDlhtu dh vuifLFkfr e ; er 'kjhj dk;y e cny x,A gkykfd ;g Hkh ekuk tkrk g fd ; eyr% ouLifr;k l gh cur gA bl er d i{k e rd ;g g fd dk;y dh ijrk e cMh l[;k e thok'e fey gA bue l dN thok'e] ifRr;k o ikèkk d uktd vxk dh Nki g ¼fp= Øekd&1½A

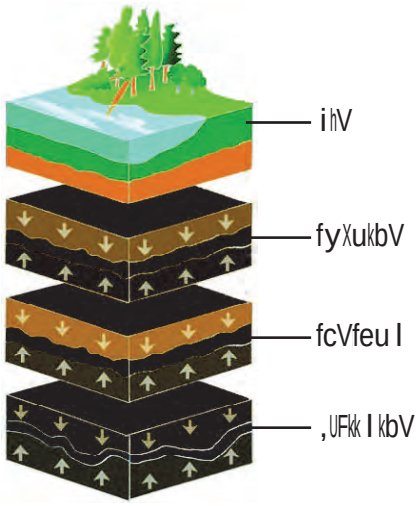


fp= Øekd&1 % dk;y dh ijr e iRrh dh Nki

,lk ekuk tkrk g fd iVkfy;e dh mRifÙk len e jgu oky thok ¼lyod½ l gb gA tc ; tho er g, rc bud 'kjhj len d in e tkdj te x, vkj fQj jr rFkk feêh dh rgk }kjk <d x,A yk[kk o"kk rd vkDlhtu dh vuifLFkfr e mPp rki o nkc ij er tho iVkfy;e rFkk ikdfrd xl e ifjofrr gk x,A

16-2 dk;y d idkj ¼Types of coal½

vki lHkh u ydMh dk dk;yk rk n[kk gh gA ;g dky jx dk Hkxj inkFk g tk cgr gh de le; e curk gA ge ;gk ij ftl dk;y dh ckr dj jg g og dky jx dk ijr iRFkj d leku dBkj gkrk gA



fp= Øekd&2 ¼ dk;y d fofHkUu idkjk dh ijr

vki ;g tkur g fd Hk&xHk e nch ouLifr;k d fo?kVu (decomposition) l dk;y dk fuek.k gvk gA ; fo?kfVr ouLifr;k loiFke ihV e ifjofrr gkrh g rFkk yxkrkj mPp rki ,o nkc d dkj.k Øe'k% fyXukbV] fcVfeul o ,UFkkIkbV dk;y e cny tkrh g ¼fp= Øekd&2½A

dk;y e e[;r% dkcUk ,o mld ;kfxd gkr g] dkcu dh ifr'kr ek=k d vkèkkj ij dk;y dk fuEufyf[kr oxk e ckVk x;k g&

1- ihV& ;g ouLifr d dk;y e :ikrj.k dh igyh voLFkk gA ble yxHkx 25&35% dkcu gkrk gA bldk mi;kx vfèkdrj bèku d :i e fd;k tkrk gA

2- fyXukbV& ;g dk;yk] Hkjk dk;yk d uke l Hkh tkuk tkrk gA ble yxHkx 35&45% rd dkcu gkrk gA bldk mi;kx fo|r mRiknu e fd;k tkrk gA

3- fcVfeul& ;g idfr e lcl vfèkd ek=k e ik;k tku okyk rFkk lokfèkd mi;kx e vku okyk dk;yk gA ble dkcu yxHkx 45&85% rd gkrk gA bldk mi;kx e[;r% rkih; vkj lheV l;=k e] iij dkj[kkuk e] vkVkekckby ,o oL= m|kxk e fd;k tkrk gA bldk mi;kx bLikr l;=k e dkd d :i e Hkh fd;k tkrk gA bl dk;y e lYQj dh ek=k lcl vfèkd ikb tkrh gA

4- ,UFkkIkbV& bl dBkj dk;yk Hkh dgr g] ;g ,d mRre J.kh dk dk;yk gA ble dkcu 85% l vfèkd gkrk gA vfèkd dkcu ifr'kr d dkj.k ;g vfèkd le; rd tyrk g] bll èkvk vkj jk[k de mRiUu gku d dkj.k bldk mi;kx ?kjy bèku d :i e fd;k tkrk gA

mi;Dr idkjk e geu n[kk fd dk;y d fofHkUu :ik e dkcu dh ifr'kr ek=k Øe'k% c<rh tkrh gA bll ,lk yxrk g fd dk;y e flQ dkcu g] ijr ,lk ugh gA dk;y e dkcu d lkFk gkbMkstu] vkDlhtu] ukbVkstu] lYQj] vknrk ¼ueh½ vkfn Hkh ik, tkr gA

dk;y d bu idkjk dh leku ek=k dk tyku ij Å"ek dh ek=k ¼Å"eh; {kerk½ d vkèkkj ij 0;kikfjd mi;kx dh nf"V l budh xfMx dh tkrh gA

16-3 dk;y d xM ¼Grades of coal½

dk;y dh Å"eh; {kerk dk ekiu d fy, xM (G) dk mi;kx fd;k tkrk gA bldk vkèkkj ldy dykjh eku ¼Gross Calorific Value½ gA bldh bdkb fdyk dykjh ifr fdykxke ¼kcal/kg½ gA

lkj.kh Øekd&1 % dk;y d xM

xM	ldy dykjh eku (GCV) (kcal/kg)	xM	ldy dykjh eku (GCV) (kcal/kg)
G-1	7000 l Åij	G-10	4301 l 4600 rd
G-2	6701 l 7000 rd	G-11	4001 l 4300 rd
G-3	6401 l 6700 rd	G-12	3701 l 4000 rd
G-4	6101 l 6400 rd	G-13	3401 l 3700 rd
G-5	5801 l 6100 rd	G-14	3101 l 3400 rd
G-6	5501 l 5800 rd	G-15	2801 l 3100 rd
G-7	5201 l 5500 rd	G-16	2501 l 2800 rd
G-8	4901 l 5200 rd	G-17	2201 l 2500 rd
G-9	4601 l 4900 rd		

dk;y dk mi;kx mldh xfMx d vulkj fd;k tkrk gA gekj NÙkhlx< jkT; e Hkh fofHkUu xM dk dk;yk ikIr gkrk gA vkb,] n[k ;g dgk&dgk feyrk gA

16-4 NÙkhlx< e dk;yk ¼Coal in Chhattisgarh½

dk;yk d HkkMkj.k ,o mR[kuu e Hkkjr e NÙkhlx< dk ,d egRoi.k LFkku gA NÙkhlx< e dkjck] jk;x<] ljxtk rFkk dkfj;k e dk;y dh Hkfexr ,o [kyh [knku gA dkjck fty e jtxkekj] cxnok] ljkdNkj ,o ckdhekxjk dh [knkuk e G-4 ,o G-5 xM dk dk;yk ikIr gkrk gA bld vykok xojk] fnidk ,o dleMk dh [knkuk l G-11 xM dk dk;yk ikIr gkrk gA gekj NÙkhlx< jkT; e ,u-Vh-ih-lh- ¼u'kuy Fkey ikoj dkikj'ku½] lh-,l-b-ch- ¼NÙkhlx< LVV byfDVflVh ckM½ d rkih; l;=k e dk;y dk mi;kx

fd;k tkrk gA bld vykok ,Ykfefu;e l;= ckydk] bLikr l;= fHkykb] rkih; ,o bLikr l;= jk;x< o jk;ij d flyrjk e fLFkr vk|kfxd l;=k e dk;y dk mi;kx gk jgk gA bl idkj fofHkUu mi;kxk d dkj.k bl dkyk ghjk Hkh dgr gA

i'u %

1- thok'e bèku fdl dgr g\

2- dk;yk dl curk g\

3- fdl idkj d dk;y e lYQj dh ek=k lokfèkd ikb tkrh g\

vHkh rd geu thok'e bèku dk;y d ckj e tkuk gA vkb,] vc nlj egÙoi.k thok'e bèku iVkfy;e dk tkuA

16-5 iVkfy;e ¼Petroleum½

iVkfy;e nk 'kCnk iVk (petra) ¾ pêku o vkfy;e (oleum) ¾ ry l feydj cuk g vFkkr pêku dk ryA iVkfy;e dl cuk ;g ge tku pd gA iVkfy;e ryh;] xgj jx dk rFkk fof'k"V xèk okyk no gA ;g iFoh dh lrg d uhp cgr xgjkb e ik;k tkrk gA

iVkfy;e dk ,d fuf'pr jklk;fud l= ugh gkrk g D;kfd ;g db gkbMkdkcu dk feJ.k gkrk gA bu gkbMkdkcu dk iFkDdj.k lkèkkj.k vklou fofèk }kjk ugh fd;k tk ldrk vr% bld fy, ge ,d fo'k"k fofèk dk mi;kx djuk iMrk g] ftl iHkkth vklou dgr gA

16-5-1 iVkfy;e dk iHkkth vklou ¼Fractional distillation of petroleum½

vkiu n[kk gkxk fd tc ge cru e ikuh dk xe djr g rc ok"i curh gA ;fn bl cru dk <d n rk <Ddu d vnj dh vkj ikuh dh dN cn fn[kkb nrh gA ;g ifØ;k vklou dgykrh gA vkb,] ge nk nok d feJ.k d vklou dk le>u dk i;kl djr gA vklou dh ifØ;k e vxj nk nok d feJ.k dk xe fd;k tk, rk ; nkuk ok"i e ifjofrr gk tkr g vkj ok"i dk BMk dju ij o iuh no e cny tkr gA

lkekU; rki ij lHkh no yxkrkj okf"ir gkr jgr g ijr tc bUg xe djr g rk ok"i dh ek=k c<rh tkrh gA ok"i dh ;g ek=k no d DoFkukd d 0;RØekuikrh gkrh g vFkkr ftl no dk DoFkukd fuEu gkxk] ml dh ok"i vfèkd cuxh vkj mPp DoFkukd oky no dh ok"i de cuxhA bl ok"i dk BMk dju ij fuEu DoFkukd oky no dh vfèkd ek=k ikIr gkrh g vkj mPp DoFkukd oky no dh deA bl ge nk nok A vkj B d mnkgj.k }kjk le> ldr g&

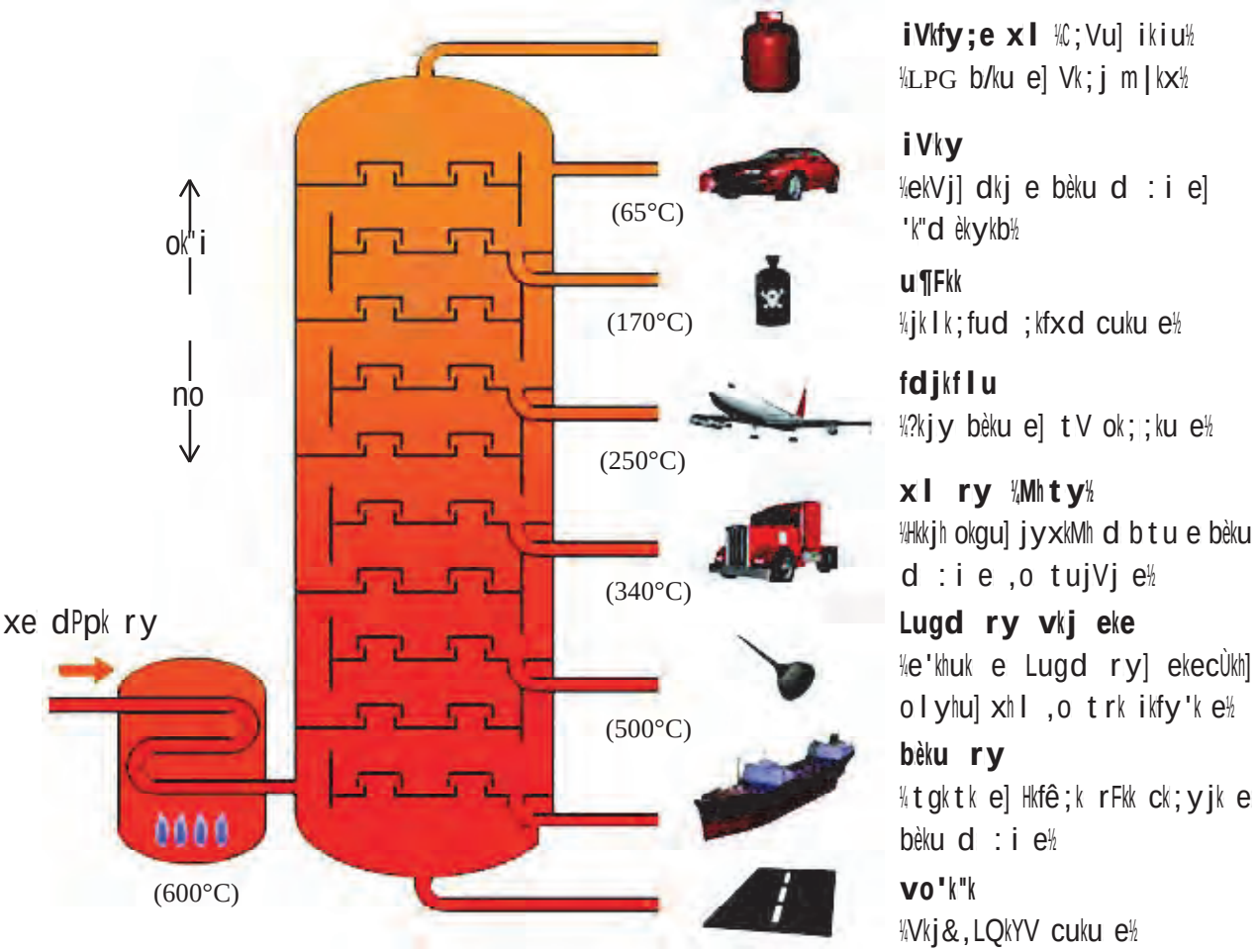
no A $ no B **xe dju ij** ok"i **BMk dju ij** no

¼fuEu DoFkukd½ ¼mPp DoFkukd½ ¼A dh ok"i T;knk] ¼A dh ek=k T;knk]

B dh ok"i de½ B dh ek=k de½

;fn bu nkuk nok dk ijh rjg iFkd djuk gk rk vklou dh ifØ;k dk ckj&ckj nkgjkuk gkxkA

ge tkur g fd iVkfy;e db gkbMkdkcu dk feJ.k g] ftud DoFkukd e cgr de vrj gkrk gA ,l feJ.k d ?kVdk dk lkèkkj.k vklou fofèk d }kjk iFkd djuk dfBu gkrk g vr% bld fy, fo'k"k midj.k dk i;kx fd;k tkrk g] ftl iHkktd LrHk dgr gA bl idkj] nk ;k nk l vfèkd feJ.kh; nok dk] ftud DoFkukd d eè; cgr de vrj gkrk g] iFkd dju dh fofèk iHkkth vklou dgykrh gA



fp= Øekd&3 % iVkfy;e dk iHkkth vklou

iVkfy;e d iHkkth vklou d fy, loiFke dPp ry dk Hkêh e xe fd;k tkrk g vkj ok"ik dk iHkktd LrHk d fupy Hkkx e igpk;k tkrk gA ok"ik dk ;g feJ.k LrHk e Åij dh vkj mBrk g vkj l?kfur gkdj no :i e uhp dh vkj vkrk gA LrHk e vklou dh fØ;k yxkrkj pyrh jgrh g] D;kfd xe ok"i d dkj.k l?kfur no iu% ok"i e cny tkrk gA bl idkj fuEu DoFkukd oky ;kfxd LrHk d Åijh Hkkx e vklfor gk tkr g vkj bUg vyx ,d= dj fy;k tkrk gA LrHk e Åij l uhp Øe'k% fuEu DoFkukd l mPp DoFkukd oky no iFkd dj fy, tkr gA bl idkj vyx&vyx DoFkukd oky iHkkt iFkd gk tkr g ¼fp= Øekd 3½A

geu n[kk fd iVkfy;e d iHkkth vklou l fofHkUu rki ij db egRoi.k inkFkk dh ikflr gkrh g bUg iVkjlk;u dgr g ftudk mi;kx fofHkUu {k=k e fd;k tkrk gA vkèkfud le; e db m|kx bUgh inkFkk ij vkèkkfjr gA

i'u %

1- iHkkth vklou fdl dgr g\

2- iVkfy;e dk iHkkth vklou D;k vko';d g\ iHkkld LrHk e Åij dh vkj dku&lh xl ikIr gkrh gA

3- iVkfy;e dk jklk;fud l= D;k ugh gkrk g\

16-6 iVkjlk;u ¼Petrochemicals½

iVkfy;e l mRiUu jlk;u iVkjlk;u dgykr gA iVkjlk;u d ikjfHkd mi;kx dh dgkuh cgr gh jkpd gA cgr le; igy] [kkMh {k=k e iVkfy;e èkhj&èkhj xM<k l Lor% fudyrk jgrk FkkA ble mifLFkr inkFk ok"i'khy gkr FkA vr% dN le; i'pkr ble ,d fpifpik inkFk cp tkrk FkkA bldk mi;kx ukok dk tyjkèkh cuku e fd;k tkrk FkkA ykxk u bldk mi;kx edku cukr le; bV] iRFkj tkMu d fy, Hkh fd;kA yxHkx 200 o"k igy iVkfy;e l feêh dk ry ¼fdjkflu½ iFkd fd;k x;k] rc l bldk mi;kx bèku rFkk idk'k d fy, cgrk;r e gku yxkA

mUuhloh 'krkCnh d eè; iVkfy;e l ikIr tyh dk i;kx etnjk }kjk t[ek vkj tyu d mipkj gr fd;k tkrk FkkA bld vkèkkj ij gh lkn; il kèku lkefx;k e iVkfy;e tyh d mi;kx dh 'k#vkr gbA iVkjlk;u dk mi;kx viekt d] j'k ¼ikfy,LVj] ukbyku] ,fØfyd vkfn½] ikfyFkhu vkj vU; ekuo fufer lykfLVd vkfn d vk|kfxd fuek.k e fd;k tkrk gA

vkt fofHkUu {k=k e lykfLVd mRiknk u Økfrdkjh ifjoru yk fn;k gA bl m|kx dk n'k dh vFk0;oLFkk e egRoi.k ;kxnku gA fofHkUu {k=k e bll cuh oLrvk dk 0;kid mi;kx gku d dkj.k bldh egÙkk c<rh tk jgh gA

16-7 lykfLVd dk iu% pØ.k ¼Recycling of plastic½

lykfLVd dh oLr, mi;kx dju d i'pkr bèkj&mèkj Qd nh tkrh g fdr ; feêh e vi?kfVr ugh gk ikrh gA ft ld dkj.k budk u"V djuk vFkok bUg iu% mi;kx e yku yk;d cukuk vko';d gk tkrk gA vui;kxh lykfLVd dh oLrvk dk mi;kxh mRiknk e cnyu dh ifØ;k dk lykfLVd dk iu% pØ.k dgr gA

lu 1988 e lykfLVd m|kx lLFkk d }kjk fofHkUu lykfLVd mRiknk dk igpku dkM fn, x,A lykfLVd dk iu% pØ.k dju l igy lykfLVd mRiknk dk mud igpku dkM d vulkj vyx&vyx fd;k tkrk gA bu igpku dkMk dk lkr legk e ckVk x;k gA

igpku dkM e l[;k dk rhu rhjk d irhd d eè; j[kk tkrk g ¼lkj.kh Øekd&2½A leku dkM oky lykfLVd dk iu% pØ.k ,d lkFk fd;k tkrk gA

lkj.kh Øekd&2 % lykfLVd igpku dkM ,o mi;kx

igpku dkM							
oLrqvk d uke	ikuh ckry] 'khry i; ckry] te dk tkj	ikuh dk ikbi] cPpk d f[kyku] tl gr ckry] 'kEi rFkk Øhe gr ckry	ihohlh ikbi] tl gr ckry	?	?	?	?

fØ;kdyki&1

- viu vkl&ikl ikb tku okyh lykfLVd dh oLrqvk d igpku dkM dk ukV dhft,A
- iR;d dkM dh dku&dku lh oLr, feyh] mUg oxhdr dhft,A
- D;k vkidk lHkh lkr dkM dh oLr, feyh\ viu lkFkh }kjk ukV dh xb oLrqvk d dkM dk Hkh n[k rFkk d{kk e ppk djA
- pkj l lkr dkM okyh dku&dku lh lykfLVd dh oLr, feyh mUg lkj.kh Øekd&2 dk dkih e cukdj Hkfj,A
- lykfLVd d iu% pØ.k ij fofHkUu ek/;ek l tkudkjh ,d= dj d{kk e bl ij ppk djA

16-8 bèku dk ngu ¼Combustion of fuels½

ge tkur g fd fdlh oLr d tyu d fy, vkDlhtu dh vko';drk gkrh gA vkDlhtu dh mifLFkfr e oLr dk tyuk ngu dgykrk gA ngu dh ifØ;k e Å"ek fudyrh g] vr% ;g ,d Å"ek{kh vfHkfØ;k gA

dk;y d ngu dh ifØ;k e e[;r% dkcu MkbvkDLkbM rFkk Å"ek mRiUu gkrh gA

$$C + O_2 \longrightarrow CO_2 \uparrow + Å"ek$$

;fn dk;y dk ngu vkDlhtu dh vkf'kd ek=k e gkrk g rk dkcu ekukvkDlkbM ikIr gkrh gA

$$C + ½\ O_2 \longrightarrow CO \uparrow + Å"ek$$

dk;y d ngu d i'pkr cp vo'k"k dk jk[k dgr gA bl idkj geu n[kk fd bèku d ngu l dkcu MkbvkDlkbM] dkcu ekukvkDlkbM vkj jk[k curh g ftudh vfèkd ek=k i;koj.k dk inf"kr djrh gA

16-9 thok'e bèku d c<r mi;kx dk i;koj.k ij iHkko

thok'e bèku dkcfud inkFkk dk : ikrj.k gA c<r vk|kxhdj.k d dkj.k thok'e bèku dk mi;kx yxkrkj c<rk tk jgk gA ;fn blh rjg ge thok'e bèku dk mi;kx djr jg rk i;koj.k ij bldk n"iHkko iMxkA

- bèku dk tyku l tk dkcu MkbvkDLkkbM mRiUu gkrh g mldk dN Hkkx rk gj iM&ikèkk }kjk idk'k l'y"k.k e mi;kx dj fy;k tkrk g ijr T;knkrj Hkkx ikèkk?kj iHkko (greenhouse effect) mRiUu djrk gA bld dkj.k iFoh dk rkieku c< jgk gA
- bèku d ngu l mRiUu dkcUk ekukvkDlkbM ,d fo"kyh xl g tk jDr e ik, tku oky ghekXykfcu e] vkDlhtu dh vi{kk rhork l ?kyrh gA ;fn dkcu ekukvkDlkbM dh ek=k jDr e vfèkd gk tk, rk eR; rd gk ldrh gA
- rkih; l;=k e dk;y d ngu l mRiUu gku okyh jk[k vkl&ikl d {k=k e mMrh g] ml mMu jk[k (fly ash) dgr gA ;g QQMk dk lØfer djd flfydkfll chekjh mRiUu djrh g ftll QQMk dk {kfr igprh gA
- bèku e ik, tku oky ukbVktu rFkk lYQj ngu d i'pkr mud vkDlkbM e cny tkr g ftud o"kk d ty e ?kyu d dkj.k vEy o"kk gkrh gA

16-10 thok'e bèku dk lj{k.k ¼Conservation of fossil fuels½

thok'e bèku Åtk dk ,lk lkr g ftl cuu e djkMk o"k yxr gA nljh vkj bld Kkr HkMkj flQ dN lk o"k vkj pyu oky gA ge bld n#i;kx dk jkdu dk i;kl djuk pkfg,A gekj }kjk bld lrfyr mi;kx dju ij gh ;g Hkkoh ih<h d fy, miyC/k gk ldxkA

- thok'e bèkuk d n#i;kx dk jkdu d mik;k dh tkudkjh lenk; dk nuh pkfg,A
- dk;yk [kuu gr u, oKkfud rjhdk dk mi;kx djuk pkfg, ftll dk;y dh li.k ek=k ikIr gk ld rFkk vuko';d gkfu u gkA
- okguk e lihfMr ik—frd xl (CNG) d mi;kx dk ikFkfedrk nuh pkfg, D;kfd ble ukbVktu o lYQj ugh ik;k tkrkA
- lykfLVd dk mi;kx lhfer gkuk pkfg,A
- okguk d }kjk iVkfy;e mRiknk dh [kir dk de dju d fy, okguk d lefpr j[k&j[kko ij tkj nuk pkfg,A Hkkjr e iVkfy;e lj{k.k vulèkku lfefr ¼PCRA½ ykxk dk lykg nrh g fd xkMh pykr le; fdl idkj iVky@Mhty cpk,A mudh lykg g&

- ☛ tgk rd lHko gk] xkMh eè;e vkj ,d leku xfr l pykb,A
- ☛ ;krk;kr flXuy ij vFkok tgk vkidk irh{kk djuh gk xkMh dk btu cn dj nhft,A
- ☛ Vk;jk dk nkc lgh jf[k, vkj xkMh dk fu;fer j[k&j[kko lfuf'pr dhft,A

i'u %

1- lykfLVd dk iu% pØ.k fdl dgr g\

2- ngu fdl dgr g\ le>kb,A

e[; 'kCn (Keywords)

thok'e bèku ¼fossil fuel½] dk;yk ¼coal½] iVkfy;e ¼petroleum½] iHkkth vklou ¼fractional distillation½] iu% pØ.k ¼recycling½] ngu ¼combustion½] lj{k.k ¼conservation½] lyod (plankton), mMu jk[k (fly ash), vEy o"kk (acid rain)

geu lh[kk

- mPp rki ,o nkc ij vkDlhtu dh vuifLFkfr e tho&trvk vkj ouLifr;k d vo'k"kk d :ikrj.k l thok'e bèku cur gA dk;yk ,o iVkfy;e thok'e bèku gA
- ouLifr;k ,o trvk d er 'kjhj l dk;yk rFkk lenh thok ¼lyod½ d er 'kjhj l iVkfy;e dh mRifÙk gb gA
- dk;yk fuek.k e loiFke ihV ikIr gkrk g] lcl mÙke dk;yk ,UFkk lkbV gkrk gA
- 0;kolkf;d mi;kx dh nf"V l dk;y d xM mudh Å"eh; {kerk d vkèkkj ij fn, tkr gA
- iVkfy;e dk ,d fuf'pr jklk;fud l= ugh gkrk D;kfd ;g db gkbMkdkcu dk feJ.k gkrk gA
- iHkkth vklou ,l nok d feJ.k d iFkDdj.k d fy, fd;k tkrk g ftud DoFkukd e cgr de vrj gkrk gA
- iHkktd LrHk e lcl Åij dh vkj iVkfy;e xl rFkk lcl uhp xk<k vo'k"k ikIr gkrk gA
- nfud thou e mi;kxh fofHkUu lykfLVd mRikn iVkjlk;u dh gh nu gA
- vui;kxh lykfLVd mRiknk dk mi;kxh mRiknk e cnyu dh ifØ;k dk lykfLVd dk iu% pØ.k dgr gA

vH;kl

1- lgh fodYi pfu,&

(i) dk;y dk fuek.k fuEufyf[kr d vo'k"kk l gkrk g&

¼v½ ouLifr;k ¼c½ trvk

¼l½ ouLifr ,o trvk nkuk ¼n½ bue l dkb ugh

(ii) thok'e bèku cuu d fy, vko';d fLFkfr;k g&

¼v½ mPp rki ¼c½ mPp nkc

¼l½ vkDlhtu dh vuifLFkfr ¼n½ mi;Dr lHkh

(iii) fdl idkj d dk;y e dkcu dh ek=k lokfèkd gkrh g&

¼v½ ihV ¼c½ fyXukbV

¼l½ fcVfeul ¼n½ ,UFkkIkbV

(iv) ih-oh-lh- l fufer oLrvk dk igpku dkM D;k g&

¼v½ 1 ¼c½ 2

¼l½ 3 ¼n½ 4

2- fjDr LFkku dh ifr dhft,&

(i) dk;yk ,o iVkfy;e ---------- bèku gA

(ii) dk;y d fuek.k e loiFke ---------- idkj dk rFkk vr e ---------- idkj dk dk;yk curk gA

(iii) dkcu dh lcl de ek=k ---------- idkj d dk;y e ikb tkrh gA

(iv) iHkkth vklou rc fd;k tkrk g tc nok d ---------- e vrj cgr de gkrk gA

(v) iVkfy;e nk 'kCnk ---------- vkj ---------- l feydj cuk gA

3- thok'e bèku fdl idkj cur g\ le>kb,A

4- dk;y d fofHkUu idkjk dk foLrkjiod fyf[k,A

5- thok'e bèku d vfèkd mi;kx l i;koj.k ij iMu oky iHkkok dk crkb,A

6- thok'e bèku dk lj{k.k vko';d g] le>kb,A

7- iVkfy;e d iHkkth vklou l ikIr mRikn dku&dku l g\ bud D;k mi;kx gA

vè;k;&17

ik—rokl % ikdfrd vkokl

(Habitat)

17-1 ikdrokl l vfHkik; (Meaning of habitat)

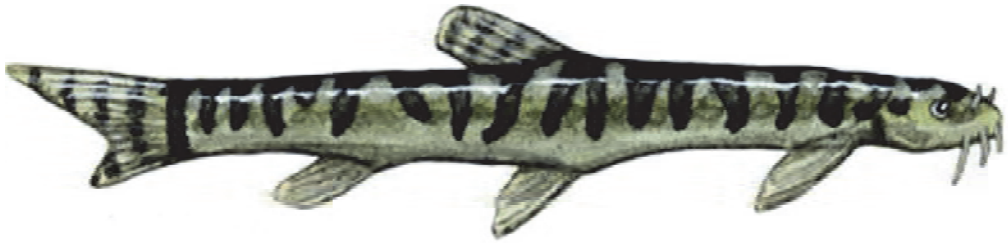
gekj jkT; e txnyij d ikl dkxj unh d rV ij dVelj xQk gA bl xQk dh Nr o nhokjk l puk;Dr ikuh Vidrk g ftl l Nr l yVdrh vkj tehu l mHkjrh 'kd tlh fo'kky vkj lnj ljpuk, curh g ¼fp=&1½A

dVelj xQk vkl&ikl dh tehu l yxHkx 35 ehVj uhp o ,d fdykehVj l vfèkd ych gA bl xQk e bruk vèkjk g fd ;fn gkFk e idMh Vkp dk cn dj n rk ,d dne Hkh vkx pyuk ef'dy gk tkrk gA xQk e v,Dlhtu dh ek=k ckgj dh ryuk e de gA bu ifjfLFkfr;k d ckotn ;gk db idkj d tho ik, tkr gA mnkgj.k d fy, pexknM] dhM&edkM] feyhihMl] cDVhfj;k vkfnA

fp= Øekd&1 % dVelj xQk dh 'kd tlh jpuk,&Nr l yVdr LVyDVkbV ,o tehu l mHkjr LVyDekbV

dVe lj xQk dk rkieku lkyHkj 25°C l 32°C d chp jgrk gA ;gk d ikuh dk rkieku yxHkx 22°C l 30°C d chp jgrk gA bldk vFk ;g g fd xQk o vnj d ikuh d rkieku e vfèkd vrj ugh gkrkA cjlkr d ekle e ;gk çk;% ck< vk tkrh gA

xQk e eNyh dh ,d ,lh tkfr g tk yxHkx vèkh gA bldh vk[k cgr gh NkVh gA bldh yckb 2 l 4 leh- gA LFkkuh; ykx bl ^^dkuh eNjh** dgr gA bl eNyh dh vU; fdLe igkMh ufn;k e ikb tkrh gA dVe lj xQk e bldh ,d [kkl fdLe feyrh gA ;g ;gk dh xQkvk e ik, tku oky l{e tyh; ikèkk] trvk tl dhMk] ?kk?kk vkfn dk [kkrh gA ; er tr vkj ikèkk dk Hkh [kkrh gA vr% ;g Ldotj ;k viektd dh Hkfedk Hkh fuHkkrh gA ; eNfy;k vDlj feêh d uhp viuk le; fcrkrh g o ikuh e lkl yrh g yfdu le;≤ ij ikuh dh lrg ij vkdj eg e gok Hkjrh gA ; viuk li.k thoudky blh xQk e fcrkrh gA ;gh çtuu djrh g vkj ;gh ej tkrh gA bl idkj ge dg ldr g fd dVe lj xQk dk ikuh bu eNfy;k dh vkcknh dk çk—rokl gA



fp= Øekd&2 % dkuh eNjh

- ;gk dVe lj dh xQkvk dh fdu fo'k"krkvk dh ckr dh xb g\
- ;fn ck< d lkFk ; dkuh eNfy;k xQk l ckgj pyh tk, rk dl thfor jgrh gkxh\
- ; eNfy;k vU; eNfy;k l dl fHkUu g\

dVe lj xQk e tfod dkjd dkuh eNjh vkj vU; tho gA ogk dk rkieku] pu;Dr nhokj] ikuh vkj idk'k vkfn vtfod dkjd gA vr% fdlh Hkh i;koj.k e jgu ;kX; ljf{kr LFkku] rkieku] ikuh o gok bR;kfn ogk d vtfod dkjd gkr g rFkk ogk ij Hkk tu dh miyC;krk o fofHkUu itkfr;k dh mifLFkfr vkfn tfod dkjd gkr gA

fdlh Hkh ikdrokl d vtfod o tfod dkjd ogk d thok dk fofHkUu rjhdk l iHkkfor djr gA

17.2 çk—rokl ,o i;koj.k d ?kVdk d eè; vrlcèk (The interrelationship between natural components in a habitat)

vkb,] ge viu çk—rokl vkj i;koj.k d l tho&futho ?kVdk d eè; vrlcèk dk tkuA

fØ;kdyki&1

vki lcg lk dj mBu d ckn l jkr e lku rd viuh fnup;k dk dN le; rd lkp vkj ,d fnu e vkid }kjk mi;kx e ykb xb vko';d oLrvk dh lph cuk,A lph e vkid lkl yu d fy, vko';d gok] mi;kx e yk;k x;k VFkc'k] ikuh] nèk ;k pk; tk vki ihr g vkfn lHkh phtk dk 'kkfey djA

vc bl lph dh oLrvk d lkeu mudh ikflr d lkr fy[kA t l & vkid diM ;fn lr l cu g rk lr dikl d ikèkk l çkIr gkrk g vkj vkidh pliy ;fn lykfLVd l cuh g rk lykfLVd iVkfy;e inkFk l çkIr gkrk gA

lkj.kh Øekd&1

Ø-l-	oLr	fdl l cuh g	çkflr dk lkr
1	deht	lr	dikl dk ikèkk
2	pliy	lykfLVd	iVkfy;e inkFk
-----			

mi;Dr lkj.kh ,d fnu dh fnup;k d vkèkkj ij cukb xb gA ;fn ge bl ,d llrkg] ,d ekg] ,d o"k vFkok viu ij thoudky d fy, cukr g rk vU; l tho vkj futho ?kVdk ij gekjh vrfuHkjrk Li"V :i l fn[kkb nxhA

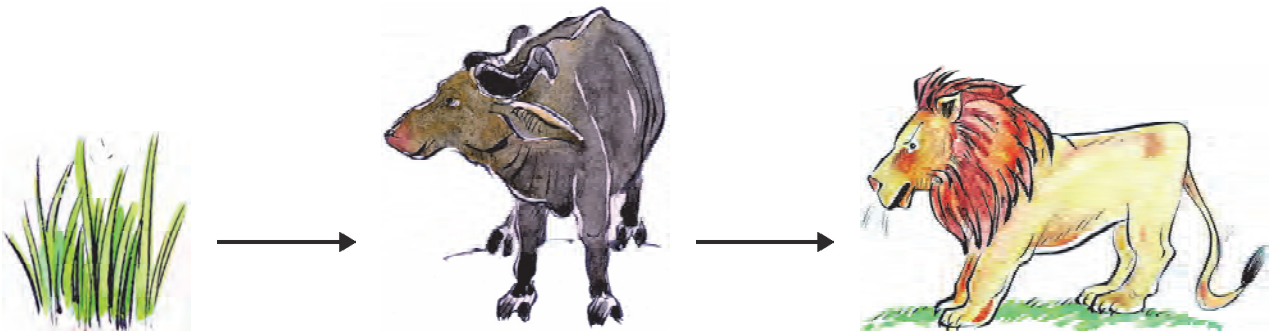
- gekj fy, vfuok; vtfod ?kVd dku&dku l g\
- ,l tfod ?kVd dku&dku l g ftud fcuk gekjk thou vlHko g\

vc vkidk ;g vglkl gvk gkxk fd ge db thok l lcèk j[kr g] dN cgr t :jh] dN de egRoi.kA ,l gh lHkh dk thou fofHkUu thok ij fuHkj gA vFkkr lHkh thok d eè; vrlcèk gA pkg og vki gk ;k xykc] 'kj gk ;k QQnA çR;d tho fdlh u fdlh lenk; dk fgLlk g o vU; l tho o futho ?kVdk l tMk gA

17-2-1 tfod ?kVdk e vrlcèk (Interrelationship of living components)

vkiu n[kk g fd thok d chp d vrlcèk db dkj.kk l cur g] t l ituu] Hkkt u o lj{kkA thok d chp vrlcèk dk ,d ie[k dkj.k Hkkt u o ml l feyu okyh Åtk gA vkb,] bl ,d mnkgj.k l le>r g&

ou Hkk Nùkh lx< d ?kkl d xhy enkuk] nyny vkj ufn;k d ikl ?ku txyk e feyrk gA ;g ?kkl vkj vU; ikèk [kkrk gA ;gk ou Hkk vkj ?kkl d chp ,d lcèk g tk Åtk d cgko d :i e gA ?kkl idk'k l'y"k.k dh fØ;k }kjk viu fy, Hkk tu cukrh gA bl Hkk tu l bl Åtk feyrh gA ou Hkk Åtk d fy, ?kkl [kkrk gA ;gk Åtk dk cgko ?kkl l ou Hkk dh rjQ gk jgk gA ou Hkl dk vxj 'kj [kkrk g rk ;g vrlcèk bl idkj fn[kk ldr g&



?kkl ou Hkk 'kj

fp= Øekd&3 % [kk| Ük[kyk

Åtk d bl cgko dh Ük[kyk dk [kk| Ük[kyk dgr gA fdr ge bl ckr ij Hkh è;ku nuk gkxk fd ou Hkk doy ?kkl gh ugh [kkrk dN nlj ikèkk dk Hkh [kkrk gA ,l gh] nlj vkj tr Hkh ?kkl [kkr g vkj 'kj nlj trvk dk Hkh [kkrk gA bl çdkj cuh gb l Hkh [kk| Ük[kykvk dk ;fn ge tkM n rk [kk| tky cu tk,xkA

- ou Hkk] ?kkl] 'kj vkj vU; iM ikèkk o trvk dk ydj [kk| tky cuk,A
- mi;Dr [kk| tky e ou Hkk ylr gk tk, rk [kk| tky ij D;k iHkko iMxk\
- vki viu l tMh nk [kk| Ük[kyk, cuk,A bu nkuk e vki l e vrlcèk Hkh crk,A

ik"k.k Lrj (Trophic level)

fp= Øekd&3 e nh xb [kk| Ük[kyk e dN ,l tho g tk idk'k l'y"k.k dh fØ;k l viuk Hkk tu cukr gA bUg mRiknd dgr gA dN tho ,l Hkh g tk viu Hkk tu d fy, ikèkk ;k vU; thok ij fuHkj djr g] bUg miHkkDrk dgr gA tk fd bl [kk| Ük[kyk e ou Hkk vkj 'kjA ;gk ou Hkk ikFkfed miHkkDrk g vkj 'kj f}rh;d miHkkDrkA bl Ük[kyk e vkj Hkh miHkkDrk gk ldr gA vr e [kk| Ük[kyk e ,l tho tMr g tk thok }kjk 'kjhj l ckgj fudky x, vif'k"V inkFkk vkj thok d eju d ckn mUg

ljy inkFkk e rkM nr gA ; tho vi?kVd dgykr gA vi?kVu dh fØ;k e cu ljy inkFk fQj l i;koj.k dk fgLlk cu tkr gA bl [kk| Ük[kyk dk ge fuEu idkj l fy[k ldr g&

?kkl → ou Hkl k → 'kj → vi?kVd
¼mRikn d½ ¼ikFkfed miHkkDrk½ ¼f}rh;d miHkkDrk½

[kk| Ük[kyk dh iR;d dMh ,d ik"k.k Lrj dgykrh gA

- dVelj xQk dh [kk| Ük[kyk cuk,A

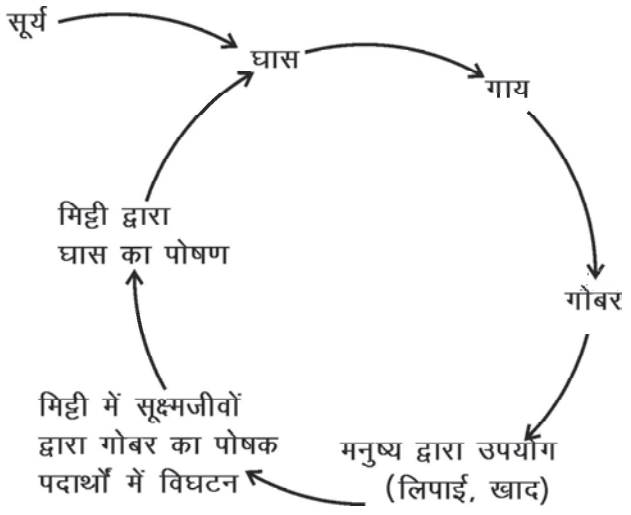
D;k vki tkur g

dVelj xQk e ck< d nkjku gh l{e ikèk] l{e tr o vU; ik"kd inkFk xQk e io'k dj ikr gA ,l h fLFkfr e doy dN gh le; d fy, dkuh eNjh dk ; ik"kd inkFk Hkk tu d :i e ikIr gkr g vU;Fkk dkuh eNjh xQk e mifLFkr er tr vkj ikèkk dk gh [kkrh gA vr% ;gk ikb tku okyh [kk| Ük[kyk viekt d [kk| Ük[kyk gkrh g] ft le iFke ik"kd Lrj ij mRikn d u gkdj er inkFk gkr gA

er tho&tr → dkuh eNjh → pexknM

17.2.2 tfod&vtfod ?kVdk e vrlcèk (Interrelationship between biotic and abiotic components)

[kk| Ük[kyk dk n[kdj ,l k yxrk g fd Åtk o ik"kd inkFk ,d drkj e cgr gA yfdu ,l k ugh gA budk cgko pØ e gkrk gA bl ,d mnkgj.k l le>r g&



fp= Øekd&4% ik"kd pØ

bl pØe ?kkl] xk;] eu";] l{etho vkfn tfod ?kVdk d mnkgj.k gA lkFk gh l; dk idk'k] bèku] feêh] fo?kfVr inkFk vkfn vtfod ?kVdk d mnkgj.k gA pØe rhj dh fn'kk Åtk d cgko d lkFk&lkFk ,d ?kVd dk nlj ?kVd l vrlcèk Hkh n'kkrh gA

17.3 çk—rokl e fofoèkrk (Diversity in habitat)

vc rd geu dkuh eNjh d çk—rokl d ckj e ppk dh gA vkb,] vU; thok d çk—rokl d ckj e ppk djr gA

fØ;kdyki&2

vkiu viu vkl&ikl fdlh ,l iM dk n[kk gkxk tk ml {k= e lkekU; :i l ik, tkr gA tl& rn] egvk] vke] tkeu] ccy] uhe] v'kkd vkfnA ,l fdlh ,d iM dk p;u dj vkj mld ckj e fuEu fyf[kr tkudkjh ,d= dj&

- bl çtkfr d iMk dk vkiu dgk&dgk n[kk g\

  ¼txy e@enku e@igkM ij@unh d fdukj@ikuh l nj@vU; dgh½

- tgk ; iM mxr g vkj cM gkr g] ml LFkku dh fo'k"krk, fy[k] tl ogk d lkekU; rkieku] ikuh] feêh vkfn d ckj e A

- bl iM dh vko';drk, Hkh fy[k] tl ijkx.k dl gkrk g] Qy dku [kkrk g vkj cht dl Qyr g vkfnA

- D;k vc vki bl iM d çk—rokl dk Li"V dj ik,x\

- vki bl iM dk fp= cuk,A

- gekj vkl&ikl ,l dku&dku l tho g ftUg ge nlj thok dh ryuk e vfèkd l[;k e n[kr g\ ,l dN ikèkk vkj trvk d mnkgj.k fy[kA

D;k vki tkur g

gekjh vkrk e db l{etho jgr g ftud dkj.k ge Hkktu ipku e enn feyrh gA bue l dN tho ,l g ftudk ikdrokl gekjh vkr gA ;fn bUg ;gk l gVk fn;k tk, rk ; thfor ugh jgr o gekj LokLF; ij Hkh bldk foijhr iHkko gkrk gA

17.4 thoudky vkj fofHkUu çk–rokl (Changing habitat in a life span)

vc ,d ,l tho d ckj e ppk djr g tk viu thoudky dk vyx&vyx le; fofHkUu LFkkuk ij fcrkrk gA

ckãuh Md ,d i{kh gA bl l[kkc] pdok&pdoh vkfn ukek l Hkh tkuk tkrk gA ;g cÙk[k Hkkjr e gh ugh vÝhdk] ;jki vkj ,f'k;k d db n'kk e ikb tkrh gA Hkkjr e xeh d yxHkx 4&5 eghuk e ; yík[k] flfDde] v#.kkpy in'k] fgeky; dh Åpkb;k e fn[kkb iMrh gA ; bud i tuu LFkku Hkh gA lfn;k d fnuk e ; gekj n'k d nf{k.k dh rjQ fn[kkb iMrh gA blh le; ; NÙkh lx< e Hkh fn[kkb iMrh gA ijr ; ;gk i tuu ugh djrh gA lfn;k e ckãuh Md flQ gekj n'k d vU; LFkkuk l gh ugh cfYd mÙkj io d vU; n'kk l Hkh vkrh gA tc fdlh tho d thoudky e ikdrokl cnyrk g rk ,d ikdrokl l nlj ikdrokl e tkuk iokl dgykrk gA bl ifØ;k e tho dN le; ckn iuh viu LFkk;h ikdrokl e ykV tkrk gA

fp= Øekd&5 % ckãuh Md

len rV l 5000 ehVj rd dh Åpkb;k ij ?kkl d fo'kky enku] ehB o [kkj ikuh d rkykc] nyny vkj ufn;k d rV ckãuh Md d çtuu LFky gA çtuu d nkjku ik"k.k dh t:jr vfèkd gkrh g] vM nu d fy, ljf{kr txgk dh t:jr iMrh g vkj ;g lc bUg fgeky; d bykdk e fey tkrk gA ;gh d ?kkl] vukt] vU; cht] >hxk] e<d] dhM vkfn budk Hkktu gA

bu LFkkuk ij lnh d vkr&vkr tc [kk| dk ;g lkr de gk tkrk g rc ; [kku dh ryk'k e ;gk dh vi{kk de BM LFkkuk dh vkj fudy iMrh gA o;Ld cÙk[kk d lkFk lrku cÙk[k Hkh gkr gA ; cÙk[k bu de BM LFkkuk ij ufn;k] >hy&rkykck] nyny] [krk] ckèkk vkfn d rV ij fn[kkb nrh gA leæ d rV l ; nj jgrh gA

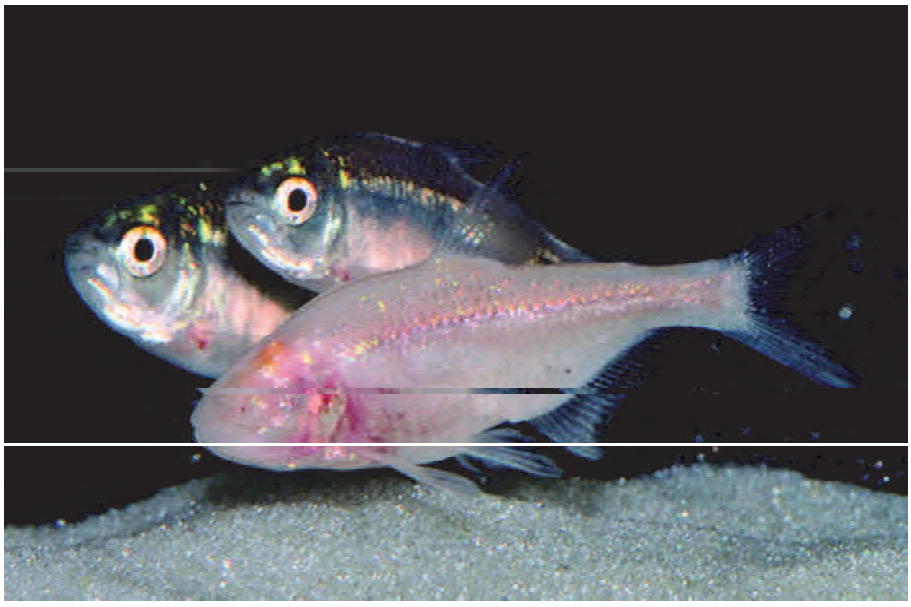
- ckãuh Md dk çk—rokl D;k g\
- D;k ckãuh Md dk ioklh tho eku ldr g\ D;k\

17.5 çk—rokl d çfr vudyu (Adaptation to a habitat)

tho viu çk—rokl d çfr dl vudfyr gkr g\

tc ge fdlh tho dk fdlh çk—rokl e thou;kiu vkj çtuu djr n[kr g] rc ikr g fd ml tho dh fo'k"krk, ml çk—rokl e jgu d fy, vudy gA vudyu dh çfØ;k d db mnkgj.k gA

Hkfexr xQkvk d ikuh e jgu okyh eNfy;k çk;% vèkh gkrh gA tl dkuh eNjhA bl idkj dh ,d vkj eNyh ^^eDlhdu VVk** ij fd, x, 'kks/k l mld vkokl lcèkh fofHkUu rF;k dk irk pyrk gA bue l ,d rF; ;g g fd ikuh d [kkjiu e vrj dk iHkko eNfy;k dh vk[kk d vkdkj ij iMrk gA bl 'kks/k dk fooj.k ifjf'k"V e fn;k x;k gA



fp= Øekd&6 % eDlhdu VVk eNyh

bl vè;k; e geu n[kk fd lHkh thok dh vkcknh dk ,d ikdrokl gkrk g tgk mudh eyHkr vko';drkvk dh ifr gkrh gA ,d ikdrokl e lHkh tho viu i;koj.k d vU; thok o futho ?kVdk ij fuHkj gkr gA geu ;g Hkh n[kk g fd i;koj.k e ifjoruk d gku l thok dh thou 'kyh e Hkh ifjoru gk ldr gA oreku e ge viu i;koj.k e cgr rth l vkj vfèkd ifjoru yk jg g tk u doy ge oju nlj thok dk Hkh çHkkfor djr gA dN ifjoru cMh leL;kvk dk dkj.k cu jg gA

e[; 'kCn (Key words)

çk—rokl (habitat)] çokl (migration)] tfod ?kVd (biotic component)] vtfod ?kVd (abiotic component)] vrlcèk (inter relationship)] [kk| Ük[kyk (food chain)] [kk| tky (food web)] ik"k.k Lrj (trophic level)] mRiknd (producer)] miHkkDrk (consumer)] vi?kVd (decomposer)] viektd (scavenger)

geu lh[kk

- fdlh Hkh tho dh çe[k vko';drk, gkrh g & Hkk tu] lj{kk ,o çtuuA
- fdlh tho dk ikdrokl og LFkku g tgk mld thoudky dh lHkh ie[k vko';drk, ijh gkrh gA
- db ,l tho g tk viuk thou vyx&vyx txgk ij fcrkr g& bud çk—rokl e fofoèk i;koj.k 'kkfey gkr gA
- dN tho çoklh gkr g& lky d dN eghu ,d txg vkj vU; eghu vyx txg fcrkr gA
- tc dkb tho fdlh çk—rokl d fy, vudfyr gk tkrk g rc og ml çk—rokl e lQyrkiod thrk vkj çtuu djrk gA
- fdlh tho vkj mld [kk| dk vrlcèk Åtk d cgko dk n'kkrk gA bl [kk| Ük[kyk dgr gA [kk| Ük[kyk e mtk dk ie[k L=kr l; gA
- [kk| Ük[kyk e mRiknd] miHkkäk vkj vi?kVd gkr g ftUg ik"k.k Lrj dgr gA
- çR;d tho dk viu çk—rokl d vtfod ?kVdk l Hkh vrlcèk gkrk gA

vH;kl

1- lgh fodYi pu&

(i) dVelj xQk e pexknM] dhM&edkM] ?kk?k] fxtkb] er tho&tUr vkj dkuh eNjh ik, tkr gA bl tkudkjh d vk/kkj ij ,d lgh [kk| Ük[kyk gkxh&

¼v½ pexknM→fxtkb→dkuh eNjhA

¼c½ er tho&tUr→dkuh eNjh→pexknMA

¼l½ pexknM→er tho&tUr→dkuh eNjhA

¼n½ dhM&edkM→pexknM→?kk?kA

(ii) çoklh tho &

¼v½ thoudky ,d gh txg e fcrkr gA

¼c½ gj lky ub txg ij jgr gA

¼l½ fu;fer :i l lky d dN eghu ,d txg vkj vU; eghu vyx txg fcrkr gA

¼n½ viu thoudky e ,d ckj viuk ikdrokl cnyr g ,o iuh LFkk;h ikdrokl ij ugh ykVr gA

(iii) çFke ik"k.k Lrj ij ge ik;h fdUg ikr g\

¼v½ mRikndk dkA ¼c½ ikFkfed miHkkäkvk dkA

¼l½ vi?kVdk dkA ¼n½ f}rh;d miHkkäkvk dkA

2 viuh iln d fdlh tho d çk—rokl d tfod vkj vtfod ?kVdk dk mnkgj.k lfgr le>k,A

3- D;k gkxk ;fn vki fdlh ,l Vki ij igp tk, tgk vkid vfrfjä vU; dkb Hkh l tho ?kVd u gk\ ,d y[k fy[kA

4- ;fn eu";k dk pkn ij clu d fy, Hktk tk, rk lkFk e vkj D;k&D;k Hktuk gkxk\ lph cuk,A

5- ,d [kk| Ük[kyk cuk, ftle jhN ¼Hkky½ 'kkfey gkA ftl [kk| Ük[kyk e vkiu jhN ¼Hkky½ dk 'kkfey fd;k g] bl vU; [kk| Ük[kykvk d lkFk tkMdj [kk| tky cuk,A

ifjf'k"V

mÙkj vefjdk d dN 'kkèkdrkvk u efDlu VVk uked xQk e jgu okyh eNfy;k ij 'kkèk fd;k gA xQk e eNfy;k dl igph gkxhA bld fy, 'kkèkdrkvk u ;g ifjdYiuk cukb fd tc xQk d ikl cgu okyh ufn;k e vkb ck< d ikuh u xQk e io'k fd;k gkxk rHkh bu eNfy;k d iot Hkh xQk d ikuh e vk x, gkxA bl idkj mudk u; okrkoj.k dk lkeuk djuk iMk gkxkA

'kkèkdrkvk u lcl igy xQk o ckgj d ikuh d rkieku] ih-,p- o ?kfyr vkDlhtu vkfn e ik, tku oky vrjk dk irk dju dk i;kl fd;kA bUgku ik;k fd lcl cMk vrj ikuh d [kkjiu dk FkkA ckgj d ikuh dh ryuk e xQk d ikuh dk [kkjkiu dkQh de FkkA bld vkèkkj ij ç;kx'kkyk e bu oKkfudk u xQk e ik, tku oky ikuh ,o okrkoj.k tlh ifjfLFkfr;k dk fuek.k fd;kA ble ckgj dh eNfy;k d Hk.kk dk ikykA bl u, okrkoj.k e iyh eNfy;k dh vk[kk d vkdkj e dkQh fofoèkrk fn[kh nhA dN eNfy;k dh vk[k cgr gh cMh Fkh vkj dN dh cgr gh NkVhA tc NkVh vk[kk okyh eNfy;k dk vyx l çtuu djk;k x;k rk mUgku n[kk fd ; NkVh vk[kk okyk y{k.k mudh lrku e Hkh FkkA ,lk ugh Fkk fd eNfy;k dh vk[kk d vkdkj e igy dkb fofoèkrk ugh jgh gkxhA yfdu ,dne vyx o u, okrkj.k e vku d dkj.k fofoèkrk dkQh vfèkd fn[ku yxhA

vè;k;&18

dpjk vkj mldk icèku

(Waste and its Management)

18-1 dpj l vfHkik; (Notion of waste)

fnu Hkj e ge ftru Hkh dke djr g] yxHkx mu lHkh l fdlh u fdlh idkj dk dpjk mRiUu gkrk gA ;g dpjk D;k&D;k gk ldrk g\ uhp ,d lkj.kh nh xb gA ,lh gh lkj.kh viuh dkih e cuk, o lph dk vkx c<k,A

lkj.kh Øekd&1

Ø-l-	?kj l fudyk dpjk
1-	lfCt;k rFkk Qyk d fNyd
2-	lykfLVd
3-	
4-	
5-	

viuh lph dk è;ku l n[kA

- ble l mu phtk dk NkV ftudk vki nkckjk mi;kx dj ldr gA
- D;k vHkh Hkh dN pht ,lh cph g ftudk mi;kx fdlh vkj d }kjk fofHkUu dk;k e fd;k tk ldrk g\ budk Hkh NkfV,A

fp= Øekd&1% dpj d <j l NVuh

vkiu n[kk fd tk pht gekj fy, vui;kxh g] bue l dN pht fdlh vkj d fy, mi;kxh gk ldrh gA tl& ijku lekpkj&i= tk gekj fy, dpjk g] fdr ;g dkxt fey d fy, ,d dPph lkexh gA ol gh lykfLVd dk VVk&QVk lkeku o xÙk gekj fy, dpjk g ijr dckMh d fy, vk; dk lkr gA vr% dpj dk lhèkk lcèk oLr d mi;kxh ;k vui;kxh gku l tMk gkrk gA

18.2 fdruk dpjk&dlk dpjk

fnu Hkj e ge dpj dh fdruh ek=k fudkyr gA vkb,] bldk irk yxk,A

fØ;kdyki&1

,d eè;e vkdkj dh ckYVh yA ble ,d fnu d fy, viu ?kj l fudyu oky dpj dk bdëk djA ;g ek=k vkid ifjokj }kjk ,d fnu e fudky x, dpj dh ek=k gkxhA bl idkj vki viu vkl ikl e jgu oky ykxk rFkk dkykuh@'kgj@xko e jgu oky ykxk d }kjk fudky tku oky dpj dh yxHkx ek=k dk vueku yxk ldr gA

- lkfp, fd vxj bruk dpjk jkt fudydj ,d txg bdëk gk rk D;k gkxk\
- bll dku&dku lh leL;k, mRiUu gkxh\
- bl dpj o bll tMh leL;kvk dk fuiVkjk dl fd;k tk ldrk g\

vxj vki dN fnuk rd viu ?kjk l fudyu oky dpj dk n[k rk vki ik,x fd ble vfèkdk'k ek=k lfct;k o Qyk d fNydk vkj cph gb [kk| lkexh dh gkrh gA

- D;k ;g dpjk yc le; rd ,l gh cuk jgrk g\

vkiu Hkh vuHko fd;k gkxk fd bl idkj dk dpjk FkkM le; ckn lM&xy tkrk gA lMu&xyu dh ifØ;k l{ethok d dkj.k liUu gkrh gA bl ifØ;k e l{etho bl dpj e mifLFkr tfVy dkcfud inkFkk dk ljy inkFkk e cny nr gA ;g ifØ;k vi?kVu dgykrh gA bl idkj d dpj dk tfod :i l u"V gku okyk ¼to fuEuhdr½ dpjk dgr gA

?kjy dpj e cgr lkj inkFk ,l gkr g tk cgr yc le; d ckn Hkh ol gh cu jgr g] tl& lykfLVd dk lkeku] iky hfFku] èkkr] dkp] byDVkfud inkFk vkfnA vr% ok dpjk tk thok }kjk vi?kfVr ugh gk ldrk g mUg to vfuEuhdr dpjk dgr gA

- vkid fopkj l budk vkx D;k gkrk gkxk\

lkekU; rkj ij ge bl dpj dk ;k rk fdlh ,d txg ij Qd nr g ;k fQj dckMh dk cp nr gA

vHkh rd geu viu ?kjk l fudyu oky dpj dh gh ckr dh gA ?kj d vykok vkj Hkh LFkku g tgk l ifrfnu dkQh ek=k e dpjk fudyrk gA bu LFkkuk e vk|kfxd ifr"Bku] fpfdRlky;] ckt kj o 'kkldh; o vU; lLFkku 'kkfey gA

fp= Øekd&2 % dpj dk <j

- gekj ?kjk l rk dckMh dpjk y tkrk g ij bu lLFkkuk l fudyu oky dpj dk D;k gkrk gkxk\
- ?kjk l bdë fd, x, dpj dk dckMh D;k djr gkx\

18-3 dpjk icèku (Waste Management)

18-3-1 dikLV [kkn d }kjk (By composting)

ge n[kr g fd gekj ?kjk l fudyu oky dpj e tfod :Ik l u"V gku okyk dpjk yxHkx 50 ifr'kr rd ;k bl l vfèkd gkrk gA D;k u bldk icèku ge viu ?kjy Lrj ij djA vxj gekj ?kj ij ;k vkl ikl dgh Hkh tgk [kkyh txg gk rk ge ogk ij bl dpj dk [kkn e ifjofrr dj ldr gA [kkn cuku d fy, ,d xï e jlkb ?kjk l fudyu oky dpj ¼lM&xy Qyk vkj lfCt;k o [kk| lkexh o ifÙk;k½ vkfn dk Hkj nr gA bl Åij l feêh l <ddj yxHkx ,d ekg rd NkM nr gA xï e Mky x; dpj ij thok.kvk dh fØ;k d dkj.k dpjk [kkn e cny tkrk g ftl tfod [kkn ¼dikLV½ dgr gA

bl rjg cukb xb [kkn e ikèkk dh of) d fy, vko';d ukbVk tu] QkLQkjl] ikVf'k;e tl ik"kd rRo mifLFkr gkr gA ;g feêh dh ty vo'kk"k.k {kerk e of) djrh gA

dpvk dh lgk;rk l Hkh ifÙk;k] lM&xy Qyk] lfCt;k vkj [kk| lkexh dk dikLV e ifjofrr fd;k tk ldrk gA

D;k vki tkur g

dpvk }kjk dikLV cuku dh fofèk& bl gr fdlh Nk;knkj LFkku dk pudj ble fuEufyf[kr rhu Lrj cuk; tkr g&

igyk Lrj & feêh djhc 15 leh- ekVh ijr

nljk Lrj & feêh d Åij ?kkl dh djhc 10 leh- dh ijr

rhljk Lrj & nlj Lrj d Åij xkcj dh djhc 15 leh- ekVh ijr

bu Lrjk d Åij ty dk fNMdko fd;k tkrk g vkj ble mÙke uLy d dpvk dk NkM fn;k tkrk gA dp, èkhj&èkhj Hkhrj dh vkj py tkr gA bl <j dk Åij l tV dh ekVh ckjh l <d nr gA bl <j ij ifrfnu ty dk fNMdko djr gA yxHkx 15 fnuk d ckn bl feJ.k dk Qyk nr gA

blh le; bl feJ.k e to fuEuhdr gk ldu oky dpj dk feyk nr g rFkk bl iuh tV dh ckjh l <d fn;k tkrk gA bl ij 20&30 fnuk rd le;≤ ij ty dk fNMdko fd;k tkrk gA 20&30 fnuk d ckn dpvk dh lgk;rk l dikLV [kkn r;kj gk tkrh gA bl oeh dikLV dgr gA

- D;k ?kjk l fudyu oky lHkh dpj l dikLV [kkn cukb tk ldrh g\ D;k ;k D;k ugh\

18-4 dpjk icèku d i;kl (Effort made towords waste management)

18-4-1 ,d 'kgj e dpj dk icèku

ljr xtjkr jkT; dk ,d lkQ lFkjk 'kgj g] tk Hkkjr d lcl LoPN 'kgjk e l ,d gA lu 1994 e bl 'kgj e lyx QykA lyx jkx d fy, mÙkjnk;h thok.k (bacteria) lØe.k d ekè;e l Qyr g vkj pg bu lØfer thok.kvk d okgd gkr gA ljr 'kgj dh xnxh e ink g, bu pgk u lØfer gkdj ykxk d [kku&ihu dh lkefx;k dk lØfer dj fn;kA n[kr gh n[kr ijk 'kgj lyx uked chekjh dh piV e vk x;kA ykxk u bl egkekjh d Qyu dk lkjk nk"k uxjkfydk i'kklu d Åij e< fn;k vkj dgk x;k fd 'kgj e xnxh d dkj.k gh bl jkx dh Hk;kogrk bruh jgh gA 'kgjh i'kklu u bl Lohdkj fd;k rFkk 'kgj l dpj dh lQkb gr dk; ;ktuk cukbA bl ;ktuk d rgr ij 'kgj dk Nh tku e ckVk x;k rFkk iR;d tku d fy, vyx&vyx vk;Dr fu;Dr fd; x;A Bkl dpjk icèku foHkkx rFkk bll tM foHkkxk u vke ukxfjdk dk dN dkM fn;A bu dkMk e ukxfjd viu {k= dh leL;k fy[kdj foHkkx dk lki nr FkA bl leL;k ij 24 ?kV d vnj dk;okgh dh tkrh FkhA dk;okgh gk tku d lk'pkr ; dkM ukxfjdk dk okil n fn, tkr FkA

bld vykok lk'kklu }kjk vke turk ij dpj Qyku ij dN tekuk yxku dk ikoèkku Hkh j[kk x;kA nkckjk bl rjg dh xyrh dju ij ykxk dk nxuk tekuk nuk iMrk FkkA bu 0;oLFkkvk l ek= 18 eghuk e gh ijk 'kgj xnxheDr cu x;kA

18-4-2 ,d bykd e dpj dk icèku

dukVd d MkEyj uked ,d NkV l dLc dh rhu efgykvk u dpjk icèku dh ,d vyx idkj dh efge ikjHk dhA bld vrxr ; viu bykd d ?kjk e tk&tkdj ykxk l ?kjy Lrj ij gh xhyk o l[kk dpjk vyx&vyx dju dk lfuf'pr djrh gA xhyk dpjk bykd d lQkbdfe;k dk lki fn;k tkrk gA l[k dpj dk ,d txg ,df=r dj fy;k tkrk gA g¶r e ,d fnu lfuf'pr dj bykd d ykxk dh enn l l[k dpj d vyx&vyx leg cuk, tkr gA dpj d ; leg lcfèkr iuhpØ.k bdkb;k rd igpk, tkr gA bl efge l tM ykxk d vulkj igy mud bykd dk lkjk dpjk ,d txg Qd fn;k tkrk FkkA ijr bl efge d ckn Qd tku oky dpj dh ek=k yxHkx vkèkh jg xb g] ft le l vfèkdk'k Hkkx tfod :i l u"V gku oky dpj dk gh gA

18-4-3 0;fDrxr Lrj ij dpj dk icèku

dpj dh leL;k doy xnxh LkkQ djd ml fBdku yxku dh gh ugh gA njvly ;g nljh db leL;kvk l Hkh tMh gA mfpr dpjk icèku 0;oLFkk e bu lHkh leL;kvk dk Hkh lekèkku Nik gvk gkrk gA bl ckr dk iek.k rfeyukM d oYykj fty d Jhfuokl u fn;kA Jhfuokl xf.kr e Lukrd dju d ckn jktxkj ryk'k jg Fk] rc budk è;ku bykd d c<r dM&djdV] cjktxkjh vkj ctj èkjrh dh vkj x;kA bUgku ipk;r ,o ftyk i'kklu l feydj ijku cl LVM d ikl dh dM d <j okyh txg dN le; d fy, ekx yhA Jhfuokl u dM&djdV dk 18 l 20 Jf.k;k e ckVuk 'k: fd;kA dpj dk bl idkj l legdr fd;k ft le dkxt] xÙkk] ykgk] ,Y;fefu;e] lykfLVd vkfn dk NkVkA NV g, dpj dk dckMh dk cp fn;kA ckdh cp xyu oky dpj dk fQj l db Hkkxk e vyx fd;k x;kA bld ckn tkuoj j[ku 'k: fd,A

Jhfuokl bl dpj e l [kku yk;d lkeku NkVdj mUg tkuojk dk f[kyku yxA tkuojk dk j[ku l dpj d fuiVkj dh leL;k dk lekèkku gvk] lkFk gh T;knk ek=k e xkcj Hkh feyu yxkA xkcj dk dN Hkkx xkcj l;= yxkdj mi;kx fd;k x;k ftll bèku dh ikflr gku yxhA lMk gvk xkcj [kkn d :lk e mi;kx fd;k tku yxkA dN xkcj o ,lk Hkk tu ftl lk'k ugh [kkr Fk mul dp, okyh [kkn cukuk 'k: fd;k x;kA

og dpjk ftl dp, Hkh ugh [kkr Fk] ml [ky e lMu d fy, NkM fn;k x;kA bl idkj d dpj lMu l dhM] ePNj ;k vU; tho ink gku dh lHkkouk jgrh gA bl lHkkouk dk n[kr g, mUgku ex] e<d

o fNidyh vkfn dh enn yhA bu lHkh ifØ;kvk l fudyu oky xn ikuh d fy, NkVk lk rkykc cuok;k ftle eNfy;k ,o cr[kk dk ikykA ml ikuh dk vkDlhtuhdr djd [krk e mi;kx fd;kA

dN xkcj l miy cuk,A budh jk[k dk mi;kx lkcu cuku e gvkA uhc o lrj d fNydk e miy dh jk[k feykdj gkFk èkku dk lkcu cuk;k x;kA

blh idkj vMk d fNydk dk ihldj ikmMj cuk yrA ;g ikmMj e[;r% dfY'k;e dkckuV dk cuk gkrk g ftl ikèkk dh [kkn d :lk e i;kx fd;k x;kA bld lkFk gh gfì;k dk pjk ftle dfY'k;e QkLQV gkrk g] Hkh [kkn cuku e i;Dr gvkA dpj e fey cky vkfn dk vyx dj 0;kikfj;k dk cpk x;kA

mi;Dr dk;k l Jhfuokl u to fuEuhdr gk ldu oky dpj d vfèkdk'k fgLl dk iuk% mi;kx dj oYykj tl uxj dk i.k :lk l dpjkeDr cuk fn;kA ;g dk; doy ,d 'kgj e gh ugh oju 4 ftyk d 40 xkok e py jgk gA bld vkj ftyk e Qy tku dh mEehn gA

- mi;Dr rhuk i;klk e l dkulk i;kl vkidk lcl vPNk yxk vkj D;k\
- vki viu bykd e dpj dk icèku dju d fy, bue l D;k&D;k i;kl dj ldr g\

18-4-4 dpjk icèku&gekjh igy

mi;Dr mnkgj.kk e geu n[kk fd dpjk ,df=r gku d ckn vyx&vyx idkj l mldk icèku dl fd;k tkrk gA ;fn ge bl fn'kk e i;kl dj fd T;knk ek=k e dpjk ,df=r gh u gk rk bl leL;k l fuiVu e vkj vfèkd enn fey ldrh gA

- D;k ge dpj dk de dju e viuk ;kxnku n ldr g\

vkb,] ge ,l inkFkk dh lph cukr g ftudk ge ,d ckj mi;kx dj Qd nr g tcfd bld LFkku ij ge LFkkb :i l ;k yc le; rd pyu oky lkekuk dk i;kx dj ldr gA

lkj.kh Øekd&2

,d ckj mi;kx dju oky lkeku	LFkkb :i l mi;kx fd, tku oky lkeku
lykfLVd di	LVhy ;k dkp d di

Lo; }kjk l>k, x, fofHkUu fodYik e l fdUgh pkj&ikp fodYik dk viukdj vki Hkh dpjk icèku dh fn'kk e ,d lkFkd igy dj ldr gA

pkj 'R' l dpjk icèku

- Reduce& dpj dk mld iFke lkr ij gh de djA mnkgj.k d fy, viuh dkih d iR;d iUu dk mi;kx gk] ;g lfuf'pr djA viuh fdrkc dk lHkkydj j[k vkj vxy lky vU; cPPkk dk i<u d fy, nA
- Refuse& mnkgj.k d fy, lykfLVd Fkfy;k d mi;kx dk vLohdkj djA
- Reuse& mnkgj.k d fy, lykfLVd] dkp dh ckryk vkj vU; lkefx;k dk vyx&vyx dkek e iuh mi;kx djA
- Recycle& mnkgj.k d fy, jlkb ?kjk l fudyu okyh gjh lfCt;k rFkk Qyk d fNydk dk i'kvk dk f[kyku e mi;kx djA ge lHkh bu pkj R dk viukdj dpj dk de dju e viuk egÙoi.k ;kxnku n ldr gA ft ll dpj dh de ek=k yMfQy ;k Hk&Hkj.k e tk,A bl rjg i;koj.k vkj Hkfexr ty lkrk dk nf"kr gku l Hkh cpk;k tk ldrk gA

geu lh[kk

- dpj dk oLrvk d mi;kx ;k vui;kx l ifjHkkf"kr djr gA
- dpj dk leg e ckVu ij mldk fuiVku dju e lfoèkk gk tkrh gA
- tk dpjk thok }kjk vi?kfVr gk tkrk g ml to fuEuhdr dpjk rFkk tk vi?kfVr ugh gk ikrk g ml to vfuEuhdr dpjk dgr gA
- ?kjy dpj dk vfèkdk'k Hkkx to fuEuhdr gk ldrk gA
- ?kjy dpj dk dN Hkkx iuhpØ.k ;kX; gkrk gA
- dpj dk icèku ?kjy Lrj ij gh vfr vko';d gA
- to fuEuhdr dpj l cuh tfod [kkn df"k d fy, cgr mi;kxh gA
- dpj dh leL;k l fuiVu d fy, ge e[; :Ik l pkj R dk mi;kx djuk pkfg,&

R – Refuse, R - Reduce, R - Reuse, R – Recycle

e[; 'kCn (Keywords)

to fuEuhdr (biodegredable)] to vfuEuhdr (non-biodegredable)] tfod [kkn ;k dikLV (bio-fertilizer)] iuZpØ.k (recycle)] Hk&Hkj.k (landfills)] vi?kVu (decomposition)

vH;kl i'u

1- lgh fodYi pu&

(i) fuEu fyf[kr e l dpjk iFkDdj.k dk lcl vPNk Lrj dku lk g\

¼v½ lkr ij ¼c½ lkenkf;d HkMkj.k LFky ij

¼l½ YkMfQYl ij ¼n½ iFkDdj.k dh vko';drk ugh g

(ii) l{ethok d i;kx l fdu inkFkk dk vi?kVu fd;k tk ldrk g\

¼v½ èkkr l cu inkFk ¼c½ to fuEuhdr inkFk

¼l½ byDVkfud inkFk ¼n½ to Hkkj

(iii) dikLV [kkn cuku e Hkfedk fuHkku okyk tho g&

¼v½ dpvk ¼c½ e<d ¼l½ fNidyh ¼n½ ex

2- dpjk fdl dgr g\

3- vi?kVu dh ifØ;k d ckj e crk,A

4- dpj dk iFkDdj.k lkr ij gh djuk pkfg,A D;k\

5- dpjk d teko l gku okyh fdUgh rhu leL;kvk d ckj e fy[kA

6- iuZpØ.k dk ifjHkkf"kr djA bl l gku oky ykHkk dk le>k,A

7- dikLV cuku d fy, fdu&fdu inkFkk dh vko';drk gkrh g\

8- Jhfuokl d oYyj 'kgj dh xnxh dk lkQ dju oky mnkgj.k l dpj d icèku dh fn'kk e vkiu D;k&D;k lh[kk\

mÙkjekyk

v/;k;&1 oxhdj.k ,o mld vk/kkj

1- (i) c (ii) n (iii) n

2- (i) oxhdj.k (ii) ekujk (iii) vkj-,u- f0gVdj

v/;k;&2 inkFk Z idfr ,o 0;ogkj

1- (i) c (ii) c (iii) v (iv) c
(v) c (vi) n

4- (i) ,d idkj d (ii) fVMy iHkko (iii) foy; (iv) fuycu
(v) foy;u

v/;k;&3 ije.k ljpuk

1- (i) l (ii) c (iii) l

2- (i) leku (ii) byDVku (iii) leHkkfjd

v/;k;&4 xfr

1- (i) c (ii) v (iii) c (iv) n

2- (i) 'kU; (ii) foLFkkiu (iii) 20 m/s (iv) 'kU;

v/;k;&5 cy ,o xfr d fu;e

1- (i) l (ii) l (iii) n (iv) l

2- (i) ck°; cy (ii) 'kU; (iii) tMRo (iv) nxuk
(v) lfn'k

v/;k;&6 thou dh ekfyd bdkb&dkf'kdk

1- (i) v (ii) v (iii) n (iv) v
(v) c

v/;k;&7 cgdkf'kdh; ljpuk&Ård

1- (i) c (ii) l (iii) n

2- (i) logu@tkbye (ii) midyk (iii) i'kh; o l;kth

v/;k;&8 jklk;fud vkc/ku

1- (i) c (ii) c (iii) l (iv) l
(v) c

2- (i) R;kx] fuvku (ii) rhu (iii) vkB] nk (iv) lgl;kth] o|r l;kth]
(v) foy;] vfoy;

v/;k;&9 jklk;fud l= vkj eky ldYiuk

1- (i) v (ii) v (iii) l (iv) v
(v) c

2- (i) vk;fud (ii) 342 (iii) 2 (iv) 6.022×10^{23}
(v) 18

3- (i) 6.022×10^{23} (ii) SO_4^{2-} (iii) Mg^{2+} (iv) 14 xke
(v) 2 eky

v/;k;&10 jklk;fud vfHkfØ;k,¡ ,o lehdj.k

1- (i) l (ii) l (iii) c (iv) n

2- (i) vfHkdkjd] mRikn (ii) vi?kVu (iii) fn'kk (iv) Å"ek'kk"kh

v/;k;&11 x#Rokd"k.k

1- (i) l (ii) l (iii) v (iv) v
(v) v

2- (i) 98 N (ii) $v^2 = 2gh$ (iii) $6.67 \times 10^{-11} Nm^2/kg^2$ (iv) m/s^2
(v) ,d leku ¼;fn ok;q e ?k"k.k cy ux.;½

v/;k;&12 dk; ,o Åtk

1- (i) c (ii) v (iii) n (iv) c

2- (i) ty (ii) 36×10^5 J (iii) fu;r (iv) _.kkRed
(v) ½ mgh

v/;k;&13 gekjk LokLF;

1- (i) n (ii) v (iii) n

v/;k;&14 /ofu

1- (i) c (ii) c (iii) n (iv) c
(v) n (vi) c

2- (i) 20Hz l 20 kHz (ii) ehVj (iii) rjxn/; (iv) ek/;e

v/;k;&15 gkbMkdkcu

1- (i) ,Ydu (ii) Ük[kyu (iii) leko;oh (iv) Ük[kyk leko;oh
(v) LFkku leko;ork (vi) ltkrh; J.kh

2- (i) LFkku (ii) vf/kd (iii) rhu (iv) vkB
(v) ,Ydu

v/;k;&16 dk;yk] iVkfy;e ,o iVkjlk;u

1- (i) l (ii) n (iii) n (iv) 3

2- (i) thok'e (ii) ihV] ,UFkk lkbV (iii) ihV (iv) DoFkukd
(v) iVk] vkfy;e

v/;k;&17 ik—rokl

1- (i) c (ii) l (iii) v

v/;k;&18 dpjk vkj mldk ic/ku

1- (i) v (ii) c (iii) v

ik;kfxd ijh{kk ;ktuk

¼d{kk&9½

le; % 3 ?kV **i.kkd % 25**

1-	dkb rhu i;kx ¼tho foKku] jlk;u foKku] Hkkfrd foKku l ,d&,d i;kx vfuok;½	15 vd ¼5 $ 5 $ 5½
2-	i;kx l lcfèkr ekf[kd i'u	02 vd
3-	ik;kfxd fjdkM	03 vd
4-	ik;ktuk ¼l= e fd, x, dk;½	05 vd
	;kx	25 vd

tho foKku d ik;kfxd vdk dk foHkktu

1-	vko';d lkexh	01 vd
2-	fofèk] ukekfdr fp=	02 vd
3-	iLrrhdj.k	01 vd
4-	ifj.kke] lkoèkkfu;k	01 vd
	;kx	05 vd

Hkkfrd ,o jlk;u foKku d ik;kfxd vdk dk foHkktu

1-	vko';d lkexh	01 vd
2-	fl)kr ,o l=] ukekfdr fp=	01 vd
3-	voykdu] x.kuk	02 vd
4-	ifj.kke] lkoèkkfu;k	01 vd
	;kx	05 vd

ik;kfxd dk;

tho foKku

Ø-	'kh"kd
1-	iÙkh dh dkf'kdkvk dk voykdu djukA
2-	eu"; d xky dh dkf'kdkvk dk voykdu djukA
3-	ru dh vkMh o [kMh dkV e dkf'kdkvk dh 0;oLFkk o dk;k dk voykdu djukA
4-	ikni Ård&ijUdkbek dk voykdu djukA

jlk;u foKku

Ø-	'kh"kd
1-	LVkp@xkn@nèk dk dkykbM r;kj dj fVMy iHkko }kjk dkykbM cuu dh tkp djukA
2-	dkij lYQV d tyh; foy;u vkj vk;ju ¼ykg dh dhy] vkyfiu½ dh lgk;rk l foLFkkiu vfHkfØ;k dk vè;;u djukA
3-	lkfM;e lYQV rFkk cfj;e Dykjkbm dh fØ;k }kjk f}foLFkkiu vfHkfØ;k dk vè;;u djukA
4-	vuc> pu rFkk ty dh vfHkfØ;k }kjk l;ktu rFkk Å"ek{ki vfHkfØ;k dk vè;;u djukA

Hkkfrd foKku

Ø-	'kh"kd
1-	ofu;j dfyil dh lgk;rk l [kk[ky cyu dh ycb@vkrfjd ;k ckgjh 0;kl@xgjkb Kkr djukA
2-	LØxt dh lgk;rk l rkj dk 0;kl Kkr djukA
3-	ljy ykyd dh lgk;rk l ycbZ d lki{k vkorZdky e ifjoru dk vè;;u dj L-T^2 d eè; xkQ [khpukA
4-	xfr d vkdMk l fLFkfr≤ xkQ [khpu o xfr d idkj dk vè;;u djukA

ik;kfxd dk;

tho foKku

thou dh ekfyd bdkb % dkf'kdk

mí'; % iÙkh dh dkf'kdkvk dk voykdu

vko';d lkexh % iÙkh&fj;k @ck;kfQye@vU;] LykbM] doj fLyi] yky L;kgh] l{en'khA

fofèk % fj;k dh iÙkh yA bl ,d >Vd l nk VdMk e QkMA QV g, VdMk dk idk'k lkr d lkeu j[kdj n[kA vkidk QV g, fdukjk ij tkeuh lrg dh ijr fn[kkb nxhA bl ijr dk NkVk lk VdMk LykbM ij yA bl ij ikuh dh ,d cn Mkydj doj fLyi yxk,A l{en'kh d fuEu vkoèku e bldk voykdu djA vkidk tk fn[kkb fn;k mldk gcg fp= cuk,A vc bl ijr dk mPp vkoèku e n[kA vkidk tk dN Hkh vyx ;k u;k fn[kkb fn;k gk ml viu }kjk cuk, x, fp= e tkMA

i'u % 1- vè;k;&6 ^^thou dh ekfyd bdkb % dkf'kdk** e fn, x, fp= Øekd&2 dh lgk;rk l viu }kjk cuk, x, fp= dk ukekfdr djA

2- bl fp= e dkf'kdkvk dh ljpuk o 0;oLFkk d ckj e fy[kA bl gr vki fuEufyf[kr fcnvk dk è;ku j[k ldr g& dkf'kdkvk dh vkdfr] vrdkf'kdh; vodk'k dh mifLFkfr ;k vuifLFkfr] dnd dh mifLFkfr ;k vuifLFkfr] Dykjklykl dh mifLFkfr ;k vuifLFkfr] vU; ljpuk,A

fun'k % ;g fØ;kdyki vki fj;k d vykok vU; ifÙk;k d lkFk Hkh dj ldr g ijr ekly iÙkh jgu ij vklkuh jgxhA bl fLFkfr e Li"V voykdu d fy, vki yky L;kgh@vkyrk@lÝfuu l vfHkjftr djA

lkoèkkuh % 1- doj fLyi yxkr le; gok d cycy u vk,A

2- iÙkh dh lrg dk vfèkd vfHkjftr gku l cpku d fy, vfHkjftr dju d ckn vfrfjDr vfHkjtd ty l èkkdj dj gVk yA

thou dh ekfyd bdkb % dkf'kdk

mí'; % xky dh dkf'kdkvk dk voykdu djukA

vko';d lkexh % LykbM] doj fLyi] vkbLØhe dh pEep] yky L;kgh@vkyrk@lÝfuu] l{en'khA

fofèk % vkbLØhe dh pEep l xky dk gYd l [kjp dj xky dh vkrfjd lrg dh [kjpu fudkyA bl LykbM ij j[kA yky L;kgh@lÝfuu@vkyrk dh ,d cn Mkydj

vfHkjftr djA vc bl doj fLyi l <d nA è;ku jg] gok d cycy doj fLyi e u tku ik,A vc LykbM dk fuEu vkoèku {ker e n[kA tk dN fn[kkb n jgk g mldk fp= cukdj ukekfdr djA bld fy, vè;k;&6 ^^thou dh ekfyd bdkb&dkf'kdk** e fn, x, fp= Øekd&3 dh lgk;rk yA

i'u % xky dh dkf'kdkvk vkj iÙkh dh dkf'kdkvk e ik;h tku okyh lekurkvk vkj vlekurkvk dk ukV djA

cgdkf'kdh; ljpuk % Ård

mí'; % ru dh vkMh o [kMh dkV e dkf'kdkvk dh 0;oLFkk o dk;k dk voykduA

vko';d lkexh % dkey ru okyk ikèkk ¼ftehdn@lnkcgkj@euhlykV½] ,d dkp dk fxykl] yky L;kgh] dVj@CyM] gMyl A

fofèk % pu g, ikèk dh nk 'kk[kk, yA nkuk 'kk[kkvk d ru l tM Hkkx dk CyM ;k dVj dh lgk;rk l lery dj yA

fdlh ,d 'kk[kk dh vkMh o [kMh dkV dk gMyl dh lgk;rk l voykdu djA fn[kkb nu okyh dkf'kdkvk dh 0;oLFkk dk n[kA bld fy, vki vè;k;&7 ^^cgdkf'kdh; ljpuk % Ård** d fp= Øekd&1 v o c dh enn y ldr gA

vc dkp d fxykl dk rhu pkFkkb ikuh l Hkj yA ble yky L;kgh dh bruh ek=k feyk n fd ikuh xgj yky jx dk gk tk,A bl ikuh e nljh 'kk[kk dk [kMh dj yxHkx nk ?kV d fy, l; d idk'k e j[k nA nk ?kVk d ckn bl 'kk[kk d ru dh vkMh o [kMh dkV dk voykdu djA igy o nlj voykduk dh ryuk dju ij vkidk tk vrj fn[kkb fn, mudk fy[kA

yxHkx nk ?kV ckn fxykl e Mch gb 'kk[kk dh ifÙk;k d fdukjk o f'kjkvk dk voykdu djA ;g irk dj fd ikuh dk yky jx bu fgLlk e fn[kkb nrk g ;k ughA blh 'kk[kk d ru dh vkMh o [kMh dkV dk gMyl dh lgk;rk l voykdu dj vU; Hkkxk rd ikuh d igpk, tku oky ekx dk igpkuu dk i;kl djA bl ekx dk n'kkr g, ru dh vkMh o [kMh dkV dk fp= cuk,A ¼vkMh o [kMh dkV d fy, ikB e fn, x, ^^vkidh enn d fy,** fgLl dh lgk;rk yA½

cgdkf'kdh; ljpuk % Ård

mí'; % ikni Ård&ijUdkbek dk voykduA

vko';d lkexh % dyk] iVhfM'k@okp Xykl] fMlfDVx fuMy] vk;kMhu foy;u] LykbM] doj fLyi] l{en'khA

fofèk % dy d ue Hkkx dk iVhfM'k@okp Xykl e ydj fuMy dh lgk;rk l elyA ely g, dy dk FkkMk lk fgLlk ydj LykbM ij j[kA bl ij vk;kMhu foy;u dh dN cn Mkydj doj fLyi yxk,A è;ku jg gok d cycy doj fLyi e u tku ik,A vc LykbM dk n[k] t lk fn[kkb n jgk g mldk fp= cukdj ukekfdr djA bld fy, vè;k;&7 ^cgdkf'kdh; ljpuk % Ård** dh lgk;rk yA

i'u % dkf'kdkvk dh ljpuk vkj 0;oLFkk dlh g\ bld fy, vki bu fcnvk ij è;ku dfnr dj ldr g& dkf'kdkvk dh vkdfr] vUrdkf'kdh; vodk'k dh mifLFkfr@vuifLFkfr] dnd dh mifLFkfr@vuifLFkfrA

lkoèkkfu;k % 1- ;fn LykbM ij vk;kMhu foy;u dh vfrfjDr ek=k gk rk ml ikuh dh dN cnk l bl èkkdj gVk nA

2- l{en'kh dh fuEu o mPp vkoèku {kerk e LykbM dk voykdu djA

ukV % bl i;kx dk vki dy d fNyd l Hkh dj ldr gA

jlk;u foKku

inkFk % idfr ,o 0;ogkj

mí'; % LVkp@xkn@nèk dk dkykbM r;kj dj fVMy iHkko }kjk dkykbM cuu dh tkp djukA

vko';d lkexh% chdj (250 mL)] ij[kuyh] dkp dh NM] cuj] f=ikn LV.M] rkj dh tkyh] Mkij] ytj Vkp] LVkp ikmMj@xkn@nèk rFkk ikuhA

fl)kr % dkykbM e foy; d.kk dk vkdkj bruk NkVk gkrk g fd mUg vk[kk l ugh n[kk tk ldrkA ; d.k ryh ij Hkh ugh cBr rFkk bUg Nkudj vyx ugh fd;k tk ldrkA dkykbM d ; d.k idk'k dh fdj.k dk Qyk nr g ftld dkj.k idk'k fdj.k dk ekx fn[kkb nrk gA ;g iHkko fVMy iHkko dgykrk gA ;g iHkko foy;u }kjk inf'kr ugh fd;k tkrk gA

i;kx fofèk % ,d ij[kuyh dk ty l vkèkk Hkj y rFkk mle 0.5 g LVkp ikmMj feykdj iLV cuk yA ,d vU; chdj e 100 mL ty ydj ml mckyA ij[kuyh d iLV dh nk&pkj cn èkhj&èkhj chdj e feyk, vkj dkp dh NM dh lgk;rk l fgykr tk,A bl feJ.k dk 5 feuV rd mcky rFkk èkhj&èkhj B.Mk djA

bl idkj cu feJ.k ij ytj Vkp l idk'k MkyA idk'k fdj.k d ekx dh yEcor fn'kk l fVMy iHkko dk n[kdj cu feJ.k dh dkykbMy idfr d lcèk e fu"d"k fudkyA

fu"d"k % feJ.k dh idfr rFkk mldk dkj.k fy[kA

lkoèkkfu;k %

1- midj.k lkQ gku pkfg,A

2- chdj d ty e iLV dk Mkyr le; ml yxkrkj dkp dh NM l fgykr jguk pkfg,A

3- dkykbM dk èkhj&èkhj B.Mk djuk pkfg,A

4- fVMy iHkko dk idk'k fdj.k d ekx dh yEcor fn'kk l n[kuk pkfg,A

xkn dk dkykbM r;kj djuk %

xkn dk dkykbM cuku d fy, Bkl xkn dk ckjhd ihl yA bld lk'pkr chdj e 100 mL ty ydj mle 2 xke xkn p.k feyk, rFkk dkp dh NM l yxkrkj fgykr tk,A bl ,d&nk ckj gYdk xe djA bl feJ.k dk BMk dj ytj Vkp l idk'k Mkydj fVMy iHkko dk n[kA

ukV % Bkl xkn d LFkku ij no xkn dh 15&20 cn Mkydj Hkh ;g i;kZx fd;k tk ldrk gA

lkoèkkfu;k % io e n'kkb xb lkoèkkfu;k d vfrfjDr fuEufyf[kr lkoèkkfu;k Hkh j[kA

1- xkn dk p.k :Ik e ;k no :i e yA

2- dkykbM dk gYdk xe dj BMk gku d lk'pkr gh fVMy iHkko dh tkp djA

nèk dk dkykbM r;kj djuk %

nèk dk dkykbM cuku d fy, ,d chdj e 100 mL ty yA mle rhu ;k pkj cn nèk dh Mkydj dkp dh NM l fgyk,A bl feJ.k ij ytj Vkp l idk'k Mkydj fVMy iHkko dk n[kA

jklk;fud vfHkfØ;k,¡ ,o leh dj.k

mí'; % dkij lYQV d tyh; foy;u vkj vk;ju ½ykg dh dhy] vkyfiu½ dh lgk;rk l foLFkkiu vfHkfØ;k dk vè;;u djukA

vko';d lkexh % ij[kufy;k] ykg dh rhu dhy ;k vkyfiu] jreky iij] èkkxk] ij[kuyh LVM] dkij lYQV] tyA

fl)kr % ,lh vfHkfØ;k ftle ,d rRo] nlj rRo dk mld fdlh ;kfxd d tyh; foy;u l foLFkkfir djrk g] foLFkkiu vfHkfØ;k dgr gA

$$Fe(s) + CuSO_4(aq) \rightarrow FeSO_4(aq) + Cu(s)$$

bl vfHkfØ;k e vk;ju u dkij dk dkij lYQV d tyh; foy;u l foLFkkfir dj mldk LFkku Lo; y fy;k g] vr% ;g foLFkkiu vfHkfØ;k gA

i;kZx fofèk % ykg dh rhu dhy ;k vkyfiu y] mUg jreky iij l jxMdj lkQ djA vc ij[kufy;k dk *d* vkj *[k* fpfUgr djA iR;d ij[kuyh e 10 mL dkij lYQV dk foy;u yA nk dhyk dk èkkx l ckèkdj lkoèkkuhiod ij[kuyh ^[k* d dkij lYQV foy;u e yxHkx 30 feuV rd Mckdj j[kA ryuk dju d fy, ,d dhy dk vyx

l ckgj j[kA 30 feuV lk'pkr nkuk dhyk dk dkij lYQV d foy;u l ckgj fudky yA lkj[kuyh *d* vkj *[k* e j[k dkij lYQV foy;u d jx dh ryuk djA dkij lYQV d foy;u e Mch dhyk d jx dh ryuk ckgj j[kh dhy l dj rFkk iklr voykdu dk rkfydk e ukV djA

voykdu rkfydk

Øekd		ij[kuyh d ryuk gr yh xb dhy	ij[kuyh [k		fu"d"k
			i;kx d io	i;kx d i'pkr	
1	dkij lYQV foy;u dk jx				
2	dhy dk jx				

fu"d"k %

- ykg dh dhyk ij fdl jx d] fdl inkFk dh ir teh fy[kA
- i;kx oky dkij lYQV foy;u d jx e D;k ifjoru gvk rFkk mldk dkj.k fy[kA
- ;gk foLFkkiu fØ;k e fdl vk;u }kjk fdl vk;u dk foLFkkiu gvk] ml lehdj.k lfgr le>kdj fy[kA

lkoèkkfu;k %

1 midj.k lkQ o LoPN gkuk pkfg,A

2 i;kx d io dhyk dk jreky iij l jxMdj lkQ dj yuk pkfg,A

3 dhy dkij lYQV d foy;u e Mch jguh pkfg,A

4 dkij lYQV dk foy;u lrlr ;k lkn ugh gkuk pkfg, vU;Fkk foy;u d jx e ifjoru ugh fn[kkb nxkA

jklk;fud vfHkfØ;k,¡ ,o lehdj.k

mí'; % lkfM;e lYQV rFkk cfj;e Dykjkb M dh fØ;k }kjk f}foLFkkiu fØ;k dk vè;;u djukA

vko';d lkexh% pkj ij[kufy;k] Mkij] ij[kuyh LV.M] cfj;e Dykjkb M] lkfM;e lYQV] Nék i=A

fl)kr % ,l h vfHkfØ;k,¡ ftue vfHkdkjdk d chp vk;uk dk vknku&inku gkrk g f}foLFkkiu fØ;k, dgykrh g rFkk mue l ,d foijhr vk;uk dk ;Xe foy;u l vyx gk tkrk gA

lkfM;e lYQV rFkk cfj;e DykjkbM d eè; f}foLFkkiu dh fØ;k gkrh gA nkuk foy;uk d vk;uk d eè; vk;uk dk vknku&inku gkrk gA jklk;fud fØ;k fuEuku lkj gkrh g&

$$Na_2SO_4(aq) + BaCl_2(aq) \rightarrow 2NaCl\,(aq) + BaSO_4(s)$$

jxghu jxghu jxghu lQn vo{ki

i;kx fofèk % nk ij[kufy;k e Øe'k% lkfM;e lYQV rFkk cfj;e DykjkbM dk ty e foy;u r;kj djA ,d ij[kuyh e ,d pkFkkb Hkkx lkfM;e lYQV foy;u y rFkk ble Mkij dh lgk;rk l cn&cn cfj;e DykjkbM foy;u MkyA foy;u dk yxkrkj fgyk,A cfj;e DykjkbM foy;u rc rd Mky tc rd vo{ki ikIr gkA bl vo{ki dk Nkudj rhu Hkkx dj rFkk mUg Øe'k% ru HCl, ru HNO_3 rFkk ru H_2SO_4 e ?kky rFkk ikIr voykdu dk rkfydk e ukV djA

voykdu rkfydk

Ø-	i;kx	voykdu	fu"d"k
1-	lkfM;e lYQV foy;u e cfj;e DykjkbM foy;u Mkyu ij		
2-	lQn vo{ki dk Øe'k% ru HCl, ru HNO_3, ru H_2SO_4 e ?kkyu ij		

fu"d"k %

1- lkfM;e lYQV dh cfj;e DykjkbM foy;u l fØ;k }kjk cu mRikn d uke] jx rFkk voLFkk fy[kA

2- cfj;e lYQV d lQn vo{ki dh ru HCl, HNO_3 rFkk H_2SO_4 e foy;rk fy[kA

3- f}foLFkkiu dh fØ;k dk lehdj.k lfgr le>kdj fy[kA

lkoèkkfu;k %

1- ij[kuyh e ,d pkFkkb Hkkx gh lkfM;e lYQV foy;u yA

2- cfj;e DykjkbM dk Mkyr le; foy;u dk yxkrkj fgyk,A

jklk;fud vfHkfØ;k,a ,oa lehdj.k

mí'; % vuc> pu rFkk ty dh vfHkfØ;k }kjk l;ktu rFkk Å"ek{kih vfHkfØ;k dk vè;;u djukA

vko';d lkexh % ij[kufy;k] 250 mL dk chdj ¼ckjkfly½] Mkij] l[kk vuc>k pukA

fl)kar % ,lh vfHkfØ;k ftlesa nk;k nk l vfèkd vfHkdkjd feydj ,d mRikn dk fuek.k djrs g] l;ktu vfHkfØ;k dgykrh gA ftl vfHkfØ;k e mRikn d lkFk Å"ek dk mRlftu gkrk g] ml Å"ek{kih vfHkfØ;k dgrs gA

i;kx fofèk % ,d lkQ o l[kk 250 mL dk chdj y rFkk ble 5 g vuc>k puk Mky rFkk chdj dk Li'k dj n[kA ,d Mkij e ikuh y rFkk ifr feuV 5 mL ikuh chdj e Mky rFkk gku okyh fØ;k dk voykdu dj ukV djA ;g fØ;k yxHkx 5 l vfèkd ckj nksgjk,A iR;d ckj chdj dk ckgj l Li'k dj rFkk rkieku ifjoru d vuHko dk rkfydk e ukV djA vkèk ?kV ckn cu foy;u dk voykdu dj ml rkfydk e fy[kA

voykdu rkfydk

Ø-	i;kx	voykdu	fu"d"k
1-	chdj e j[k vuc> pu ij iFke ckj 5 mL ikuh Mkyu ijA		
2-	chdj e j[k vuc> pu ij vfre ckj 5 mL ikuh Mkyu ij		
3-	chdj dk fØ;k d igy Li'k dju ij		
4-	chdj dk fØ;k d i'pkr Li'k dju ij		
5-	vkèk ?kV ckn foy;u dk voykdu dju ij		

fu"d"k %

- mijkDr fØ;k dk idkj rFkk Å"ek fudyu d vk/kkj ij ;g fdl idkj dh fØ;k g] nkuk ckrk dk mYy[k djA
- mDr fØ;k dk lehdj.k }kjk n'kk,A

lkoèkkfu;k %

1 midj.k lkQ o LoPN gkuk pkfg,A i;kx gr ckjkfly dkp d cu midj.kk dk i;kx djA

2 ty lkoèkkuhiod MkyA

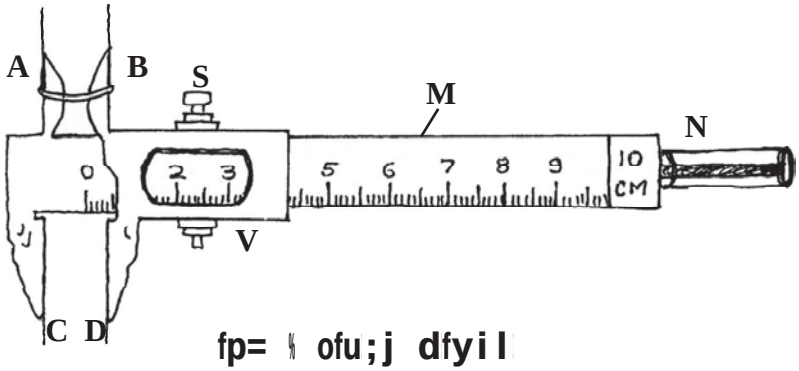
3 vuc> pu dk l[k ;k xhy gkFk l u N,] gkFkk e QQky iMu dk Hk; jgrk gA vuc> pu d VdMk dk fpeVh dh lgk;rk l idMA

ukV % vuc>k puk] ckt kj e iV dh ndku e ,d Bkl inkFk d :i e miYkCèk jgrk gA pu d VdMk ¼eghu p.k dk ugh] D;kfd og c> pu e cny pdk jgrk g½ dk fdlh dkp d ok;#) cru e j[kA

Hkkfrd foKku

i;kx'kkyk e dke vku oky dN egÙoi.k midj.k ofu;j dfyil

lkèkkj.kr% ge ehVj Ldy l 1 fe-eh- rd dh yckb uki ldr gA bl l{e yckb;k dk ekiu d fy, Ýkl d oKkfud fi;j ofu;j u ^^ofu;j dfyil** cuk;kA



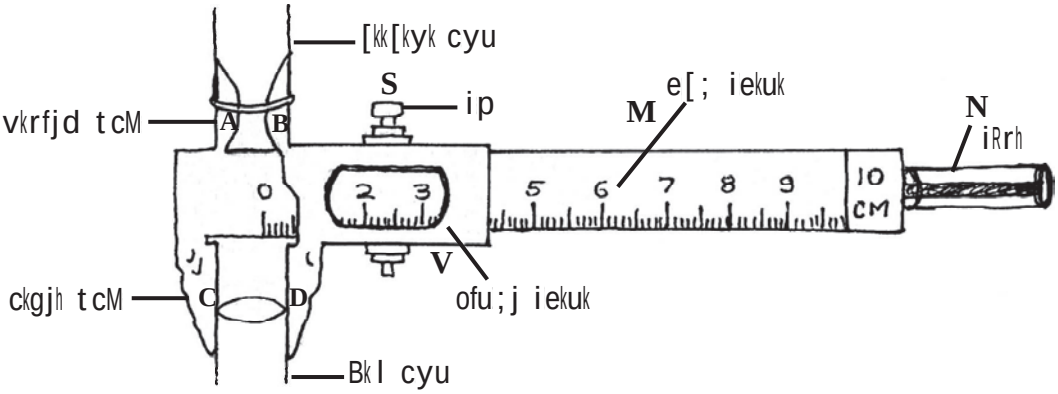
fp= % ofu;j dfyil

1. jpuk& ofu;j dfyil d e[; pkj Hkkx gkr gA

(i) e[; Ldy & ofu;j dfyil LVhy dk cuk gkrk g] ftld ,d flj ij leh- ;k feeh- e rFkk nlj flj ij bp Ldy cuk gkrk gA bl Ldy dk M l n'kk;k x;k gA

(ii) ofu;j Ldy & bl Ldy dk ,d ip dh lgk;rk l e[; Ldy ij ?kek;k tkrk g rFkk ikB;kd yu d fy, e[; Ldy d fdlh Hkh LFkku ij dlk tk ldrk gA bl Ldy dk V l n'kk;k x;k gA

(iii) tcMk & ofu;j dfyil e nk tcM gkr gA ftue l AC fLFkj gkrk g rFkk tcMk BD ofu;j ieku d Ýe ij yxk jgrk gA uhp d ckgjh tcMk dh lgk;rk l fdlh oLr ¼NM vFkok cyu½ dh yckb vFkok mldk ckÅ 0;kl uki ldr g rFkk Åij d vkrfjd tcMk dh lgk;rk l fdlh [kk[ky cyu dk vkrfjd 0;kl uki ldr gA ofu;j e yxh iRrh N dh lgk;rk l fdlh cru dh xgjkb ukih tk ldrh gA



fp= % ofu;j dfyil ¼fofHkUu mi;kx½

(vi) **LØ&** LØ dh lgk;rk l tcM dk fdlh Hkh fn'kk e ljdk;k tk ldrk gA bl S l n'kk;k x;k gA

2- **fl)kr &** fdlh jkf'k dk og NkV l NkVk eku ftl dkb ;= ;FkkFkrkiod uki ldrk g] ;= dk vYirekd dgykrk gA e[; ieku d ,d Hkkx d eku rFkk ofu;j ieku d ,d Hkkx eku e tk vrj gkrk g] ml ofu;j fLFkjkd ;k vYirekd dgr g] D;kfd ;gh og NkVh l NkVh yckb g tk bl ;= }kjk ukih tk ldrh gA

ekuk e[; Ldy d ,d Hkkx dk eku S bdkb gA ekuk ofu;j d Hkkx dk eku v g] rFkk ofu;j Ldy d n Hkkx e[; Ldy d (n–1) Hkkx d rY; gA

vFkkr $(n-1)s = nv$

$ns - s = nv$

$ns - nv = s$

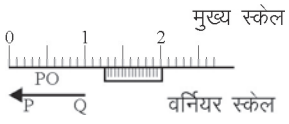
$n(s-v) = s$

$$s - v = \frac{s}{n}$$

$$s - v = \frac{s}{n} = \frac{\text{e[; Ldy d ,d Hkkx dk eku}}{\text{ofu;j Ldy ij dy Hkkxk dh l[;k}}$$

bl ofu;j dfyil dk vYirekd dgr gA ofu;j Ldy dk dy ikB;kd ofu;j d Hkkxk dh l[;k dk vYirekd l x.kk djd ikIr djr gA ofu;j dfyil dk dy ikB;kd mld e[; Ldy d ikB;kd rFkk ofu;j Ldy d ikB;kd d ;kx d rY; gkrk gA

e[; Ldy d ,d Hkkx dk eku $s = 1$ feeh- rFkk ofu;j Ldy d dy [kkuk dh l[;k $n = 10$ g rk ofu;j dk vYirekd $= \frac{s}{n} = \frac{1}{10}$ feeh- ¾ 0-1 feeh- ¾ 0-01 leh- gkxkA



fp=

;fn ofu;j dfyil l fdlh oLr dk ykb PQ dk ekiu djuk g rk ml ofu;j d uhp d nkuk tcMk d chp Qlk dj ofu;j dfyil l ikB;kd fuEukulkj Kkr djr gA

ofu;j Ldy dk ikpok Hkkx e[; Ldy d fdlh Hkh Hkkx dh lhèk e gA

vr% oLr dh ykb PQ = e[; Ldy dk ikB;kd $ ofu;j d ikpo Hkkx dk eku × vYirekd

¾ 1-2 leh- $ 5 × 0-01 leh-

¾ 1-2 leh- $ 0-05 leh-

¾ 1-25 leh-

bl idkj nh xb oLr PQ dh ykb 1-25 leh- gA

3- 'kU;kd =fV& ofu;j dfyi l d nkuk tcMk dk feyku ij ;fn ofu;j Ldy dk 'kU; rFkk e[; Ldy dk 'kU; vkil e ugh feyr g rk ;= e 'kU;kd =fV gkrh gA 'kU;kd =fV nk idkj dh gkrh g\ (i) èkukRed 'kU;kd =fV] (iii) _.kkRed 'kU;kd =fV

(i) èkukRed 'kU;kd =fV& ;fn nkuk tcMk dk feyku ij ofu;j Ldy dk 'kU;] e[; Ldy d 'kU; d nk;h vkj gkrk g rk 'kU;kd =fV èkukRed dgykrh gA bl Kkr dju d fy, ;g n[kr g fd nkuk tcM feyku ij ofu;j Ldy dk 'kU;] e[; Ldy d fdl fpUg d lhèk e gA fQj bl ofu;j d Hkkx d eku e vYirekd dk x.k djd ml dy ikB;kd l fpUg lfgr ?kVkr gA

'k) ikB;kd ¾ dy ikB;kd & ¼'kU;kd =fV½

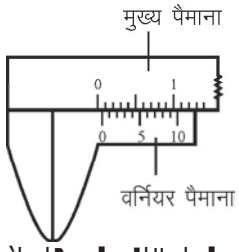
èkukRed 'kU;kd =fV ¾ 6 × 0-01 leh-

¾ 0-06 leh-

¼;fn 1-25 leh- io ikB;kd gk rk½

'k) ikB;kd ¾ 1-25 & ¼$0-06½

¾ 1-19 leh-



fp= ¼ èkukRed 'kU;kd =fV

(ii) _.kkRed 'kU;kd =fV & ;fn nkuk tcM feyku ij ofu;j Ldy dk 'kU; e[; Ldy d 'kU; d ck;h vkj gkrk g rk 'kU;kd =fV _.kkRed dgykrh gA bl Kkr dju d fy, ;g n[kr g fd nkuk tcM feyku ij ofu;j dk dku lk Hkkx] e[; ieku d fdlh Hkkx dh lhèk e gA ml Hkkx dh l[;k dk vYirekd l x.kk djd ml fpUg lfgr dy ikB;kd l ?kVkr gA 'kU;kd =fV fpUg lfgr ?kVkb tkrh gA

'k) ikB;kd ¾ dy ikB;kd & ¼'kU;kd =fV½

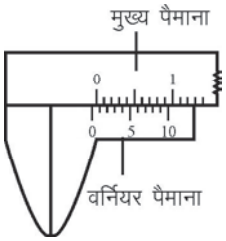
_.kkRed 'kU;kd =fV ¾ 7×0-01

¾ 0-07 leh-

;fn io ikB;kd 1-25 leh-

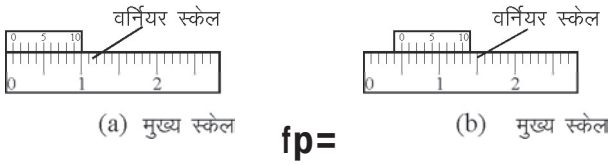
'k) ikB;kd ¾ 1-25 & ¼&0-07½

¾ 1-18 leh-



fp= ¼ _.kkRed 'kU;kd =fV

4- ofu;j ikB Kkr dju d fy, ;g n[kr g fd ofu;j ieku d 'kU; l igy e[; ieku dk ikB D;k g\ fQj n[kr g fd ofu;j ieku dk dku&lk Hkkx e[; ieku d fdl Hkkx l feyrk g\ ofu;j ieku dk tk Hkkx e[; ieku d fdlh Hkkx dh lhèk e feyrk g] mle ofu;j d vYirekd dk x.kk djd ofu;j ieku dk ikB Kkr dj yr gA



fp=

mijkDr fp= (a) e e[; o ofu;j ieku dk 'kU; fey jgk g vkj ofu;j ieku d 10 Hkkx] e[; ieku d 9 Hkkx d cjkcj g rk mijkDr fofèk l vYirekd 0-1 feeh ;k 0-01 leh- Kkr dj fy;kA fp= (b) e ofu;j ieku dk 'kU; e[; ieku d 4 feeh- [kku d utnhd g rFkk ofu;j ieku dk 4 ;k Hkkx] e[; ieku d fdlh Hkkx dh lhèk e g vr% vrj doy pkj Hkkxk d cjkcj gA

∴1 Hkkx d fy, vrj ¾ 0-1 feeh-

∴4 Hkkx d fy, vrj ¾ 4×0-1 ¾ 0-4 feeh-

i.k ikB ¾ e[; ieku dh eki $ ofu;j ieku dh eki

¾ 4 feeh- $ 0-4 feeh- ¾ 4-4 feeh-

5- ofu;j dfyil d fuEu mi;kx gkr g&

(i) ofu;j dfyil dh lgk;rk l fdlh oLr dh yckb] pkMkb rFkk ekVkb ekih tkrh gA

(ii) fdlh [kk[ky cyu dk vkrfjd rFkk cká 0;kl Kkr dj ldr gA

(iii) fdlh [kk[ky cyu dh xgjkb ekiu d fy, Hkh bldk mi;kx djr gA

LØxt ;k ipekih

ge tkur g fd ofu;j dfyil l 0-01 leh- ;k 0-1 feeh- rd dh eki dk ;FkkFkrk l eki ldr gA yfdu dHkh&dHkh ge 0-001 leh- ;k 0-01 feeh- eki dk ekiuk iMrk gA bld fy, ofu;j l Hkh vfèkd l{exkgh ;= i;kx djr g tk ipekih ;k LØxt dgykrk gA ;g LØxt ekbØkehVj LØ d fl)kr ij dk;dju okyk ;= gA bldh lgk;rk l n'keyo d rhlj LFkku rd 'k) eki Kkr dj ldr gA bld }kjk iry rkj dh f=T;k Kkr dh tkrh gA

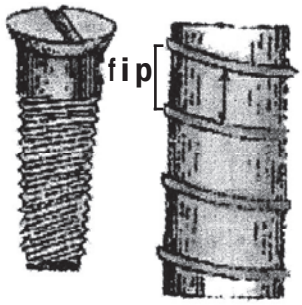
ipekih dk fl)kr & tc fdlh ,dleku pfM;k okyh f<cjh e ,d ip dk ?kek;k tkrk g rk bldh ukd ,d ljy j[kk e vkx ;k ihN f[kldrh g] ml ip dh fip ;k ^^pMh vrjky** dgr gA ;g ip dh nk ikl&ikl okyh pfM;k d chp dh njh gA

ekuk ip dk ,d ijk pDdj ?keku e ip d flj }kjk r; njh S g rk ip dk pMh vrjky S gkxkA ;fn ipxkeh d oÙkh; Ldy ij n Hkkx g rk&

$$\text{vYirekd} = \frac{\text{ip dh fip ¼pMh vrjky½}}{\text{ip ij cu oÙkh; Ldy Hkkxk dh l[;k}}$$

$$= \frac{S}{n}$$

lkèkkj.kr% LØxt e pMh vrjky 1 feeh- rFkk oÙkh; Ldy ij cu [kkuk dh l[;k 100 gkrh gA



fp= % pMh vrjky

vr% LØxt dk vYirekd $= \frac{1}{100}$ feeh- = 0-01 feeh- ;k 0-001 leh-

ipekih dh jpuk

ipekih d e[;r% rhu Hkkx gkrs g&

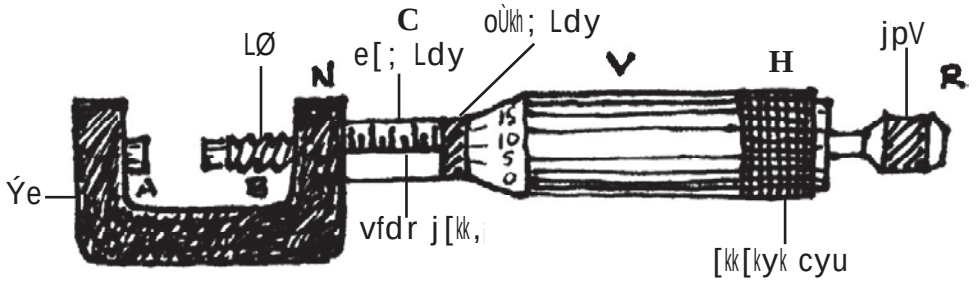
(i) U d vkdkj dk èkkrq Ýe

(ii) ip rFkk e[; Ldy

(iii) flj Ldy ;k oÙkh; Ldy

(i) U d vkdkj dk èkkrq Ýe& bl ;= e U d vkdkj dk èkkrq Ýe gkrk g ftld ,d flj ij èkkrq dk fLFkj xVdk A yxk gkrk g ftl LVM dgrs gA bl Ýe d nljh vkj fljk ij f<cjh gkrh g ftldh vnj dh lrg ij leku nfj;k ij pMh dVh gkrh gA f<cjh d vnj ip B bèkj&mèkj f[kldk;k tk ldrk gA

(ii) e[; Ldy& ;b bl ;= dk e[; Hkkx gA bl fp= e C l fn[kk;k x;k gA ;g f<cjh Ýe d nk;h vkj c<rh jgrh gA ;g c<k gvk Hkkx e[; Ldy dgykrk gA bl ij leh- rFkk feeh- e vfdr iekuk gkrk gA



fp= % LØxt

(iii) flj Ldy ;k oÙkh; Ldy& ip dk ,d yc ip 'kh"k }kjk vkx&ihN pyk;k tk ldrk gA bl 'kh"k ij cjkcj&cjkcj njh ij 100 fpUg cu gkrs gA bl ipekih dk flj Ldy ;k oÙkh; Ldy dgrs gA

vkèkfud ipekih e jpV dk icèk Hkh gkrk gA ;g fp= e R l n'kk;k x;k gA jpV dh lgk;rk l gh ip ;k LØ dk ?kek;k tkrk g tc jpV dk ?keku ij pV dh vkokt vk, rk ip dk ugh ?kekuk pkfg,A

lHkkfor =fV;k& ipekih dk i;kx djrs le; fuEu =fV;k gks ldrh g&

(i) fiPNV =fV (Back lash error)

(ii) 'kU;kd =fV (Zero error)

(i) fiPNV =fV (Back lash error) & ge tkurs g fd ip dk fl)kr g fd ip d vkx&ihN pyu dh j[kh; njh mld 'kh"k d ?keko d lekuikrh gkrh gA ijr ipekih dk yxkrkj mi;kx yku l

mldh pfM;k] ?k"k.k vkfn d dkj.k f?kl tkrh gA bll ip f<cjh e <hyk gk tkrk g bl fLFkfr e ip dk ,d fn'kk e ?kekr&?kekr ;fn ,dk,d nljh fn'kk e ?keku yx rk flj Ldy ?ke tkrk g] ip dh ukd vkx ;k ihN ugh pyrh gA ;g =fV ;= dh fiPNV =fV dgykrh gA

bl nj dju d fy, ip dk ,d gh fn'kk e ?kekuk pkfg,A ;fn fdlh dkj.k l ip dk foijhr fn'kk e pykuk iM rk ml vfèkd ?kekdj iuh mlh fn'kk e pykuk pkfg,A

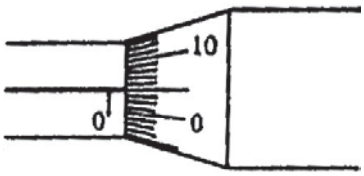
(ii) **'kU;kd =fV &** ;fn ip d flj dk LVM l Li'k djku ij e[; ieku dh vkèkkj j[kk] flj Ldy dh 'kU;kd j[kk dh Bhd lhèk e u gkrh gk rk ;= e 'kU;kd =fV gkrh gA

;g =fV fuEu nk idkj dh gkrh gA

¼d½ èkukRed 'kU;kd =fV (Positive Zero error)

¼[k½ _.kkRed 'kU;kd =fV (Negative Zero error)

¼d½ **èkukRed 'kU;kd =fV (Positive Zero error) &** ;fn ip d flj LVM l Li'k djku ij flj Ldy dk 'kU; j[kk l uhp jgrk gk rk =fV èkukRed 'kU;kd =fV gkrh gA ¼fp=½



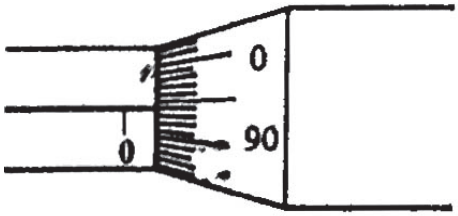
—धनात्मक शून्यांक त्रुटि

bldk eku Kkr dju d fy, ;g n[kr g fd oÙkh; ieku dk dku lk fpUg e[; ieku d 'kU; vkèkkj j[kk d Bhd lhèk e gA bl fpUg dh l[;k dk vYirekd l x.kk dju ij èkukRed 'kU;kd =fV dk eku ikIr gkrk gA bl =fV dk if{kr ikB;kd e l ?kVk nr gA

¼[k½ **_.kkRed 'kU;kd =fV (Negative Zero error)&** ;fn ip LVM l Li'k djku ij flj Ldy dk 'kU; e[; ieku dh j[kk l Åij dh fn'kk e g rk =fV _.kkRed 'kU;kd =fV gkrh gA

bldk eku Kkr dju d fy, n[kr g fd ieku dh 'kU; vkèkkj j[kk d Bhd lhèk e oÙkh; ieku dk dku lk fpUg gA fQj bl fpUg l[;k dk oÙkh; Ldy dh dy fpUg l[;k e l ?kVkdj vYirekd dk x.kk djr g bl idkj ikIr eku _.kkRed 'kU;kd =fV dgykrk gA fp= e _.kkRed 'kU;kd =fV inf'kr gA

lno ;kn j[ku dh ckr g fd 'k) ikB ikIr dju d fy, if{kr ikB e l 'kU;kd =fV dk fpUg lfgr ?kVkr gA



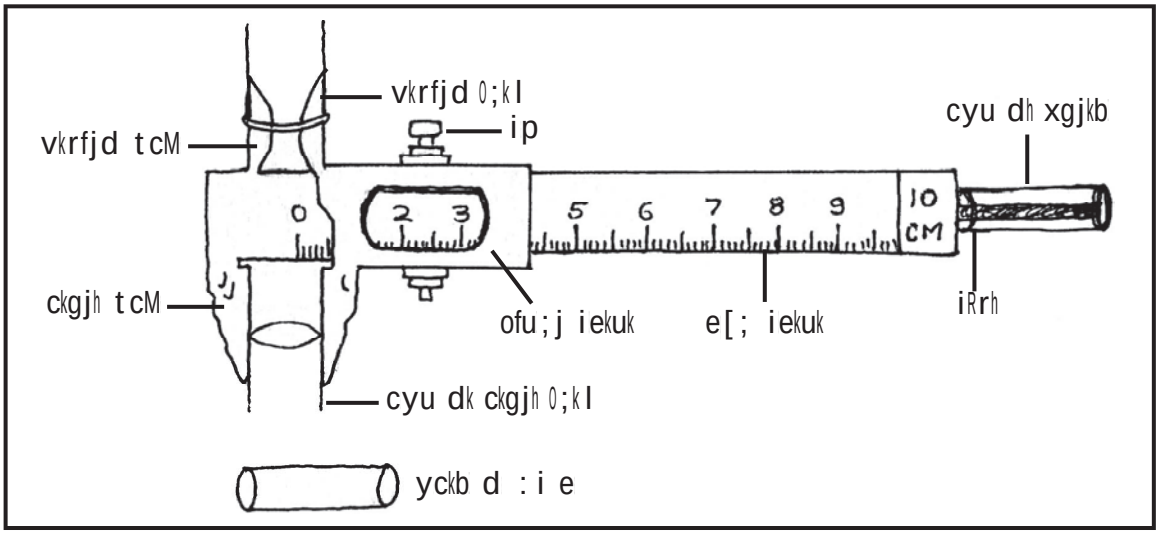
—ऋणात्मक शून्यांक त्रुटि

ekiu

mí'; % ofu;j dfyil dh lgk;rk l [kk[ky cyu dh yckb@vkrfjd ;k ckgjh 0;kl@xgjkb Kkr djukA

vko';d midj.k% ofu;j dfyil] [kk[kyk cyuA

ukekfdr fp= %



l)kfrd l= % ofu;j dfyil dk vYirekd (L.C.)

$$\text{vYirekd} = \frac{\text{e[; Ldy d ,d Hkkx dk eku}}{\text{ofu;j Ldy ij dy [kkuk dh l[;k}}$$

i;kx fofèk % ofu;j dfyil dh lgk;rk l yckb@0;kl@xgjkb Kkr dju d fy, i;kx fofèk lHkh dh ,d leku gkrh gA

;fn cyu [kk[kyk gk rk mldh vkrfjd ,o ckgjh 0;kl fp=kulkj cyu dk yxkdj ikB;kd yr gA

cyu dh xgjkb Kkr dju d fy, cyu dk fp=kulkj ¼ihN½ yxkdj 'k) ikB;kd ukV djr gA

yckb@0;kl@xgjkb dh voykdu lkjf.k;k ,d leku gkrh gA

;gk ofu;j dfyil dh lgk;rk l cyu dh yckb dh fofèk le>kb xb gA

(i) loiFke ofu;j dfyil dk vYirekd Kkr djr gA

(ii) ;fn midj.k e 'kU;kd =fV g rk mldk idkj rFkk eku Kkr djr gA

(iii) vc fn, x, cyu dk nkuk tcMk d chp bl idkj j[kr g fd mldh yckb e[; ieku d lekrj gkA

(iv) bl fLFkfr e ip dk dldj cyu dk nkuk tcMk e l fudky yr gA

(v) vc ;g n[kr g fd ofu;j dk 'kU; e[; ieku d fdl Hkkx d vkx gA ;g e[; ieku dk ikB;kd gkxkA

(vi) rRi'pkr ;g irk yxkr g fd ofu;j ieku dk dku&lk fpUg e[; ieku d fdl fpUg d lkFk feyrk gA bl l[;k dk vYirekd l x.kk dj nr gA ;gh ofu;j dk ikB;kd gkxkA

(vii) e[; ieku d ikB;kd e ofu;j d ikB;kd dk tkM nr gA ;gh cyu dh yckb gkxhA

(viii) bl fofèk dk db ckj djr g vkj mudk eè;eku fudkyr gA

(ix) vUr e bl ikB;kd l 'kU;kd =fV dk fpUg lfgr ?kVk nr gA ;gh cyu dh 'k) yckb gkrh gA

voykdu lkj.kh %

;= dk vYirekd ¾ ---------- leh-

'kU;kd =fV d fy, i{k.k lkj.kh

Ø-	e[; Ldy dk ikB	ofu;j Ldy dk ikB		dy ikB
	¼leh- e½	Hkkxk dh l[;k	Hkkxk dh l[;k × vYirekd	¼leh- e½
1-	----------	----------	----------×----------=----------	----------
2-	----------	----------	----------×----------=----------	----------
3-	----------	----------	----------×----------=----------	----------
4-	----------	----------	----------×----------=----------	----------
5-	----------	----------	----------×----------=----------	----------

cyu dh yckb d fy, i{k.k lkj.kh&

vkl r 'kU;kd =fV ¾ ± ---------- leh-

Ø-	e[; Ldy dk ikB	ofu;j Ldy dk ikB		dy ikB
	¼leh- e½	Hkkxk dh l[;k	Hkkxk dh l[;k × vYirekd	¼leh- e½
1-	----------	----------	----------×----------=----------	----------
2-	----------	----------	----------×----------=----------	----------
3-	----------	----------	----------×----------=----------	----------
4-	----------	----------	----------×----------=----------	----------
5-	----------	----------	----------×----------=----------	----------

vkl r if{kr yckb ¾ ±---------- leh-

okLrfod yckb ¾ vkl r if{kr yckb ½± 'kU;kd =fV½

ifj.kke % cyu dh vHkh"B yckb ---------- leh- ¼blh idkj 0;kl ,o xgjkb d eku dk Kkr djr gA½

lkoèkkfu;k % 1- cyu dk tcMk d eè; Bhd idkj dluk pkfg,A

2- i{k.k cyu d fofHkUu LFkkuk ij l yuk pkfg,A

3- ikB;kd ¼i{k.k½ yr le; nf"V Ldy ij yEcor j[kuh pkfg,A

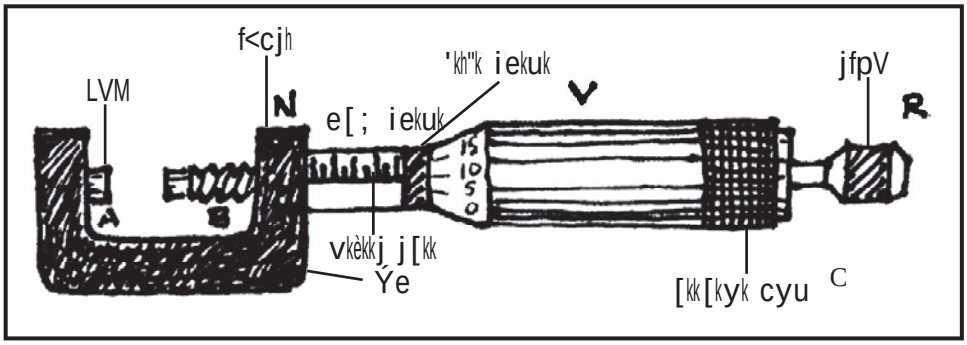
4- 'kU;kd =fV Kkr dj vr e ml ?kVk@tkM nuk pkfg,A

ekiu

mí'; % LØxt dh lgk;rk l rkj dk 0;kl Kkr djukA

vko';d midj.k % LØxt] rkj vkfnA

ukekfdr fp= %



fl)kr@l= % % LØxt dk vYirekd = $\frac{\text{LØxt dk pMh vUrjky}}{\text{oÙkh; ieku ij dy [kkuk dh l[;k}}$

$$= \frac{0.1}{100}$$

$$= 0.001 \text{ l-eh-}$$

i;kx fofèk % rkj dh f=T;k Kkr dju d fy, LØxt dk i;kx dju d io iFke 'kU;kd =fV Kkr djr gA 'kU;kd =fV fudkyu d i'pkr midj.k dk vYirekd l= dh lgk;rk l fudkyr g ;g ik;% -001 l-eh- gkrk gA

vc ik;kfxd rkj dk LØxt d ipk d chp dlr g vkj Vkih dk ?kekr g rFkk e[; Ldy dk ikB;kd ukV djr gA

oÙkh; Ldy dk ikB;kd lkoèkkuhiod i<r g ¼ble ;g n[kr g fd oÙkh; Ldy dk dku lk Hkkx e[; ieku d lkeu gA½

voykdu lkj.kh e eku j[kdj rkj dk 0;kl Kkr djr gA ikIr if{kr 0;kl e 'kU;kd =fV ?kVkdj eku ikIr djr gA

ukV % 0;kl d vkèkkj ij f=T;k Hkh fudkyh tk ldrh gA

'kU;kd =fV d fy, i{k.k lkj.kh %

Ø-	e[; Ldy dk eku	'kh"k Ldy dk eku		dy ikB
	¼leh- e½	Hkkxk dh l[;k	Hkkxk dh l[;k × vYirekd	¼leh- e½
1-	----------	----------	----------×----------=----------	----------
2-	----------	----------	----------×----------=----------	----------
3-	----------	----------	----------×----------=----------	----------

vkIr 'kU;kd =fV ± ---------- leh-

rkj d 0;kl d fy, i{k.k lkj.kh %

Ø-	e[; Ldy dk eku	oÙkh; Ldy dk eku		dy ikB
	¼leh- e½	Hkkxk dh l[;k	Hkkxk dh l[;k × vYirekd	¼leh- e½
1-	----------	----------	----------×----------=----------	----------
2-	----------	----------	----------×----------=----------	----------
3-	----------	----------	----------×----------=----------	----------
4-	----------	----------	----------×----------=----------	----------
5-	----------	----------	----------×----------=----------	----------

rkj dk vkIr 0;kl ¾ ---------- leh-

x.kuk % (i) rkj dk 0;kl ¾ if{kr 0;kl & fpUg lfgr 'kU;kd =fV

(ii) rkj dh f=T;k $= \frac{\text{rkj dk 0;kl}}{2} =$ ---------- leh-

ifj.kke % vr% fn, x, rkj dk 0;kl ---------- leh- ,o f=T;k ---------- leh- ikIr gbA

lkoèkkfu;k % 1- rkj dk ip d chp vfèkd d ldj ugh j[kuk pkfg,A

2- ikB;kd rkj d fHkUu&fHkUu LFkkuk ij yuk pkfg,A

3- jfpV dk i;kx vo'; djuk pkfg,A

4- ip ,d gh fn'kk e ?kekuk pkfg,A

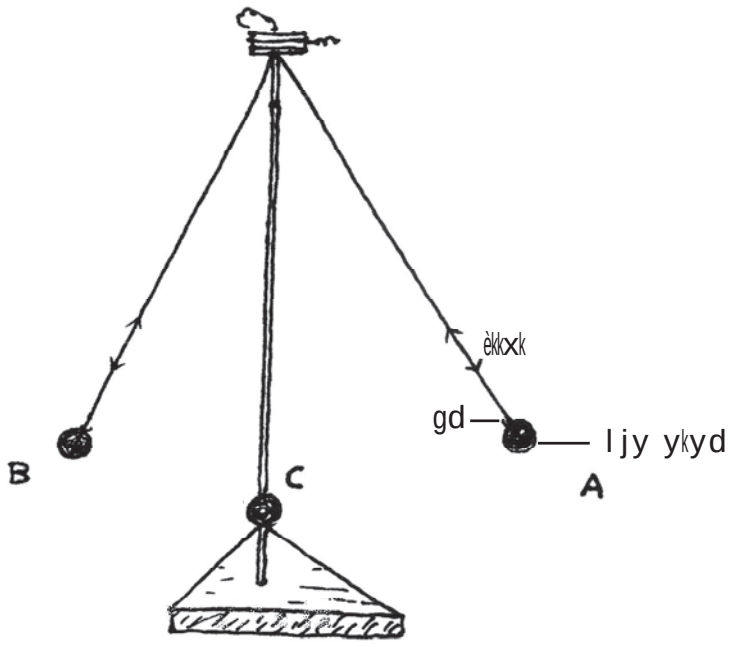
lofu

mí'; % ljy ykyd dh lgk;rk l yckb d lki{k vkordky e ifjoru dk vè;;u dj L-T^2 d eè; xkQ [khpukA

vko';d midj.k% ljy ykyd] èkkxk] ofu;j dfyil] LVki okp vkfnA

fl)kr % vyx&vyx LFkkuk ij x#Roh; Roj.k dk eku fHkUu gkrk gA ;fn fdlh LFkku ij x#Roh; Roj.k g, ml LFkku ij ljy ykyd dk vkordky T, ykyd dh yckb ftl iHkkodkjh yckb dgr g] ;fn L gk rk ljy ykyd d fu;e l vkordky] yckb d lekuikrh gkrk gA $T \alpha \sqrt{L}$

ukekfdr fp=%



i;kx fofèk % 1- loiFke ofu;j dfyi l dh lgk;rk l ljy ykyd ¼xkyd½ dh f=T;k dj yr g ;k io l fuf'pr Kkr f=T;k okyk ljy ykyd i;kx e mi;kx djr gA

2- gd dh yckb Ldy dh lgk;rk l Kkr dj yr gA

3- èkkx dh yckb bl idkj yr g fd ml yckb e xky dh f=T;k ,o gd dh yckb tkMu ij eku i.k 10 d x.kd e ikIr gkA ;g lfoèkk dk fy, djr g vko';d ugh gA

t l %& xky dh f=T;k $ gd dh yckb $ èkkx dh yckb

¾ 1-2 $ 1-4 $ 77-4

¾ 80 leh-

bl yckb dk dy yckb ;k iHkkodkjh yckb dgr gA

4- blh idkj èkkx dh yckb c<kdj 80] 90] 100 ---------- leh- djr gA

5- vyx&vyx yckb ydj 15&20 nkyu djkr g, LVki okp l le; ukV djr gA

6- vr e yckb ,o vkordky d eè; xkQ [khpk tkrk gA

voykdu lkj.kh %

1- ofu;j dfyi l xky ¼ykyd½ dh f=T;k Kkr djuk %

lkj.kh Øekd&1

Ø-	e[; Ldy dk ikB	'kh"k Ldy dk eku		0;kl dy ikB
	x	Hkkxk dh l[;k	Hkkxk dh l[;k × vYirekd (y)	¼leh- e½
1-				
2-				
3-				

0;kl e 'kU;kd =fV dk ?kVk yr gA vkIr ikB ----------

$$f=T;k = \frac{0;kl}{2}$$

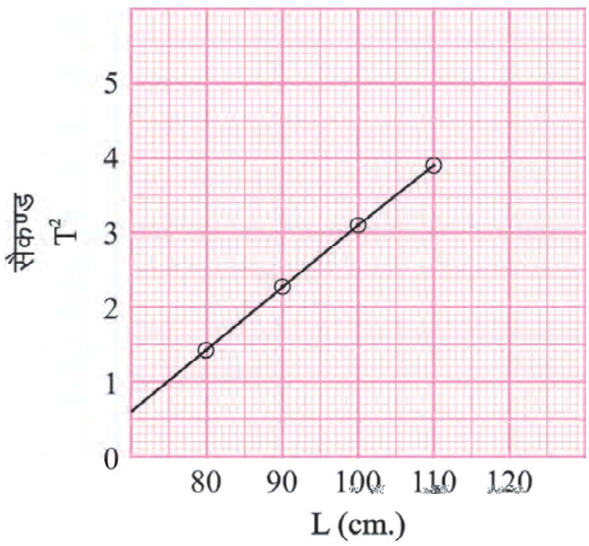
f=T;k = ---------- leh-

lkj.kh Øekd&2

Ø-	gd dh yackbZ (a)	xksys dh f=T;k (b)	èkkxs dh yackbZ (l)	dqy izHkkoh yEckbZ (a+b+l)	dqy le;	nksyudky (T) ¾ dqy le; / nksyuksa dh la[;k	T²
1- 2-							

ifj.kke % xzkQ ls Li"V gksrk gS fd $T \propto \sqrt{L}$ vFkkZr $T^2 \propto L$

vkorZdky dk oxZ izHkkoh yackbZ d lekuqikrh gksrk gS vkSj xzkQ ljy js[kk izkIr gksrh gSA



lkoèkkfu;k¡ % 1- ofu;j dSyhilZ LVSaM okp dk vYirekad Kkr djuk pkfg, lkFk gh 'kwU;kad =qfV dk Hkh lèkkèku vko';d gSA

2- ljy ykyd dh xfr ljy vkorZ xfr gksuk pkfg,A

3- ykyd dk foLFkkiu 4⁰ ls 5⁰ gksuk pkfg,A

4- ljy ykyd dh xfr esa ?k"kZ.k dk izHkko U;wu gksuk pkfg,A

xfr

mí'; % xfr d vkdMk l njh le; xkQ [khpu o xfr d idkj dk vè;;u djukA

vko';d lkexh % vkdM] ¼njh o le; d½ xkQ iij] ifly] Ldy vkfnA

fl)kr % tc dkb oLr leku le; e vleku njh pyrh g rk mldh xfr vleku xfr dgykrh g A tc dkb oLr leku le; e leku njh r; djrh g rk mldh xfr ,d leku xfr dgykrh gA ,d leku xfr dk njh≤ xkQ ,d lhèkh ljy j[kk gkrh gA

i;kx fofèk % 1- fn, g, vkdMk d vkèkkj ij njh o le; d fy, mfpr iekuk puA

2- vc le; dk xkQ iij d {kfrt v{k ij rFkk njh dk mèokèkj v{k ij j[k dj xkQ [khpA

voykdu %

le;	0	1	2	3	4	5	6	7
fLFkfr	2	6	12	12	12	18	22	29

xkQ %

ifj.kke % xkQ e j[kk AB o j[kk CD ,d leku xfr dk rFkk j[kk BC vleku xfr dk crkrk gA

lkoèkkfu;k % 1- iekuk dk p;u mfpr gk blfy, lkoèkkuh iod p;u djA

2- le; dk x v{k ij rFkk njh dk y v{k ij yxA

ik;ktuk dk;

ik;ktuk dk; gr vko';d fun'k&

1- ik;ktuk dk; NkV&NkV leg e Hkh fd;k tk ldrk gA

2- iR;d Nk= dk dy rhu ik;ktuk dk; djuk vfuok; g vFkkr Hkkfrd] jlk;u] tho foKku rhuk fo"k;k l ,d&,d ik;ktuk dk;A

3- ik;ktuk y[ku dk; Øec) gkuk pkfg,A vko';drkulkj fp=@iij@dfVx@ikn'k@lxg@QkVkxkQ@xkQ@vU; dk mYy[k Hkh fd;k tk ldrk gA

4- ik;kfxd ijh{kkofèk e iR;d Nk= }kjk fd, x, i;kx ,o ik;ktuk dk; l ekf[kd i'u iNk tkuk vfuok; gA

5- LFkkuh; leL;k dk y dj Hkh ik;ktuk dk; fd;k tk ldrk gA

tho foKku

1- oxhdj.k dh ifØ;k dk le>ukA

2- jkxk d y{k.k@if"Vdj.k@mipkj d fofHkUu rjhdk dk le>ukA

3- fdlh ,d ikèk d ikdrokl dk vè;;u djukA

4- to fuEuhdr ,o to vfuEuhdr dpj dh igpku djukA

jlk;u foKku

1- nfud thou e mi;kx fd, tku oky fofHkUu feJ.kk dk lphc) dj foy;u] dkykbM o fuycu e oxhdr djukA

2- viu vkl&ikl ik, tku oky rRok] ;kfxdk ,o feJ.kk dk lphc) djr g, mud nk&nk mi;kx fy[kukA

3- nfud thou e mi;kx e ykb tku okyh lykfLVd dh oLrvk d iuh pØ.k e lykfLVd dkM dh Hkfedk dk le>ukA

4- viuh 'kkyk d vkl&ikl jgu oky vyx&vyx 0;olk; l tM ikp 0;fDr;k l ppk dj fd fiNy ikp o"kk e mudk thok'e bèku ¼dk;yk] ,y-ih-th-] iVky] feêh dk ry½ dk mi;kx c<k ;k de gvk gA ;g Hkh irk yxk, dh thok'e bèku cpr gr mud }kjk D;k&D;k mik; fd, gA

Hkkfrd foKku

1- Roj.k] ox o enu lcèkh nfud mnkgj.kk dk ryukRed vè;;u djukA

2- ?kj@fo|ky; e ifrfnu [kir gku okyh Åtk dh x.kuk djukA

tho foKku

to fofo/krk ,o oxhdj.k

mí'; % oxhdj.k dh ifØ;k dk le>ukA

vko';d lkexh % lykfLVd dk Ldy] ydMh dk Ldy] ifly] ydMh dk xVdk] vkyfiu] ykg dh dhy] jcj dh xn] fØdV dk cYyk] pkch] dnu okyh jLlh] pkd] fdrkc] jcj] lkbfdy dk V;c] dkp dk VdMk] lery ni.kA

fofèk % bu oLrvk dh lph dk CydckM ij fy[k yA nkuk legk d lnL; viu&viu ifrfufèk pu yA bld ckn ijh d{kk dk nk legk e ckVA dkb Hkh ,d leg dk ifrfufèk leg d vU; lnL;k dh enn yr g, lph e l fdlh Hkh ,d oLr dk uke iph ij fy[kdj f'k{kd dk nA è;ku jg nlj leg d lnL;k dk irk u py ik, fd iph ij fdl oLr dk uke fy[kk x;k gA

nlj leg dk iph ij fy[k g, uke dk i'uk dh lgk;rk l c>uk gA ; i'u leg ,d d lnL;k l fd, tk,xA leg dk ifrfufèk i'u iNu d fy, mÙkjnk;h gkxk ijr leg d vU; lnL;k l lykg&e'kfojk Hkh vfuok; gkxkA ftu i'uk d tokc gk ;k ugh e vk ldr g doy o gh i'u iN tk ldr gA mnkgj.k d fy,& D;k og oLr [kyu d dke vkrh g\ iR;d leg dk ,d ckj i'u iNu dk ekdk feyxkA tk leg de l de i'uk e oLr dk uke c> yxk og fotrk gkxkA

i'u % 1- oLr c>u dh ifØ;k e nkuk legk e oLrvk d fdu&fdu x.kk dk vkèkkj cuk;k\

2- ikB e fn, x, fp= Øekd&1 dh lgk;rk ydj vki bu oLrvk d oxhdj.k dk ,d ¶yk pkV cuk,A

gekjk LokLF;

- fdUgh ikp jkxh 0;fDr;k l lEid djA fuEufyf[kr rkfydk d vulkj mul tkudkjh ikIr dj uhp fn, x, i'uk dk mÙkj fy[kA

jkxh dk uke	jkx d y{k.k	tkp djokb ;k ugh	jkx dk uke	jkx dk mipkj

i'u %

- bue l fdru ykxk u jkx dh if"V d fy, tkp djokb\
- fdu&fdu jkfx;k u mipkj djok;k\
- mipkj d fy, D;k&D;k rjhd viuk, x,\

ikdrokl

mí'; % fdlh ,d ikèk d ik—rokl dk vè;;u djukA

vko';d lkexh % dkih] ifly] jcj] 'kkiuj] jLlh] gMyl vkfnA

fofèk % bl dk; dk dju d fy, d{kk d lHkh lkFkh 3 l 5 d legk e cV tk,A bld ckn vkèk leg xktj ?kkl rFkk vkèk leg c'kje ikèk l lcfèkr tkudkjh ,d= dju dk dk; djxA tkudkjh ikIr dju e fuEufyf[kr fcnvk dk vo'; 'kkfey dj&

- ikèkk d mxu d LFkku d yxHkx 1 oxehVj d {k= e vkj dku&dku l ikèk feyA budh l[;k Hkh ukV djA bu ikèkk dk [kku oky tho&trvk dh mifLFkfr ;k mue thok d }kjk bUg [kk, tku d iek.k ¼dhV yxk iÙkk] dVh&QVh ifÙk;k vkfn½A
- ikèk d mxu oky LFkku dh feêh dk fooj.kA
- ikèk dk mi;kxA
- p;u fd, x, ikèk dk fp= Hkh cuk,A

i'u % 1- tkudkjh ikIr dju d ckn iuh d{kk e vkdj vU; legk d lkFk viuh tkudkjh dk feyku djA
2- feyku dh ifØ;k e D;k&D;k lekurk, o vlekurk, feyh\
3- ,d gh itkfr d thok d ikdrokl e fHkUurk gk ldrh gA vkid }kjk ikIr tkudkjh d lnHk e bl dFku dh foopuk djA

dpjk vkj mldk ic/ku

mí'; % to fuEuhdr ,o to vfuEuhdr dpj dh igpku djukA

vko';d lkexh % feêh ;k lykfLVd d 8&10 ik=] feêh] dkj dkxt] xkn] ty] ikdfrd dpjk ,o ekuo fufer dpjk tl& lCth d fNyd] VkQh d jij] dhy dkp d VdM ,o xkfy;k] ckry d <Ddu vkfnA

fofèk % dpj e l to fuEuhdr ,o to vfuEuhdr inkFkk dk Kkr dju d fy, fuEufyf[kr fofèk dk i;kx fd;k tkrk gA

,l ik= y tk vklkuh l miyCèk gk tl& feêh d cru ;k lykfLVd d l;ky vkfnA vkB nl ik=k e dN Lrj rd feêh dk Hkj yA ueh cuk, j[ku gr mle ty dh ek=k feyk,A dN ikdfrd ,o dN ekuo fufer dpj tl& lCth d fNyd] VkQh d jij] dhy] dkp d VdM ,o xkfy;k] ckry d <Ddu vkfn yA iR;d oLr dk vyx&vyx ik= e j[kdj feêh e nck nr gA iR;d ik= ij nck, x, dpj dk uke o fnukd fy[kdj dkxt l fpidk nr gA vc lHkh ik=k dk fdlh Nk;knkj LFkku ij j[kdj yxHkx rhu l pkj llrkg rd NkM nr gA rhu l pkj llrkg i'pkr ik= l feêh [kkndj n[k fd feêh e nckb xb oLr dk D;k gvkA oLrvk e g, ifjoruk dk ijh{k.k dj fuEufyf[kr idkj l lphc) djA

ik= Øekd	oLr dk uke	i.k vi?kfVr	vkf'kd vi?kfVr	dkb ifjoru ugh
1-				
2-				
3-				
4-				
5-				

- ,lh oLrvk d uke fy[k tk i.k :i l vi?kfVr gk xbA
- dku&dku lh oLr, ,lh g ftue dkb ifjoru ugh vk;k\

jlk;u foKku
inkFk % idfr ,o 0;ogkj

mí'; % nfud thou e mi;kx fd, tku oky fofHkUu feJ.kk dk lphc) dj foy;u] dkykbM o fuycu e oxhdr djukA

fl)kr % foy;u ,d lekxh feJ.k g] foy;u d d.k bru NkV gkr g fd mUg vk[kk l ugh n[kk tk ldrkA Nkuu dh fofèk }kjk foy; d d.kk dk foy;u l iFkd ugh fd;k tk ldrk gA d.kk d NkV vkdkj d dkj.k ; idk'k dh fdj.kk dk Qykr ugh gA blfy, foy;u e idk'k dk ekx fn[kkb ugh nrk gA fuycu ,d fo"kekxh feJ.k gA bld d.k vk[kk l n[k tk ldr g rFkk idk'k dh fdj.k dk Qyk nr g ftll mldk ekx fn[kkb nrk gA Nkudj bld d.kk dk iFkd fd;k tk ldrk gA dkykbM ,d fo"kekxh feJ.k gA bld d.kk dk vkdkj bruk NkVk gkrk g fd bUg vk[kk l ugh n[kk tk ldrk gA fdUr ; bru cM gkr g fd idk'k fdj.k d ekx dk Qyk nr gA bld d.kk dk Nkudj iFkd ugh fd;k tk ldrk gA

fofèk % Nk= mu feJ.kk dh lph viuh dkih e r;kj dj] ftudk o nfud thou e mi;kx djr gA

Ø-l-	inkFk	foy;u@dkykbM@fuycu	oxhdj.k dk vkèkkj
1-	uhc dk 'kjcr	foy;u	foy; d d.k fn[kkb ugh nr] bu d.kk dk Nkudj vyx ugh fd;k tk ldrk gA
2-			
3-			
4-			
5-			
6-			
7-			
8-			
9-			

ikIr voykduk d vkèkkj ij Nk= d{kk e ppk dj rFkk ml ppk l ikIr fu"d"kk dk fcUnokj viuh iktDV fjikV e 'kkfey djA

ukV % Nk= viu nfud thou e mi;kx fd, tku oky [kk| inkFkk] nokb;k] vkl&ikl d ifjo'k e miyC/k foy;u] dkykbM rFkk fuycu d mnkgj.k yA

lHkh iktDV fy[kr le; fo|kFkh bl ckr dk mYy[k vo'; dj fd vkidk iktDV djr le; fdl idkj dh dfBukb;k vk;h rFkk vkiu mudk fujkdj.k dl fd;kA ;fn vkiu iktDV dh dk; ;ktuk e dk; d nkjku cnyko fd;k gk rk mldk dkj.k Hkh fy[kA bl iktDV d }kjk vkiu D;k&D;k lh[kk bl ckr dk mYy[k Hkh iktDV fjikV e djA

inkFk % idfr ,o 0;ogkj

mí'; % viu vkl&ikl ik, tku oky rRok] ;kfxdk ,o feJ.kk dk lpkc) djr g, mud nk&nk mi;kx fy[kA

fl)kr % rRo inkFk dk og ey :i g] ftl jklk;fud vfHkfØ;k }kjk vU; ljy inkFkk e foHkkftr ugh fd;k tk ldrk gA ; èkkr rFkk vèkkr e oxhdr fd, tk ldr gA èkkr, pedhyh] rki rFkk fo|r lpkyd] rU;] vk?kkroè; rFkk èkkfRod èofu mRiUu djrh g] tcfd vèkkr, ; x.k inf'kr ugh djrh gA vèkkr, fofHkUu jxk dh rFkk fo|r dh dpkyd rFkk Hkxj gkrh gA ;kfxd nk ;k nk l vfèkd rRok d fuf'pr vuikr e jklk;fud l;kx l cur gA ;kfxd d x.k vo;oh rRok l fHkUu gkr gA feJ.k nk ;k nk l vfèkd rRok ;k ;kfxdk d fdlh Hkh vuikr e feyk, tku ij cur gA bud fuek.k e jklk;fud vfHkfØ;k ugh gkrhA bue vo;ok d x.k ik, tkr gA

fofèk % Nk= viu vkl&ikl d ifjo'k dk voykdu dj rRok] ;kfxdk ,o feJ.kk dk mud x.kk d vkèkkj ij igpku rFkk mud mi;kx dk tkudj lkj.kh e ukV djA

Ø-l-	mnkgj.k	rRo@;kfxd @feJ.k	vo;o	rRo@;kfxd@ feJ.k d :lk e j[ku d dkj.k	mi;kx
1-	ykg dh dhy	rRo	ykgk	ljy inkFkk e foHkkftr ugh fd;k tk ldrk	
2-	ikuh	;kfxd	gkbMkt u rFkk vkDlhtu	jklk;fud l;kx l cur gA	
3-	ihry	feJ.k	dkij rFkk ftd	fuek.k e jklk;fud vfHkfØ;k ugh gkrh	
4-					
5-					
6-					
7-					
8-					
9-					

dk;yk] iVkfy;e ,o iVkjlk;u

mí'; % nfud thou e mi;kx e ykb tku okyh lykfLVd dh 0kLrvk d iuh pØ.k e lykfLVd dkM dh Hkfedk dk le>ukA

fl)kr % oreku le; e iVkjlk;u d vrxr lykfLVd m|kx dk rth l fodkl gvk gA lykfLVd dh cuh oLrvk dk mi;kx ge viu nfud thou e cgrk;r e djr gA lykfLVd d x.k/ke d vkèkkj ij budh dkfMx dh tkrh gA tk iR;d lykfLVd oLrvk ij vfdr gkrh gA bl lykfLVd dkM dk ge vklkuh l n[k ldr gA dkfMx d vkèkkj ij gh mldk iuh pØ.k fd;k tkrk gA

fofèk %

- fo|kfFk;k d legk dk fuek.k f'k{kd d ekxn'ku e fd;k tk,A
- iR;d leg viuh 'kkyk d vkl&ikl d ikp ?kjk e tkdj] mul ppk dj mud }kjk mi;kx e ykb tku okyh lykfLVd dh oLrvk d uke rFkk mu ij vfdr dkM dk viuh dkih e ukV dj lykfLVd d iu% pØ.k ij ppk djA
- fo|kFkh viu ekgYy e Hkh ;g lo{k.k dj ldr gA
- lo{k.k d lk'pkr fHkUu&fHkUu leg ukV fd, x, voykduk dh d{kk e ppk dj 1&7 dkM rd dh oLrvk dk oxhdj.k dj rkfydkc) djA
- viu f'k{kd rFkk lkfFk;k dh enn l bu rkfydkc) oLrvk d iuh pØ.k ij ,d lkjxfHkr fjikV r;kj djA
- viuh 'kkyk ;k viu ekgYy d ikl d dckMh oky l lid dj tkudkjh ,d= dj fd lykfLVd dh oLrvk d dkM dk mud fy, D;k egRo gA
- lykfLVd dk c<rk mi;kx] LokLF; d fy, gkfudkjd gA bl fo"k; ij lLFkk ie[k@ikpk; dh enn l 0;k[;ku dk vk;ktu dj ikIr tkudkfj;k dk viuh fjikV e 'kkfey djA

dk;yk] iVkfy;e ,o iVkjlk;u

mí'; % thok'e bèku dh [kir ,o bud lj{k.k gr fd, tk jg i;kl dk tkuukA Lo; ,o lenk; dk thok'e lj{k.k d mik; gr ifjr djukA

fl)kr % thok'e bèku dh [kir ,o bud lj{k.k gr fd, tk jg i;klk dk tkuukA Lo; ,o lenk; dk thok'e bèku lj{k.k d mik;k gr ifjr djukA

fofèk %

- fo|kfFk;k d legk dk fuek.k f'k{kd d ekxn'ku e fd;k tk,A
- iR;d leg viuh 'kkyk d vkl&ikl d ikp ?kjk e tkdj] vyx&vyx 0;olk; l tM ikp 0;fDr;k l ppk dj fd fiNy ikp o"kk e mudk thok'e bèku mi;kx ¼dk;yk] ,y-ih-th-] iVky] feêh dk ry½ c<k g ;k de gvk gA ;g Hkh irk yxk, fd thok'e bèku cpr gr mud }kjk D;k&D;k mik, fd, x, gA mul ppk dj mud }kjk fd, x, mik;k dk ukV cd e lphc) dj yA fo|kFkh Hkh lenk; dk thok'e bèku lj{k.k d mik; l>k, rFkk mud lkFk dh xb ppk dk mYy[k viuh iktDV fjikV e djA

Hkkfrd foKku

xfr

mí'; % ox] Roj.k o enu lcèkh nfud mnkgj.kk dk ryukRed vè;;u djukA

vko';d lkexh % fojke ?kM+h] fHkUu&fHkUu idkj d lkèku ¼lkbfdy] ekVj lkbfdy] dkj] fjD'kk½ dkxt] iu] ifly] Vi vkfnA

fl)kUr % fdlh xfreku oLrq }kjk ,d fuf'pr fn'kk e bdkbZ le; e r; dh xbZ njh dk ox dgrs gA

$$ox = \frac{foLFkkiu}{le:}$$

Roj.k % vleku xfr e le; d lkFk ox e ifjoru dh nj dk Roj.k dgrs gA

$$Roj.k = \frac{ox\ e\ ifjoru}{le;krikyv}$$

Roj.k d eku e deh dk enu dgrs gA

i;kx fofèk % 1- ox] Roj.k o enu lcèkh nfud mnkgj.kksa dk vè;;u dju d fy, ,d ny dk xBu dj] ftle pkj&ikp lnL; gksA

2- ,l ekx dk p;u dj ftle dN lery ekx gks] dN oØ ekx o dN mcM&[kkcM okyk ekx gksA

3- fuf'pr njh dk fpfUgr dj ogk ,d lnL; ldr d fy, [kMk dj nr gA

4- ml LFkku l xtju oky fofHkUu idkj d lkèkuksa }kjk r; dh xbZ njh o le; dk ukV dj lkj.kh cuk,A njh dk Vi ;k ehVj Ldy l rFkk le; dk LVksi okp l ukiA mDr vkdMksa dk è;kuiod vè;;u dj voyksdu djA

voyksdu rkfydk

Ø-l-	fooj.k	iny	lkbfdy	fjD'kk	ekVj lkbfdy	vkVk ;k dkj
1-	iFke lery 20 eh- r; dju e yxk le;A					
2-	f}rh; oØh; ry 20 eh- r; dju e yxk le;					
3-	mcM&[kkcM 20 eh- r; dju e yxk le;					

ifj.kke % lkèkuksa }kjk ox] Roj.k o enu dk ryqkRed vè;;u dju l ;g irk pyrk g fd lery ekx e Roj.k o mcM&[kkcM ekx e enu gksxkA

lkoèkkfu;k % 1- njh fpfUgr djr le; ,d gh ekid dk i;kx dj rkfd nfj;k leku o ikIr vkdM+ 'k) gksA

2- fojke ?kMh ydj jkLr e ljf{kr LFkku ij [kM gkdj le; uki rkfd n?kVuk u gks ldA

blh vkèkkj ij lery txg ij pyuk lhf<;k l p<kuk o lhf<;k l mrju dk mnkgj.k Hkh y ldr gA

ik;ktuk dk; ¼dk; rFkk Åtk½

mí'; % ?kj@fo|ky; e ifrfnu [kir gku okyh mTkk dh x.kuk djukA

vko';d midj.k% ?kMh o fofHkUu fctyh d midj.kk dh 'kfDr ekiu gr eYVhehVj o vU; midj.kA

fl)kr % ifrfnu [kir mtk dh x.kuk fuEu l= l djxA

$$\text{ifrfnu [kir Åtk} = \frac{\text{midj.kk dh l[;k} \times \text{midj.k dh 'kfDr ¼okV e½} \times \text{le; ¼?kV e½}}{1000}$$

i;kx fofèk % vkid ?kj@fo|ky; e yx fofHkUu midj.kk }kjk ifrfnu [kir gku oky mtk dh x.kuk dj] vki viu ?kj d fctyh 0;; dh ekfld x.kuk djxA

voykdu rkfydk

Ø-l-	midj.k dk uke	midj.k dh l[;k	midj.k dh 'kfDr	midj.k d pky gkyr e yxk le;	mtk [kir	dy mtk [kir

x.kuk % 1- ifrfnu dh mtk ¾

2- ekg dh dy mtk ¾ ifrfnu dh mtk × fnuk dh l[;k

3- fctyh 0;; ¾ ekg dh dy mtk × nj

ifj.kke % ?kj@fo|ky; dh ifrfnu [kir mtk ---------- gA

lkoèkkuh % 1- fo|r l lj{kk d li.k mik;k dk ikyu djukA

2- fdlh Hkh fo|r midj.k dk mldh pky gkyr e Li'k u djukA

3- fo|r midj.kk l pky voLFkk e i;kIr njh cuk; j[kukA

Hkfo"; % vki viu ekfld fctyh 0;; dk de dju gr D;k&D;k mik; djxA