

PHYSICS

CLASS – X

CHAPTER – 2

izk'k dk viorz

REFRACTION OF LIGHT

izu 1- izk'k ds viorz lsvki D; k le> rsg

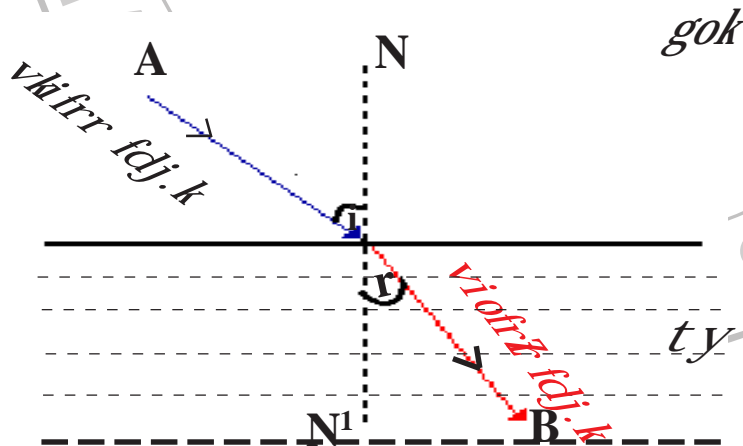
mukj & fdl hek; e lsl pkjr gkukyk izk'k tc, d ek; e lsnvjsek; e eais'k djrkgSrks izk'k dh fn'kk eai fforz gkst krkg izk'k dh fn'kk eai fforz dh; g ?kuk izk'k dk viorz dgykrh g

Rarer to Denser – yEc dh vly > qd tkrh g

Denser to rarer & yEc lsnvj gV tkrh g

vFkk~fojy lsl ?ku eatkusij yEc dh vly > qd tkrh g l ?ku lsl fojy eatkusij yEc lsnvj gV tkrh g

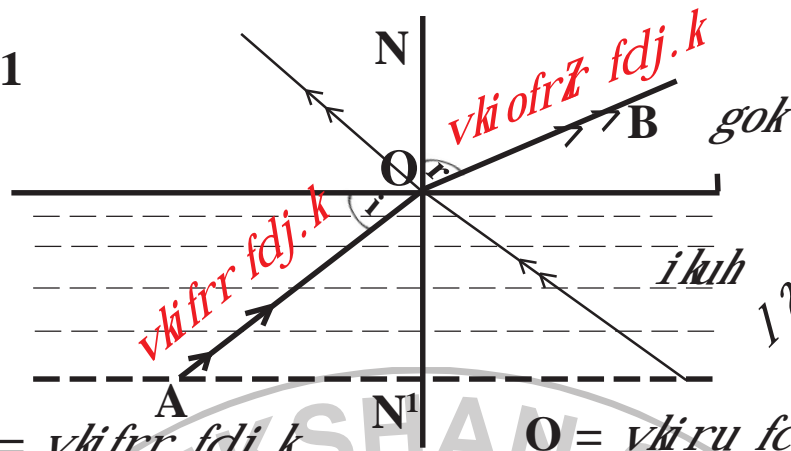
Q. No.-1



fojy lsl aku dh vly
çdk'k dk os vf/kdre 1/2

fp=&1

Q. No.-1



AO = $v \sin i$

OB = $v \sin r$

NN' = $v \sin i$

O = $v \sin r$

$\angle i$ = $v \sin r$

$\angle r$ = $v \sin i$

$\mu = \frac{c}{v}$

izu 2-viorzi dsfu; e dskfy/

v fof

Lusy dsfu; e dskfy/

mij & viorzi dsnfu; e g

(i) $v \sin i$ & $v \sin r$, oavkiru fangij Myk x; k yf rhula, d ghry eaghsa

(ii) fdl h/ jx dsizlk'k, oa/ nkse; e dsfy, vkiru dsk dh T; k, oaviorzi dsk dh T; k e, d fuf'pr vuqr gk'k g

$$\frac{\sin i}{\sin r} = \mu \text{ fu; rkd}$$

$$\frac{\sin i}{\sin r} = n_{21}$$

$$\frac{\sin i}{\sin r} = \frac{n_2}{n_1}$$

$$n_1 \sin i = n_2 \sin r$$

bl slusy dskfy; e dkl efer : i dgkt krkga bl fu; e dh/ 1621 bz easly usdha

izu 3-vioržikal (Refractive Index) lsvki D; k l e> rsga

mŭkj & fdl h ekè; e eaižlk'k dh fdj. k dksfn 'lk cnyus dh {terk dks ml dk vioržikal dgrsga

vFlók

fdl h ekè; e dk vioržikal 'lk eaižlk'k dh phy (c) rFlk ml ekè; e eaižlk'k dh phy (v) ds vuqkr dks vioržikal dgrsga bl sn ; kµ ½; vl sl fpr fd; k t krk ga

fdl h ekè; e dk vioržikal = $\frac{\text{'lk eaižlk'k dh phy}}{\text{fdl h ekè; e eaižlk'k dh phy}}$

$$vFlkz \quad \boxed{n = \frac{c}{v}}$$

izu 4-vkišk d vioržikal (Relative Refractive Index) fdl s dgrsga

mŭkj & nkele; ek d sfujišk vioržikal ds vuqkr dks vkišk vioržikal dgrsga ekè; e&1 rFlk ekè; e&2 ds fujišk vioržikal n_1 , o an₂ gk rls ekè; e&2 dkele; e&1 dsl kišk vioržikal dks iž %n₂₁ l sfu: fir fd; k t krk ga

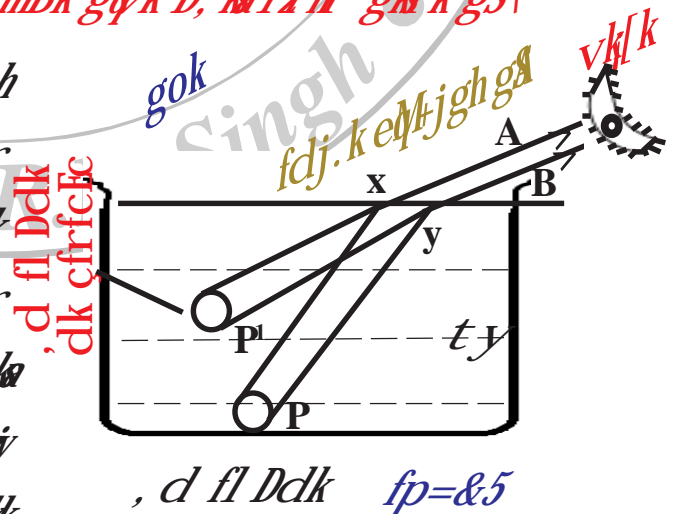
$$\boxed{n_{21} = \frac{n_2}{n_1}}$$

Okmu dlp - 1.52, fDyaV dlp - 1.65, i kuh - 1.33, glijk - 2.42

ulv & gok dk vioržikal l cl s de rFlk glijk dk l cl svf/kl gkrk ga

izu 5-ikuh eaj/lk gqk fl Ddk Aj mBk gqk D; k i žlr gkrk gs

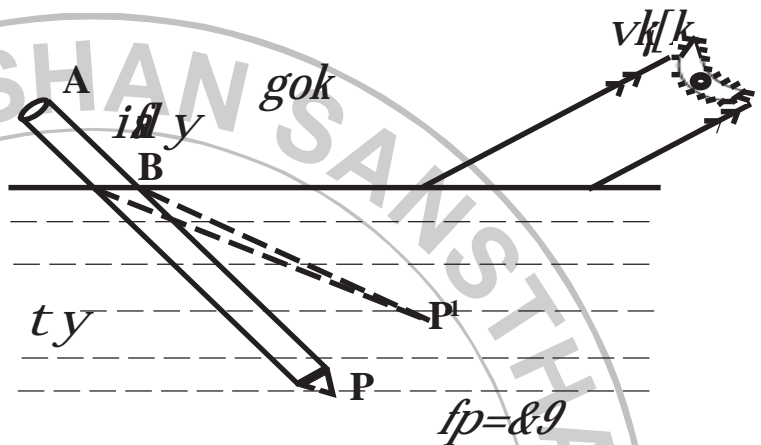
mŭkj & ižlk'k ds viorž ds dky. k i kuh eaj/lk gqk fl Ddk Aj mBk gqk i žlr gkrk ga i kuh ds vaj crž e afl Ddk dh fLFkr P gA rFlk PB nsvki fr fdj. lafudyrhga A rFlk B l s; sf dj. la ok qeavi ofrž gkrhga vFlkyEc l snjv gv t krhga D; la d i kuh ok qdh višk l ?ku ekè; e gA ; snku > qdh fdj. la vk/k ij P fcagij vFlkd h i frfcEc P'



ij nřkh t křh gř , d k iřlr gkrk gřfd i kuh eřfl Ddk dh okřrfod
fLEkrP' ij gřsysduP' ij fl Ddk dk vkřřd h fLEkr gřt kř l sřij
gř vr% i kuh eřj[kř x; k fl Ddk nřkusij dřN mBk gřk ekyř i Mřk
gř

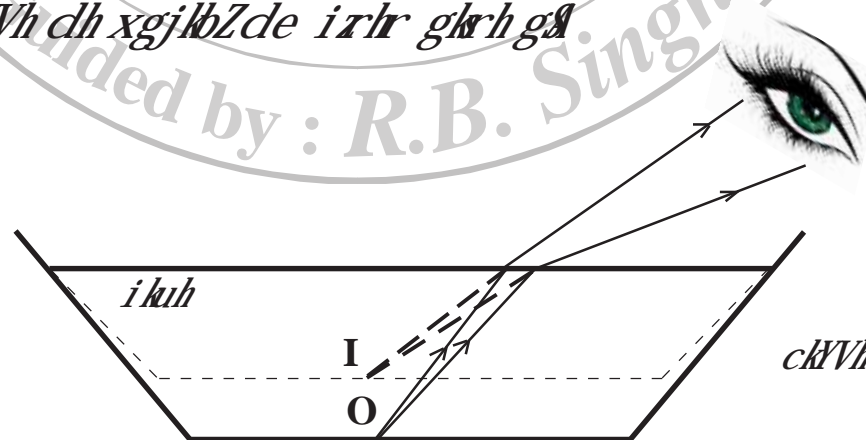
izu 6- i kuh dsvřj vlřkh Mřh gřZiřl y ; k dlp dh NM+Vsř h ekyř i Mřh gř
LoPN fp= řjk l e> křd

mřkj & i kuh eř vřkr% Mřh gřZ
iřl y vřřok dlp dh NM+
Vsř iřlr gkrh gř ; g
řWuk iřlk' k dsvřřř
ij vlřřřř gř iřlk' k
dh řdj. kř l řku eř; e
l sřojy eř; e dh vřj
pyřhgřřs; g vřřřř l snřj gř t křh gř n' křl P řcřřřdh fLEkrP'
ij nřkrk gř vr% iřl y dsvřřs dk Nřj řřřřř řij mBk gřk řřř
iřl y vřřřř l rg ij řřřřř Vsř řn[křk gř



izu 7- i kuh l sřjřh křVh dh xgřkbZde D; kř ekyř i Mřh gř

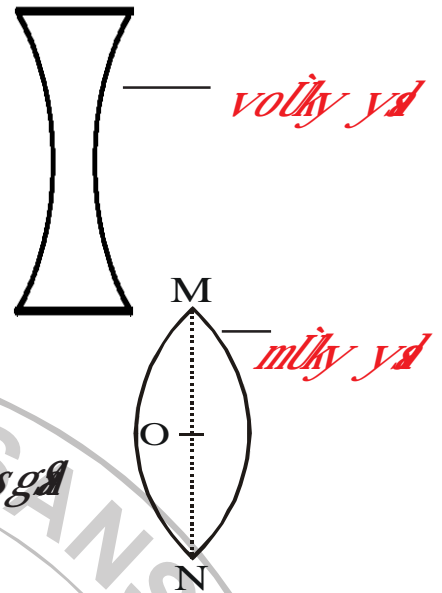
mřkj & i kuh l sřjřh křVh dh xgřkbZiřlk' k dsvřřřř dsvřřř. k de iřlr gkrh
gř i kuh l sřjřh křVh dsvřřř ij dh , d fl jkř l svřřř řdj. kř i kuh
dh l rg ij gok eř vřřř gřřř vřřřř l snřj gř řdj vlřřř ij igřřř
gř ; řřřř. kř l svřřř gřZiřlr gkrh gř křVh mřřř iřlr gkrh gř
vřřřř~křVh dh xgřkbZde iřlr gkrh gř



fp= 2-10 i kuh l sřjřh křVh dh xgřkbZdk de iřlr gkrh

ml smūky yā dgrsgā

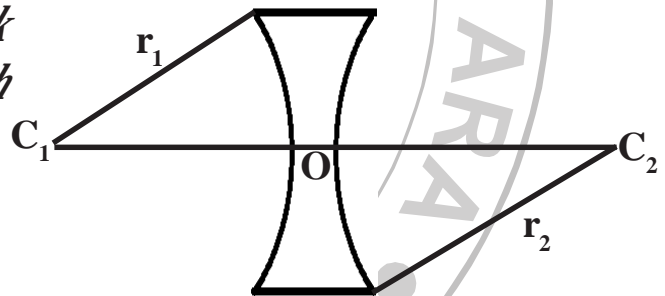
(ii) vory yā (Concave Lens) &ft l yā
dh l rgāclp eavānj dh vāj > qh gphZ
jgrhgsvFlōkft l yā dhekvbZclp
eade rFlk fdukijāij vfkēd jgrhgš
ml svory yā dgrsgā



izu 12- yā ds}kj d lsvki D; k l e> rsgā
mūkj & yā ds?kjs ds ō kl dls yā dk}kj dgrsgā
fp= eāMON }kj d gā

izu 13- yā dsoŌrk dē (Centre of Curvature), oaoŌrk f=T; k (Radius
of Curvature) dh ifjHk'kk nā

mūkj &ft u nks i k j n 'kēl xlykēdk mūk fu" B Hkx, d yā glrk gā mu xlykē
ds dēhēdsoŌrk dk dēhz rFlk mudh f=T; k vā dsoŌrk dh f=T; k dgrsgā
fp= eāC₁ rFlk C₂ oŌrk dk
dēhz rFlk r₁, oar₂ oŌrk dh
f=T; k gā

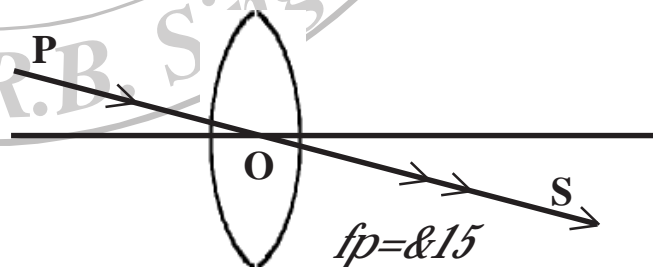


izu 14- iēku v{k (Principle axis)
fdl s dgrsgā

mūkj & yā dsoŌrk ds dēhēd sxt jusokyh dēi fud jēlk iēku v{k dgykrhgā fp=
eāC₁OC₂ iēku v{k gā

izu 15- iēlk'kē dē (Optical Centre)
lsvki D; k l e> rsgā

mūkj & yā dk og fēnqft l l sxt jus
okyh fdj. k dsfy, vki frf fdj. k, o
fuxē fdj. k l ekuktrj gkst k rsgā ml s iēlk'kē dēhz dgrsgā fp= eābl ō
l sfn/kk kx; k gā



yā dh l Hh nfy; k iēlk'kē dē l seki h t krhgā

izu 16- yd ds Qkdl rFlk Qkdl ktrj lsvki D; k l e> rsgd

mlyj & yd ds izkku vfk ds

l ekuktrj vkrhgphZfdj. ka

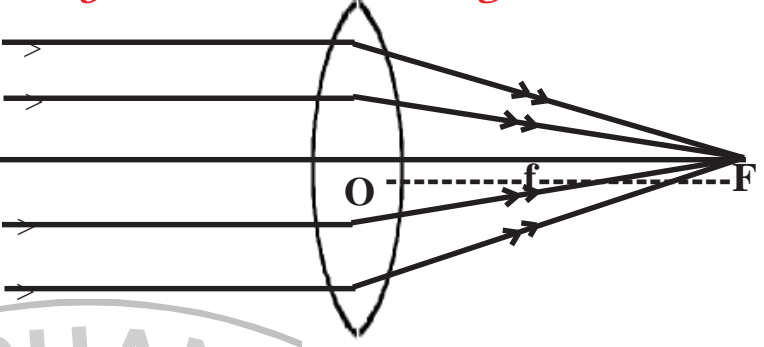
ft l fcaqij l d r gkrh

gs; k ft l fcaqij vil r

gkrh gphZirhr gkrh gs

ml fcaqdkya dk Qkdl

dgrsgd



yd ds izk'kr dshzO rFlk Qkdl (F) ds clp dh nyjh dks Qkdl nyjh dgrsgd

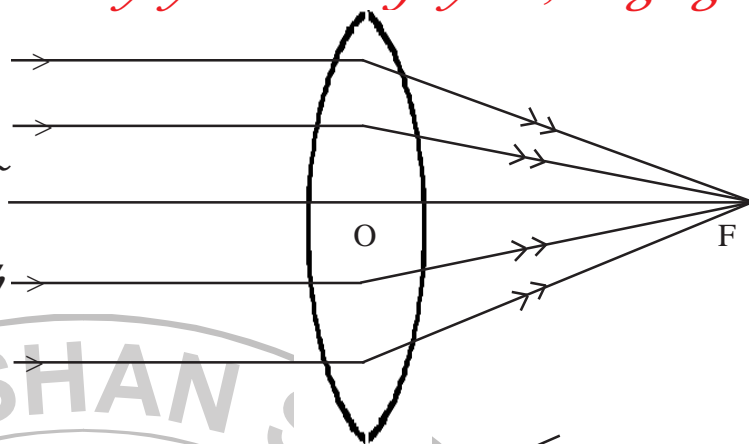
bl sfp= eaf l sfn[kk k x; k gd

izu 17- mly yd rFlk vory yd eavaj Li "V djd

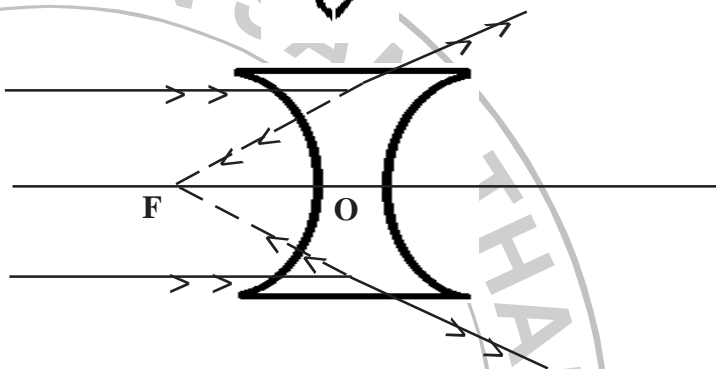
mlyj & mly yd rFlk vory yd eafufufyf[kr vaj ggd

<i>00</i>	<i>mly yd</i>	<i>voly yd</i>
<i>(i)</i>	<i>fdukjsij i rykyfdu clp ea ekWk glrk gd</i>	<i>fdukjsij ekWk, oacp ea i ryk glrk gd</i>
<i>(ii)</i>	<i>mly yd }kjk okrfod , oa dki fud nkukizlkj ds i frca curs gd</i>	<i>vory yd }kjk doy dki fud cfrfbc gh curk gd</i>
<i>(iii)</i>	<i>mly yd dk Qkdl okrfod glrk gd</i>	<i>vory yd dk Qkdl dki fud glrk gd</i>
<i>(iv)</i>	<i>mly yd dh Qkdl nyjh /kukred gkrh gS bl fy, bl dh {lerk /kukred gkrh gd</i>	<i>vory yd dh Qkdl nyjh _ .kkred gkrh gS bl fy, bl dh {lerk _ .kkred gkrh gd</i>
<i>(v)</i>	<i>mly yd dks vfHd kjh yd dgrsgd</i>	<i>vory yd dks vil kjh yd dgrsgd</i>

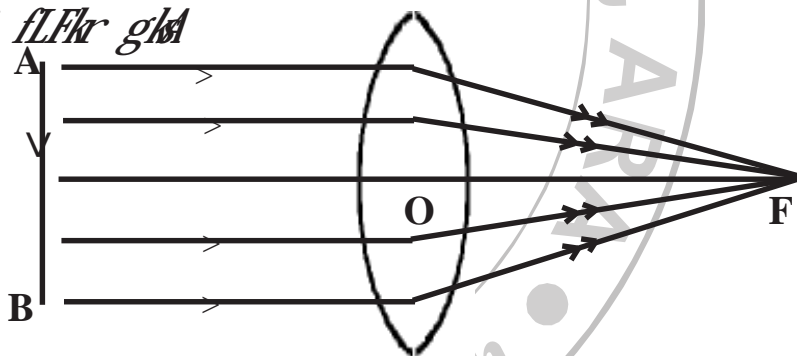
izu 18- mŭky yŭ dŭvffHl kjhrFlk vory yŭ dŭvil kjhyŭ D; lŭdgrsgŭ
 mŭkj & mŭky yŭ l s vki fr r
 l ekulŭrj fdj. kiŭ yŭ l sfuxŭ
 gkŭs dŭckn l ŭ ŭ gkŭh gSvFlkŭ~
 , d fcaŭij , d= gkŭ t kŭh gŭ
 bl h dŭj. k mŭky yŭ dŭvffHl kjh
 yŭ dgrsgŭ bl sl ŭ ŭ dŭkjhyŭ
 Hh dgk t kŭk gŭ



vory yŭ l s vki fr r
 l ekulŭrj fdj. kiŭ yŭ l sfuxŭ
 gkŭs ij vil ŭ gkŭh gSvFlkŭ~
 Qŭ t kŭh gŭ bl h dŭj. k vory
 yŭ dŭvil kjhyŭ dgrsgŭ bl s
 vil ŭ dŭkjhyŭ Hh dgk t kŭk gŭ



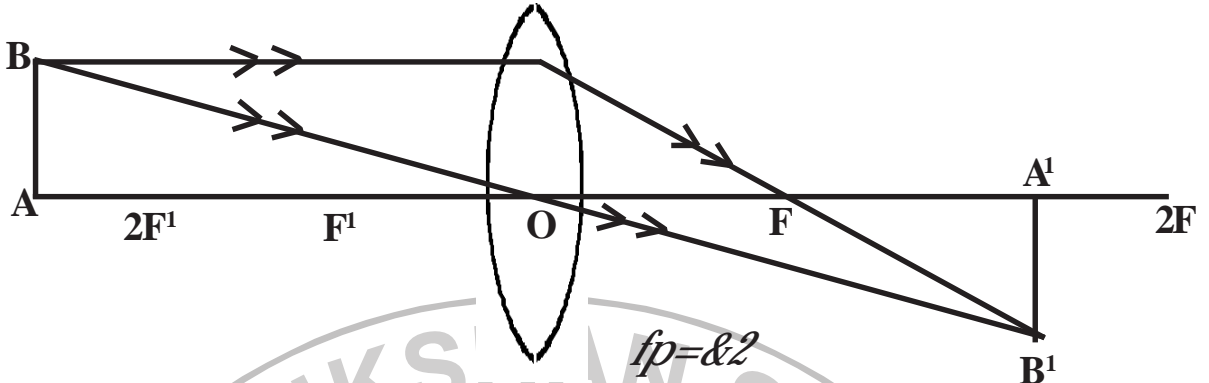
izu 19- mŭky yŭ eaŭoffHlŭ nŭj; lŭij j/ l s oLŭqdk iŭfrfŭcŭ culŭŭ
 mŭkj & (1) t c oLŭqvulŭr ij flFlŭr gŭŭ



(a) oLŭqdk iŭfrfŭcŭ F ij curk gŭ

(b) ; g iŭfrfŭcŭ oLŭrfod/ mŭVŭk rFlk oLŭql s cgŭ gh NŭVŭk gŭkŭk gŭ

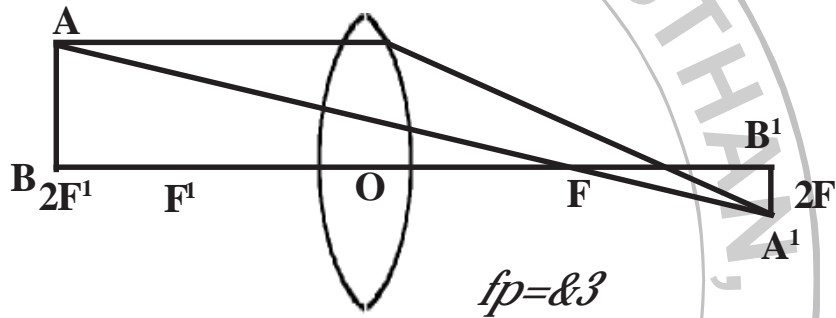
(2) *t c oLrqvulr rFlk $2F'$ ds clp fLFkr gl*



(a) *oLrqdk i frfcl c F rFlk $2F$ ds clp curk gl*

(b) *;g i frfcl c oLrfod/ mVvk rFlk oLrq l s Nvk glrk gl*

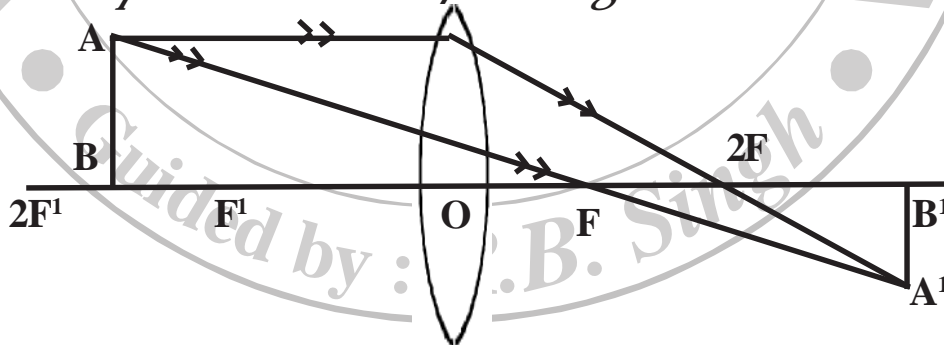
(3) *t c oLrqy dh nuh Qkll nyjh ($2F'$) ij fLFkr gl*



(a) *oLrqdk i frfcl c $2F$ ij curk gl*

(b) *;g i frfcl c oLrfod/ mVvk rFlk oLrq ds cjkj glrk gl*

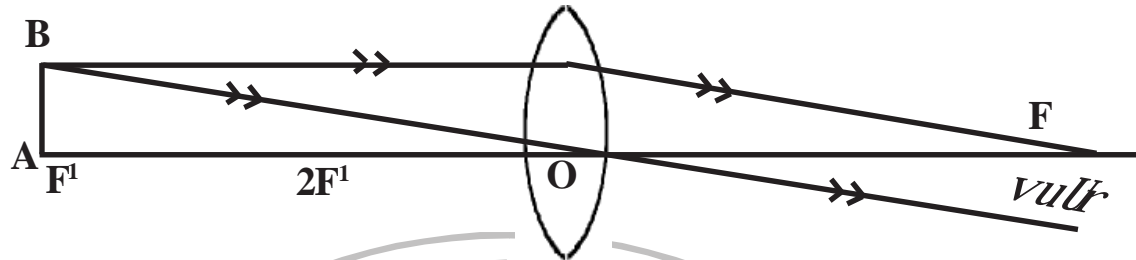
(4) *t c oLrq F' rFlk $2F'$ ds clp fLFkr gl*



(a) *oLrqdk i frfcl c $2F$ l snj curk gl*

(b) *;g i frfcl c oLrfod/ mVvk rFlk oLrq l s cMk glrk gl*

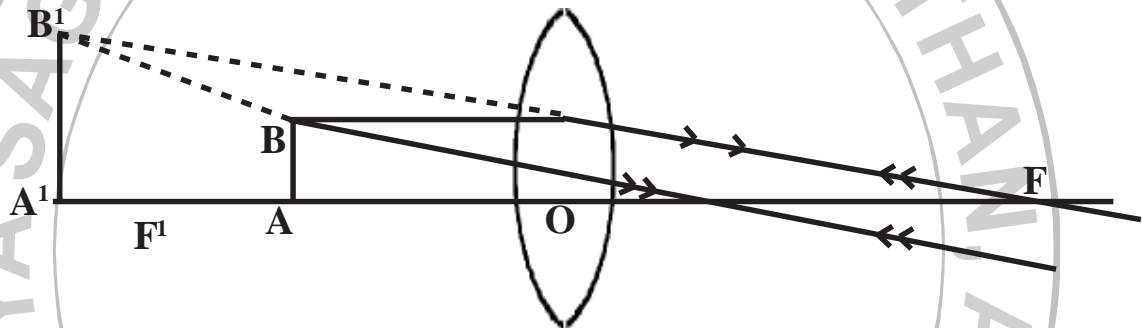
(5) *t c oLrqyđ ds Qkdl (F') ij fLEkr gkđ*



(a) *oLrqdk iŕfcŁc vutŕ ij curk gđ*

(b) *; g iŕfcŁc okŕfodŕ mŕVk rFlk oLrqŕ scMk gkŕk gđ*

(6) *t c oLrqyđ dseŕ; Qkdl rFlk yđ dsclp fLEkr gkđ*



(a) *oLrqdk iŕfcŁc yđ ds iŕNs curk gđ*

(b) *; g iŕfcŁc dkŕifudŕ l hŁk rFlk oLrqŕ scMk gkŕk gđ*

izu 20- yđ dh ŕlerk (Power of Lens) D; k gđŕ bl dk ek=d fy/lđ

mŁk&fdl h yđ dh ŕlerk ml yđ ds Qkdl kŕj dk Q đŁe gkŕk gđ

; fn yđ dh ŕlerk (P) rFlk Qkdl kŕj (f) gkŕk

$$P = \frac{1}{f}$$

*SI i) fr eayđ dh ŕlerk dke=d Mbvkŕŕj (Diopter) gkŕk gđ
bl đ l sl ŕŕr dŕsgđ bl selŕj eŁekik t kŕk gđ mŁk yđ dh ŕlerk
ekukŕed rFlk vory yđ dh ŕlerk_ . kŕed gkŕh gđ*

izu 21- 1 Diopter dh iŕŕkŕk nđ

mŁk & Diopter – 1 Diopter ml yđ dh ŕlerk gŕft l dh Qkdl nyŕŕ m gkŕh gđ

$$1 \text{ Diopter} = 1 \text{ D} = 1 \text{ m}^{-1}$$

izu 22- yđ ds lŁkt u dh ŕlerk l svki D; k l e> rsgđŕ bl dk l ŕ fy/lđ

*mũkj&t c vud i rysyã lœdks, d&nũjsdsl Ei dZej/[lk t krk gSrls l a kt u
dh{lerkmu yã lœdsvyx&vyx {lerkvlœdscit h ; lœ dscjkj glrk gã
; fn vud yã ft udh{lerk; aœe 'kP₁, P₂, P₃ gks vkj mlgã
ijLij l Ei dZej/[lk t k rks l a kt u dh{lerk*

$$P = P_1 + P_2 + P_3 + \dots$$

*yã lœds, l sl a kt u dk mi; lœ/ dœjk l ven'kZrFlk nyichu ea
fd; k t krk gã*

*izu 23-mũky yã rFlk vory yã dsnkœnksmi; lœ crloã
mũkj &mũky yã dsmi; lœ&*

- (i) *bl dk mi; lœ l ven'kZ nyichu rFlk QkVks dœjk eafd; k t krk gã*
- (ii) *nh?ZnřV nk'k dks nyj djuseabl dk mi; lœ glrk gã
vory yã dsmi; lœ&*
- (i) *bl dk mi; lœ xšřy; lœ dsnjichu eauf=dk ds: i eagrk gã*
- (ii) *bl dk mi; lœ fudV nřVnk'k nyj djuseafd; k t krk gã*

*izu 24-vkldks, d mũky/ vory rFlk dlp dh lyV nh x; h gã mudh l rglo
dksfcuk Nq dš sigphusl*

*mũkj &fcuk Li 'kZfd; smũky/ vory rFlk dlp dh lyV dksigphiusdsfy,
ckjh&ckjh l sfell h iřrd ds, d i "B dsfudV ykrsgã Nisv{lj lœdk
fujh'k k djrsgã*

- (i) *; fn Nisv{lj viusokřfod vkldj l scMšfn/[kœZi Mšsgšrls; g
mũky yã glrk gã*
- (ii) *; fn Nisv{lj viusokřfod vkldj l sNkšfn/[kœZi Mšsgšrls; g
vory yã glrk gã*
- (iii) *; fn Nisv{lj viusokřfod vkldj dscjkj fn/[kœZi MškgSrls
; g dlp dh lyV glrk gã*

izu 25-iku dk viorZkal 1.33 gA bl dFlu dk D; k rkr; ZgS

mukj & iku dk viorZkal = $\frac{\text{gok eaçdk'k dh phy}}{\text{iku eaçdk'k dh phy}}$

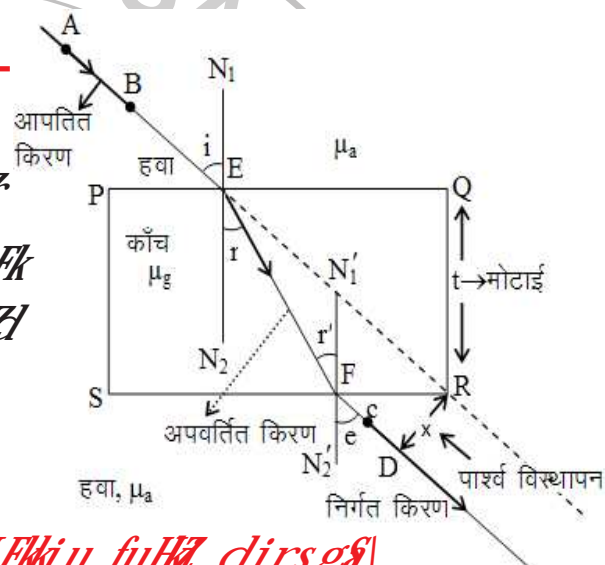
$$n_w = \frac{300000 \text{ Km/s}}{225000 \text{ Km/s}} = \frac{4}{3} = 1.33$$

gok eaiZk'k dh phy iku eaiZk'k dh phy ds 1.33 vFlkZ $\sim \frac{4}{3}$ xqjh

gkrh gA
izu 26-ik'ozl foLFkiu (Lateral Displacement) Isvki D; k l e> rsgA

mukj & dlp LyS Is fudyus okyh fuxZ
fdj. k rFlk vki fr fdj. k dsew iFl
ds clp ykFcd nyh dks ik'ozl
foLFkiu dgrsgA

fp = eDR = x ik'Zd foLFkiu gA



izu 27-fdu&fdu dkjdaij ik'ozl foLFkiu fuHjZ djrsgA

mukj & fuEu dkjdaij ik'ozl foLFkiu fuHjZ djrsgA

- (i) ik'ozl foLFkiu dlp LyS dsew/bZdk l hëk l ekuqkrh gkrk gA
- (ii) ik'ozl foLFkiu vki ru dsk dk l hëk l ekuqkrh gkrk gA
- (iii) ik'ozl foLFkiu dlp ds viorZkal dk l hëk l ekuqkrh gkrk gA
- (iv) ik'ozl foLFkiu vki fr fdj. k dsrjans; Zdk Q Dekuqkrh gkrk gA

izu 28- muky yA eafI) djaFd $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$

vFlkZ fdl h muky yA eaoLrqdh nyh(u), i frfcEc dh nyh(v) rFlk
Qkd l nyh(f) eal xak LFkiir dja

mukj & ekufd fp = eMN, d muky yA gA 2F' Isvulr nyh ij oLrq PQ
fLFkr gA ft l dk i frfcEc IB ij curk gA

$\Delta POQ \sim \Delta IOB$ *le: i ga* Q

$$\frac{IB}{PQ} = \frac{OI}{OP} \dots (i)$$

$\Delta AOF \sim \Delta BIF$ *le: i ga* P

$$\frac{IB}{OA} = \frac{IF}{OF} \dots (ii)$$

(PQ = OA)

le h (i) ~ le h (ii) I f

$$\frac{OI}{OP} = \frac{IF}{OF}$$

$$\frac{OI}{OP} = \frac{OI - OF}{OF}$$

$$\frac{v}{-u} = \frac{v - f}{f}$$

$$vf = -u(v - f)$$

$$vf = -uv + uf$$

nkur j Q u, v, f I shh nnsi j/

$$\frac{vf}{uvf} = \frac{-uv}{uvf} + \frac{uf}{uvf}$$

$$\frac{1}{u} = -\frac{1}{f} + \frac{1}{v}$$

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

$$\boxed{\frac{1}{v} - \frac{1}{u} = \frac{1}{f}}$$

izu 30 vory ya eaf) dja fd $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$

vFlkh fdl h vory ya eafLrqdh njh(u), i frfEc dh njh(v) rFlk QkdI njh(f) eaf xak LFkfr dja

mUj & ekuf fd PQ , d vory ya ga bl dk izlk'kr dhnz(O) rFlk F , oa

F' i fte, oaf}rh Qkdl gA F lsdN nyh ij oLrqAB j[lh x; hgs ft ldk i frcfc A'B' ij curkgA

ledsk $\triangle OAB$ rFlk $\triangle OA'B'$ le: i gA (A-A-A) he: irkieş lş

$$\frac{AB}{A'B'} = \frac{OB}{OB'} \quad \dots (i)$$

bl h izkj l edsk $\triangle FOM$ rFlk $\triangle A'B'F$ le: i gA

$$\frac{OM}{A'B'} = \frac{OF}{B'F} \quad (OM = AB)$$

$$\frac{AB}{A'B'} = \frac{OF}{B'F} \quad \dots (ii)$$

leh (i) rFlk leh (ii) lş

$$\frac{OB}{OB'} = \frac{OF}{B'F}$$

$$\frac{OB}{OB'} = \frac{OF}{OF - OB'}$$

$$\frac{-u}{-v} = \frac{-f}{-f + v}$$

$$\frac{u}{v} = \frac{-f}{-f + v}$$

$$u(v - f) = -vf$$

$$uv - uf = -vf$$

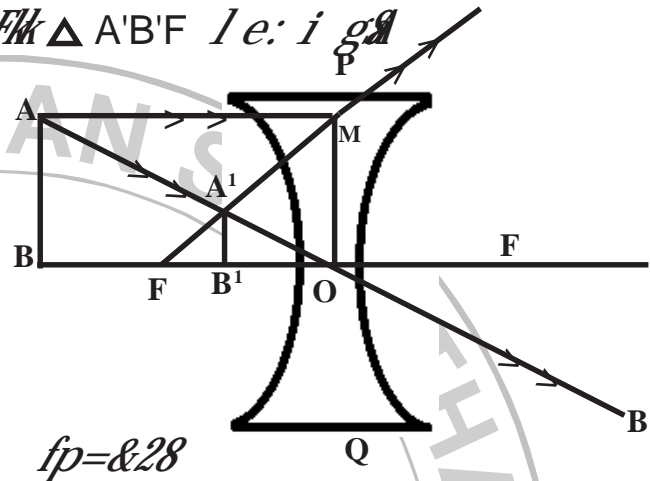
nkikarjQ u, v, f l sHlx nsisij/

$$\frac{uv}{uvf} - \frac{uf}{uvf} = \frac{-vf}{uvf}$$

$$\frac{1}{f} - \frac{1}{v} = \frac{-1}{u}$$

$$\frac{1}{f} = \frac{-1}{u} + \frac{1}{v}$$

$$\boxed{\frac{1}{u} - \frac{1}{v} = \frac{1}{f}}$$



fp lg~ i fji kh lş

$$OF = -f$$

$$OB = -u$$

$$OB' = -v$$

izu 29-vloekz fdl sdgrsgA\ xkyh yA dsl # ij vlekkjr vloekz dkl # LFkkir dja

mukhy ya ds } kjk cus i frfE dh ApkZ(h₂) , o lrqdh ApkZ(h₁) ds vuqkr dks vloekZ dgk t krk gA

$$m = \frac{h_2}{h_1}$$

fp= eamukhy ya } kjk oLrqAB dk i frfE A'B' ij curk gA

ΔAOB rFl $\Delta A'OB'$ le: i gA

$$\frac{AB}{A'B'} = \frac{OB}{OB'} \dots (i)$$

$$\frac{h_1}{-h_2} = \frac{-u}{v}$$

$$\frac{h_1}{h_2} = \frac{u}{v}$$

$$\frac{h_2}{h_1} = \frac{v}{u}$$

$$m = \frac{v}{u}$$

ya l # l\$

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$$

nkukrjQv l sxqkk djus ij/

$$\frac{x}{y} - \frac{v}{u} = \frac{v}{f}$$

$$1 - \frac{v}{u} = \frac{v}{f}$$

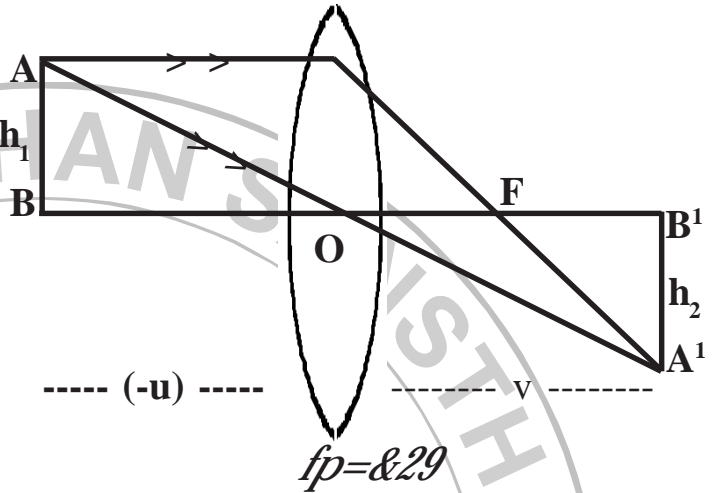
$$-\frac{v}{u} = \frac{v}{f} - 1$$

$$-\frac{v}{u} = \left(1 - \frac{v}{f}\right)$$

$$\frac{v}{u} = 1 - \frac{v}{f}$$

$$\left(m = \frac{v}{u}\right)$$

$$m = 1 - \frac{v}{f}$$



fpLg~ifjikWh l\$

$$A'B' = -h_2$$

$$AB = h_1$$

$$OB = -u$$

$$OB' = v$$

Guided by : R.B. Singh

izu 30-Ølærd dsk lsvki D; k l e>rs gÅ

*mÛkj & t c izlk'k dhfdj. k l ?ku elè; e l sfojy elè; e l sin'sk djrhgS
rksfrjNhgkst krhgÅ bl voLFkk eaviorZi dsk vkiru dsk l scMk gks
t krkgÅ t c vkiru dsk dsk<k kt krkgSrksviorZi dsk Hh c<+t krk
gÅ , d l e; ; g dsk90° dk gkst krkgÅ bl viorZi dsk dsfy,
vkiru dsk dkeku90° dk gkst krkgSt l s Ølærd dsk dgykrkgÅ bl s
c l sl fpr fd; k t krkgÅ*

izu 31-iwZvkrfjd ijkorZi lsvki D; k l e>rs gÅ

*mÛkj & ; fn l ?ku elè; e l sfojy elè; e dh vly vkifr fdj. k dsfy,
ijkorZi dsk dkeku Ølærd dsk l s FksMk Hh vfèd gkst krkgSrks izlk'k
dhfdj. k i q%l ?ku elè; e eaykV t krhgÅ bl ?kVuk dsk iwZvkrfjd
ijkorZi dgrsgÅ*

*gljk dk peduk rjla dk fVefVekuk rFkk eëejlfpdk dh ?kVuk
izlk'k dsk iwZvkrfjd ijkorZi dsdlj. k ?kVr gkrhgÅ*

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