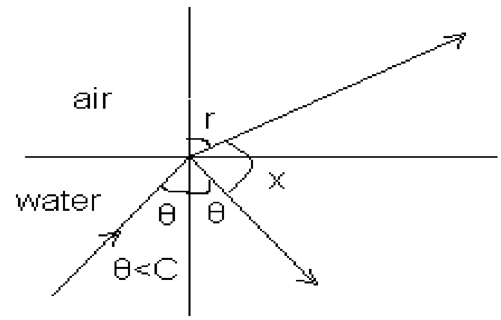
Sol.1:

Light is traveling from denser to rarer medium i.e. r > θ



X+r+ θ =180

X = 180 – r – θ

X < 180 - 2 θ |since r > θ

Ans (C)

Sol.2

$$r = \frac{i}{2}$$

$$n = \frac{\sin i}{\sin r} = \frac{\sin i}{\sin\frac{i}{2}} = \frac{2\sin\frac{i}{2} .x \cos\frac{i}{2}}{\sin\frac{i}{2}}$$

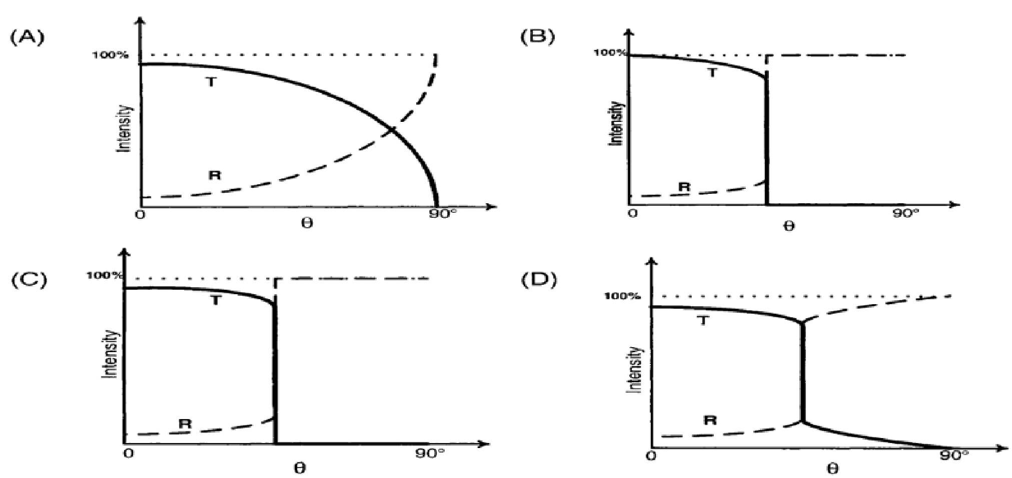
$$= 2\cos\frac{i}{2}$$

$$\rightarrow \cos\frac{i}{2} = \frac{n}{2}$$

$$\rightarrow i = 2\cos^{-1}\left[\frac{n}{2}\right]$$

Ans = (d)

Sol.3



Light is traveling from glass to air. Therefore maximum light is transmitted if the angle of incidence is less than the critical angle. And very little light is reflected.

If the angle of incidence is greater than critical angle, no light is transmitted. Hence intensity of transmitted light becomes zero.

Ans = (c)

Sol. 4:

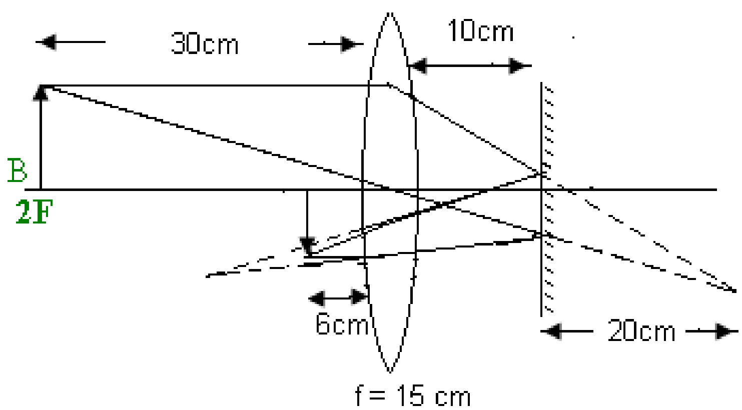
Refraction at lens,

Object is at 2f = 30cm therefore image is at 2f = 30 cm

For reflection at mirror, virtual object is at 20cm behind the mirror.

Therefore image formed at 20cm in front of the mirror.

Again for refraction through lens, u = -10 cm



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

$$\frac{1}{v} = \frac{1}{15} + \frac{1}{10} = \frac{2+3}{30} = \frac{5}{30}$$

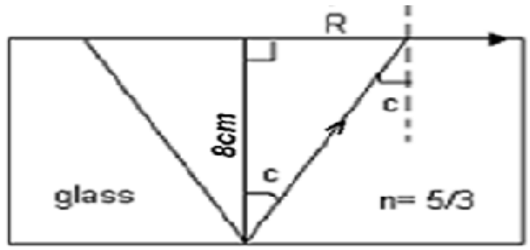
► v = 6 cm

The final real image is formed at 10+6 = 16 cm from the mirror.

Ans = (b)

Sol.5

The radius of the circular area through which the light is passed is



$$\rightarrow \quad R = \frac{h}{\sqrt{(n^2-1)}}$$

$$R = \frac{8}{\sqrt{(25-9)}} \times 3$$

$$R = \frac{8}{4} \times 3 = 6 \text{ cm}$$

Ans = (b)

Sol.6

$$\left| \frac{P_{concave}}{P_{convex}} \right| = \frac{2}{3} = \frac{f_{convex}}{f_{concave}}$$

$$\frac{1}{F} = \frac{1}{f_{concave}} + \frac{1}{f_{convex}}$$

$$= \frac{-2}{3f} + \frac{1}{f}$$

$$\frac{1}{30} = \frac{-2+3}{3f} = \frac{1}{3f}$$

$$f = 10cm$$

Where f is the focal length of convex lens

Ans= (a)

Sol.7

For given lens

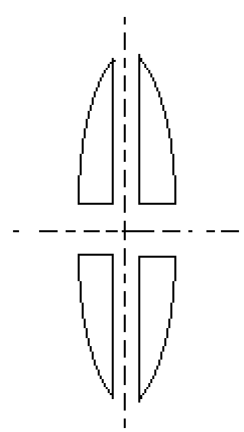
$\frac{1}{f} = (n-1)\left[\frac{2}{r}\right]$ **since $r_1 = r_2 = r$**

For a piece of lens, **$r_1 = r$ and $r_2 = \infty$**

$$\frac{1}{F} = (n-1)\left[\frac{1}{r} + \frac{1}{\infty}\right]$$

$$= (n-1)\frac{1}{r}$$

$$= \frac{1}{2f}$$

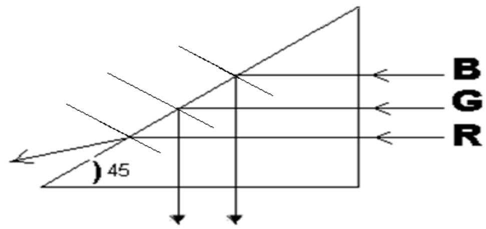


F = 2f

Ans (d)

Sol.8

Since i = 45 which is greater than C for blue and green. So they undergo TIR. But red light gets refracted.



Ans = (a)

Sol.9

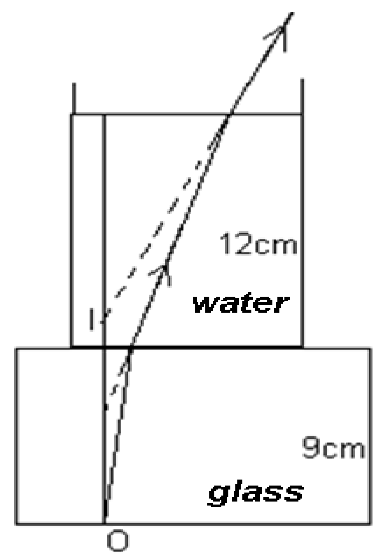
$$n = \frac{real\ thickness}{apparent\ thickness} = \frac{t}{10}$$

t = 10 x n

= 10 x 1.5 = 15 cm

Ans (c)

Sol.10



For multiple media;

Apparent depth=

$$\frac{t_1}{n_1} + \frac{t_2}{n_2} = \frac{9}{1.5} + \frac{12}{\frac{4}{5}} = 6 + 9 = 15\ cm$$

Ans (b)

Sol.11

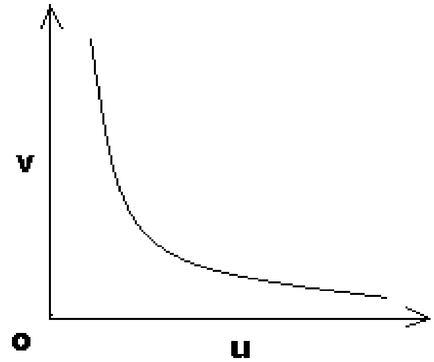
Lens equation

1/u +1/v =1/f = cont.

is the equation of

hyperbola

Ans = (d)



Sol.12

In air $\frac{1}{f} = (n_g - 1)\left[\frac{1}{r1} + \frac{1}{r_2}\right]$

In water $\frac{1}{f'} = \left(\frac{n_g}{n_w} - 1\right)\left[\frac{1}{r1} + \frac{1}{r_2}\right]$

$$\frac{f'}{f} = \frac{(n_g - 1)}{(n_g - n_w)}\ x\ n_w$$

$$f' = \frac{0.5}{0.17}\ x\ 1.33\ x\ f = 4f$$

Ans = (c)

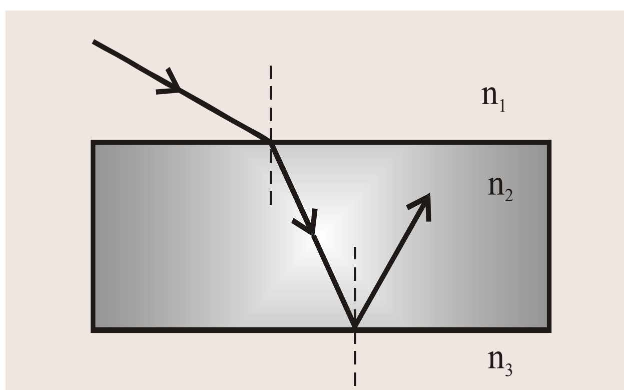
Sol.13

Due refraction at Ist face, ray bends towards the normal i.e. $n_2 > n_1$

At IInd face No TIR takes place → $n_2 < n_3$

→ $n_1 < n_2 < n_3$

Ans = (a)



Sol.14

From figure, when u = v = 40cm = 2f

→ f = 40 / 2 = 20cm

Ans = (b)

Sol.15

In equation $n=A+B/\lambda^2$,

Dimensions of B are same as that of $[\lambda]^2 = [L]^2$

i e the dimensions of B are same as that of area

Ans = (d)

Sol.16

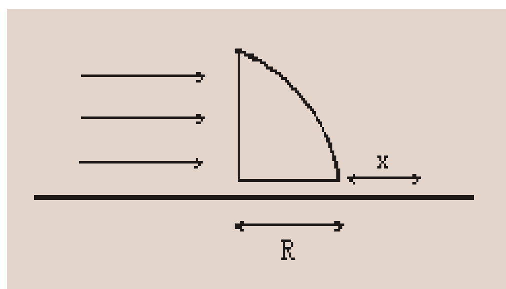
Since the rays are normal to the first surface, no deviation takes place.

At the II[nd] surface,

$$\frac{n_1}{u} + \frac{n_2}{v} = \frac{n_1 - n_2}{R}$$

$$\frac{1.5}{\infty} + \frac{1}{v} = \frac{0.5}{5}$$

$$v = \frac{5}{0.5} = 10\ cm$$

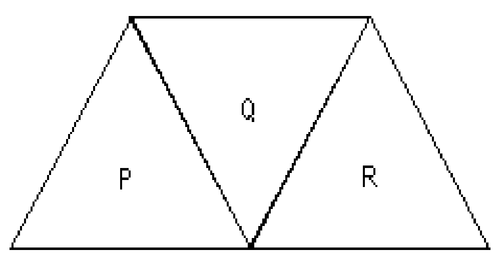


Ans = (d)

Alternative: Since radius is 5cm, the rays converges to focal length =2r =10cm

Sol.17

Addition of two identical prisms as in figure is same as addition of parallel sided slab.



Ans = (a)

Sol.18

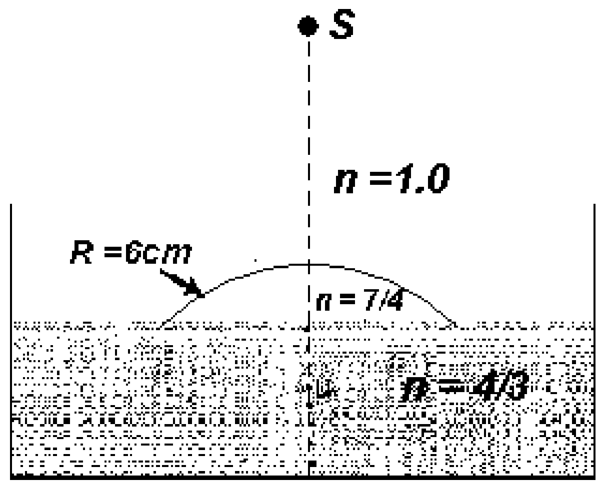
For refraction at the curved surface

$$\frac{n_1}{u} + \frac{n_2}{v} = \frac{n_1 - n_2}{R}$$

$$\frac{1}{24} + \frac{7}{4xv} = \frac{\frac{7}{4} - 1}{6} = \frac{3}{4} x \frac{1}{6} = \frac{1}{8}$$

$$\frac{7}{4xv} = \frac{1}{8} - \frac{1}{24} = \frac{1}{12}$$

$$v = \frac{7}{4} x\ 12 = 21cm$$



For the refraction through oil – water interface

$$a.d = \frac{r.d}{wn_o} = \frac{21}{\frac{7}{4} x \frac{3}{4}} = 16\ cm$$

Therefore x = 18 – 16 = 2cm

Ans = (a)

Sol.19

For refraction at glass-wat

$${}_g n_w = \frac{n_w}{n_g} = \frac{sini}{sinr}$$

$$n_g = \frac{sinr}{sini} \times n_w \quad \text{-------(1}$$

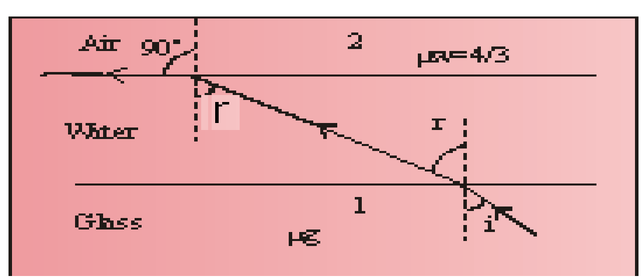
For water –air interface,

$$n_w = \frac{1}{sinr}$$

$$n_w \times sinr = 1$$

Equation (1) becomes

$$n_g = \frac{1}{sini}$$



Ans = (b)

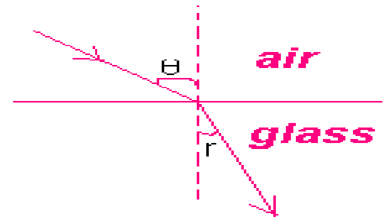
Sol.20

$$n_g = \frac{1}{\sin\theta} \rightarrow \sin\theta = \frac{1}{n_g}$$

$$\text{Also } n_g = \frac{\sin\theta}{\sin r}$$

$$\rightarrow \sin r = \frac{\sin\theta}{n_g} = \frac{1}{n^2}$$

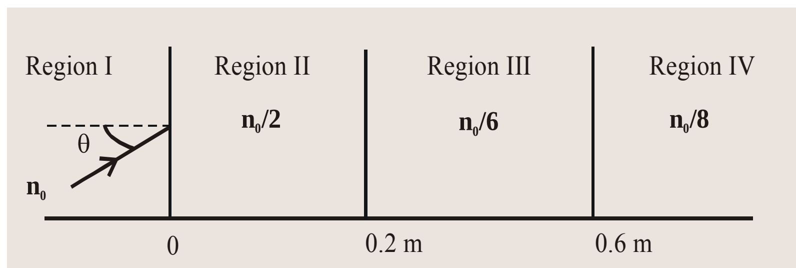
$$\rightarrow \quad r = \sin^{-1}\left[\frac{1}{n^2}\right]$$



Ans = (c)

Sol.21

Refraction through the multiple parallel media,



$n_1 \sin i_1 = n_2 \sin i_2 = n_3 \sin i_3 = n_4 \sin i_4 = \ldots.$

$$n_o \sin\theta_1 = \frac{n_o}{2}\sin\theta_2 = \frac{n_o}{6}\sin\theta_3 = \frac{n_o}{8}\sin 90$$

$n_o \sin\theta_1 = n_o/8$

$\rightarrow \theta_1 = \sin^{-1} \left[\frac{1}{8}\right]$

Ans = (b)

Sol.22

$$\text{Time} = \frac{thickness}{vel.} = \frac{t}{v}$$

$$\text{But} \quad n = \frac{c}{v} \quad \rightarrow v = \frac{c}{n}$$

$$\rightarrow \text{time} = \frac{nt}{c} = \frac{3t}{2c} \qquad | \; n = 1.5 = 3/2$$

Ans =(b)

Sol.23

RI of glass with respect to water is

$$\rightarrow n_g = \frac{5}{4}\ x\ n_w = \frac{5}{4}\ x \frac{4}{3} = \frac{5}{3}$$

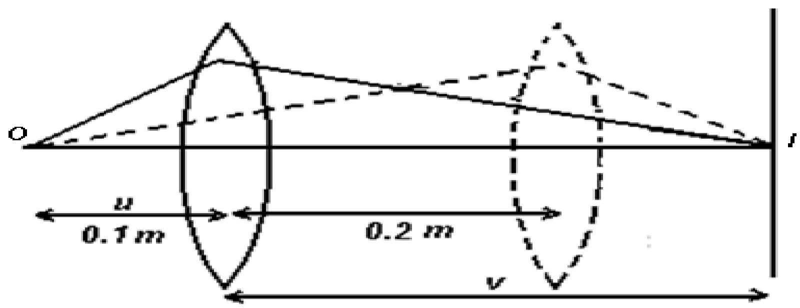
$${}_w n_g = \frac{n_g}{n_w} = \frac{v_w}{v_g} = \frac{\lambda_w}{\lambda_g} = \frac{5/m}{4/m} = \frac{5}{4}$$

| same number of waves occupied in 5cm of water and 4cm of glass

Ans = (a)

Sol.24

Here u = 0.1cm and v = 0.1 + 0.2 = 0.3cm



Therefore,

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

$$= \frac{1}{0.1} + \frac{1}{0.3}$$

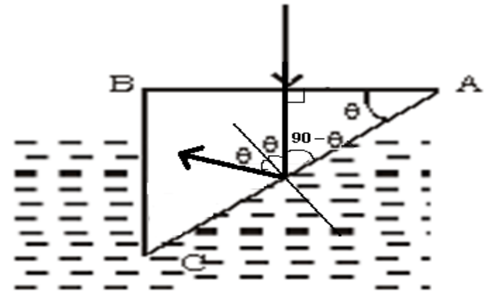
$$= \frac{3+1}{0.3} = \frac{4}{0.3}$$

$$\rightarrow f = \frac{0.3}{4} = 0.075m$$

Ans = (C)

Sol.25

From figure, for TIR



$$\sin\theta \geq \frac{1}{{}_w n_g} = \frac{n_w}{n_g} = \frac{4}{3} \, x \, \frac{2}{3} = \frac{8}{9}$$

$$\rightarrow \sin\theta \geq \frac{8}{9}$$

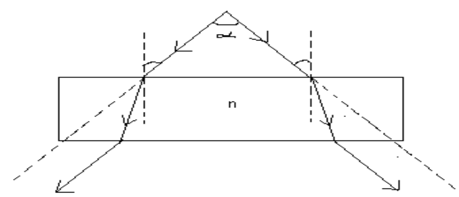
Ans = (a)

Sol.26

Only lateral shift take place and hence incident and emergent rays are parallel

→ divergent angle of emergent rays = α

Ans = (b)



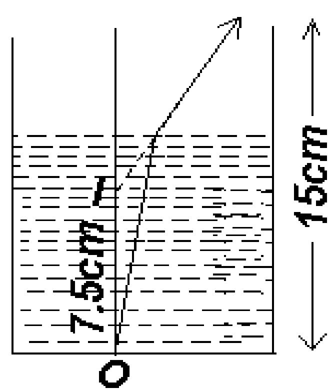
Sol.27

$$n = \frac{real\ depth}{apparent\ depth}$$

→ real depth = n x apparent de

$$= \frac{4}{3} \, x \, \frac{15}{2} = 10 \; cm$$

Ans = (d)

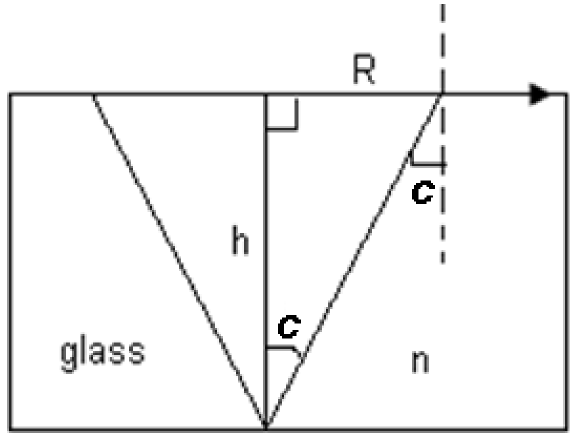


Sol.28

The radius of the circular area through which the light is passed is

$$\rightarrow \quad R = \frac{h}{\sqrt{(n^2-1)}}$$

$$\rightarrow \text{diameter} = 2R = \frac{2h}{\sqrt{(n^2-1)}}$$



Ans = (c)

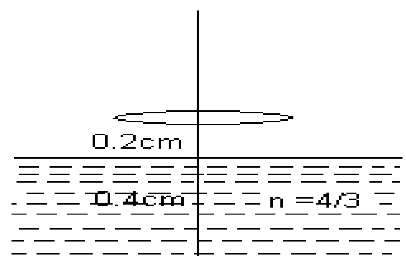
Sol.29

$$\text{A d} = \frac{r\,d}{n} = \frac{0.4}{4}\ x\ 3 = 0.3\ cm$$

Apparent distance of the fish from lens,

u = 0.3 + 0.2 =0.5cm

f =3 m



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

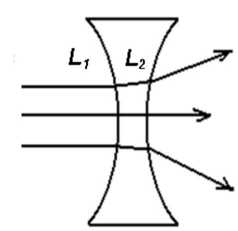
$$= = \frac{1}{3} - \frac{1}{0.5} = \frac{1-6}{3} = \frac{-5}{3}$$

$$\rightarrow V = \frac{-3}{5} = -0.6\,m$$

→**Ans = (a)**

Sol.30

Since lens acts as diverging lens, RI of material in the lens must be greater than that of the surrounding



Ans = (d)

Sol.31

Magnification,

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

$$or\ I = \frac{v}{u}\ x\ O$$

$$= \frac{2\ x\ 1.4\ x\ 10^9}{10^{11}}$$

$$= 2.8\ cm$$

Ans (c)

Sol.32

a d = 0.3 m

$n_w = 4/3$

$$_w n_a = \frac{r\,d}{a\,d}$$

$$\Rightarrow r\,d = {_w n_a} \times a\,d$$

$$= \frac{1}{n_w} \times a\,d$$

$$= \frac{3}{4} \times 0.3$$

$$= \frac{0.9}{4} = 0.225\ m$$

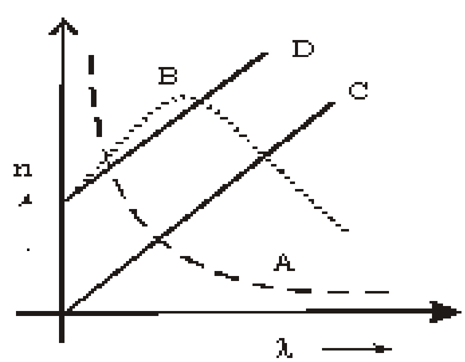
Ans = (a)

Sol.33

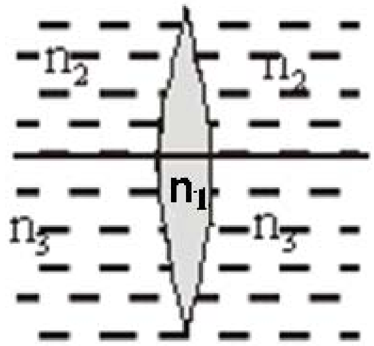
we known that

$$n = A + \frac{B}{\lambda^2}$$

Ans = (a)



Sol.34



In medium of RI n_2 lens acts as diverging lens

In medium of RI n_3 lens acts as converging lens

Ans = (d)

Sol.35

For convex lens $n > n_1$

For diverging lens $n < n_2$

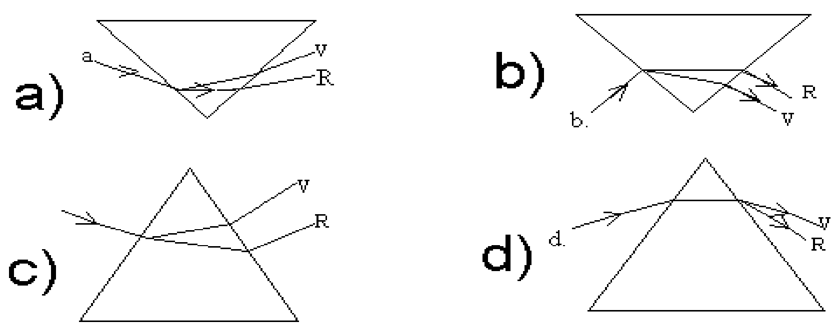
i.e. $n_2 > n > n_1$

Ans = (c)

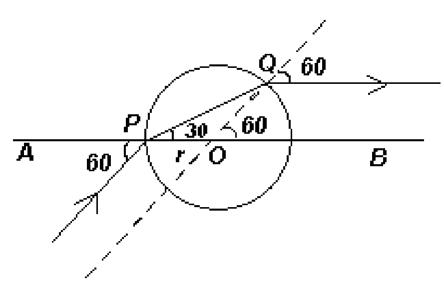
Sol.36

For the dispersion of light, light must incident on one refracting surface from the base side and emerges from other side.

Ans = (a)



Sol.37



From the symmetry of the figure,

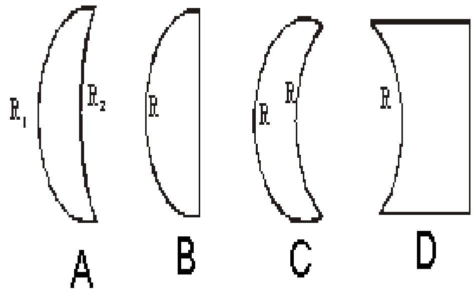
Angle of incidence $i = 60^\circ$

Angle of refraction $r = 30^\circ$

$$n = \frac{sini}{sinr} = \frac{sin60}{sin30} = \frac{\sqrt{3}}{2}x\frac{2}{1} = \sqrt{3}$$

Ans = (b)

Sol.38

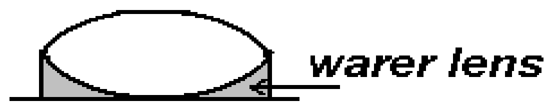


Fig(C) not acts as a lens. It is because radius of curvature of both surfaces are same but with opposite sign. From lens equation f = ∞

Ans = (c)

Sol.39

For water lens in air , r_1 = - 0.2m , $r_2 = \infty$ and n=4/3



$$\frac{1}{f} = \left(\frac{4}{3} - 1\right)\left(\frac{-1}{0.2}\right)$$

$$= \frac{-1}{3 \times 0.2}$$

$$f = -0.6m$$

Ans = (C)

Sol.40

n =$\sqrt{2}$.

$i_1 = r_1 = 0$

But $r_1 + r_2 = A = 30$

$\rightarrow r_2 = 30$

But

$$n = \frac{\sin i_2}{\sin r_2} = \frac{\sin i_2}{\sin 30}$$

$$\rightarrow \sin i_2 = n \times \sin 30$$

$$= \sqrt{2} \times \frac{1}{2} = \frac{1}{\sqrt{2}}$$

$$\rightarrow i_2 = 45$$

∴ d =0 + 45 - 30 = 15

Ans = (c)

Sol.41

For TIR, $i > C$

$\rightarrow \sin i > \sin C$

$\rightarrow \sin i > 1/n$

Or $n > 1/\sin i$

Ans = (c)

Sol.42

For TIR, $i > C$

$\rightarrow \sin i > \sin C$

$\rightarrow \sin i > 1/n$

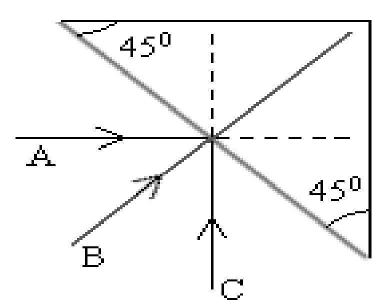
Or $n > 1/\sin i$

$n > 1/\sin 45$

$n > \sqrt{2} = 1.41$

Ans = (d)

Sol.43



Since the rays A and C bends towards normal and angle of incidence for the second face is less than C.

Ans = (b)

Sol.44

The glass and the liquid have the same refractive index so that refraction through both glass and liquid is same

Ans = (b)

Sol.45

d= $i_1 + i_2 - A$ is maximum if i_1 or i_2 is maximum.

i.e. ray incident grazing the surface or ray emerges grazing the surface suffers maximum deviation

Ans = (c)

Sol.46

$$n = \cot\frac{A}{2}$$

$$n = \frac{\sin\frac{A+D}{2}}{\sin\frac{A}{2}}$$

$$\rightarrow \sin\frac{A+D}{2} = n \ x \sin\frac{A}{2}$$

$$= \cot\frac{A}{2} \ x \sin\frac{A}{2}$$

$$= \frac{\cos\frac{A}{2}}{\sin\frac{A}{2}} \ x \sin\frac{A}{2} = \sin\left[\frac{\Pi}{2} - \frac{A}{2}\right]$$

$$A + D = \Pi - A$$

$$D = \Pi - 2A$$

Ans = (a)

Sol.47

same length 't' occupied x no. of waves in medium-1 and y no. of waves in medium-2

$${}_1n_2 = \frac{\lambda_1}{\lambda_2} = \frac{t/x}{t/y} = \frac{y}{x}$$

→ **Ans = (d)**

Sol.48

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

$$\rightarrow v = m\,u$$

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

$$\rightarrow \frac{1}{u} + \frac{1}{mu} = \frac{1}{f}$$

$$\rightarrow \frac{1}{u}\left(1 + \frac{1}{m}\right) = \frac{1}{f}$$

$$\rightarrow u = \left(1 + \frac{1}{m}\right) f = f\,\frac{(m+1)}{m}$$

Ans = (a)

Sol.49

For the combination of the lenses

$$\frac{1}{f_1} + \frac{1}{f_2} = \frac{1}{f}$$

Since the combination acts as convex lens f is positive

$$\frac{1}{f_1} > \frac{1}{f_2}$$

Therefore from above equation

Ans = (c)

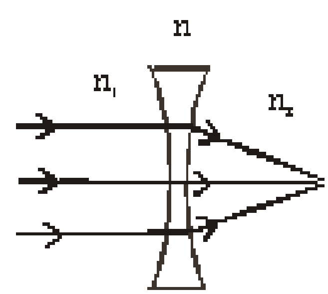
Sol.50

Rays are not deviated at the first face

Therefore $n_1 = n$

At the second face converging rays show that $n < n_2$

i.e. $n_1 = n < n_2$



Ans = (a)

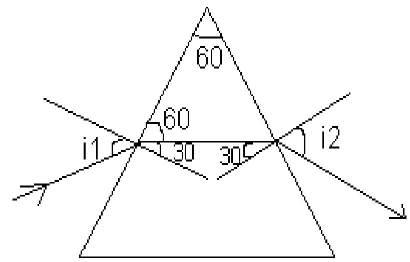
Sol.51

In minimum deviation position for equilateral prism,

$r_1 + r_2 = 60^\circ$

$2r = 60^\circ$ or $r = 30^\circ$

for any colour.



Ans (a)

Sol.52

The emergent ray is parallel to the incident ray and only displacement occurs. Also displacement is very small as thickness of glass is very small

Ans (c)

Sol.53

$$\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$$
$$= \frac{1}{2} + \frac{1}{0.1}$$
$$= \frac{1+20}{2} = \frac{21}{2}$$
$$\rightarrow f = \frac{2}{21} = 0.095\ m = 9.5\ cm$$

Ans =(b)

Sol.54

$$\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2} = \frac{2}{0.2}$$
$$f = \frac{0.4}{2} = 0.2\ m$$

Magnification = $m = \frac{v}{u} = 1$

i.e. v = u = 2f = 2 x 0.2 = 0.4 m

Ans = (b)

Sol.55

t/v = time taken by light to cover distance t in a medium

Distance traveled by light in air = n x distance travelled by it in a medium

= n x t = nt

Ans = (a)

Sol.56

F= 20cm , n = 1.5 ,

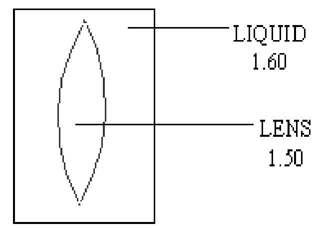
In air, $\frac{1}{f} = (n-1)\left[\frac{1}{r1} + \frac{1}{r_2}\right]$

In liquid, $\frac{1}{f'} = \left(\frac{n}{n_l} - 1\right)\left[\frac{1}{r1} + \frac{1}{r_2}\right]$

$$\frac{f'}{f} = \frac{(n-1)}{(n-n_l)} \times n_l$$

$$f' = \frac{0.5}{-0.1} \times 1.66 \times 20 = -160cm$$

$n_l = 1.6$



Ans = (d)

Sol.57

$$n_w = \frac{c}{v} = \frac{\lambda a}{\lambda w}$$

$$\lambda w = \frac{\lambda a}{n_w} = \frac{500}{4/3} = 125 \times 3 = 375 \text{ nm}$$

Colour of the light not changes when it pass from one medium to another

Ans = (c)

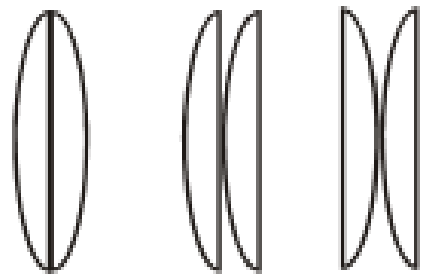
Sol.58

The equivalent focal length of the combination is

$$\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}$$

Which is same for all combinations of lens.

Ans = (b)

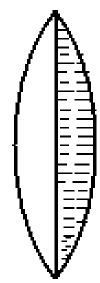


Sol.59

It is like a combination of two Plano – convex lenses.

Therefore only one image is formed.

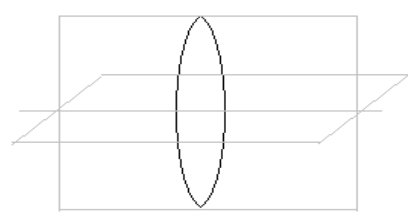
Ans = (a)



Sol.60

focal length of pieces of lens not changed as radii of curvature of lens not changed

Ans (b)



Sol.61

Focal length not changes as radius of curvature of faces not changed

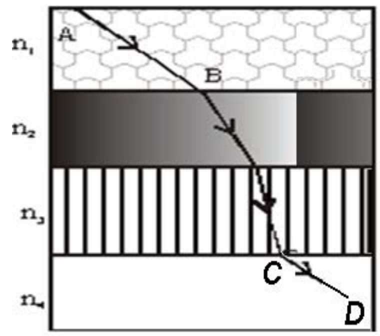
Area of lens exposed to the light = 3A/4

[$A=\pi d^2/4$ new area $A^1 = (A - \pi(d/2)^2/4) = A - A/4 = 3A/4$]

►Intensity of light =3I/4

Ans (d)

Sol.62



For refraction through the multiple parallel media,

$n_1\sin i_1 = n_2\sin i_2 = n_3\sin i_3 = n_4\sin i_1$

$\rightarrow n_1 = n_4$

Ans = (d)

Sol.63

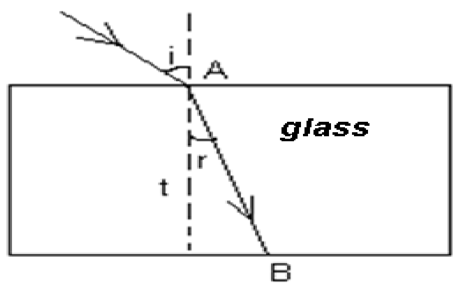
Dispersive power is defined for a medium, and it is independent of the shape of the medium.

Ans= (d)

Sol.64

In figure $\cos r = \frac{t}{AB}$

$\rightarrow AB = \frac{t}{\cos r}$



Ans = (c)