GEOMETRICAL OPTICS

1. The focal length f is related to the radius of curvature r of the spherical convex mirror by:

(1) $f = +\frac{1}{2}r$ (2) $f = -r$

(3) $f = -\frac{1}{2}r$ (4) $f = r$

2. The same size images are formed by a convex lens when the object is placed at 20cm or at 10cm from the lens. The focal length of convex lens is _____ cm.

3. A short straight object of height 100 cm lies before the central axis of a spherical mirror whose focal length has absolute value $|f| = 40$cm. The image of object produced by the mirror is of height 25 cm and has the same orientation of the object. One may conclude from the information :

(1) Image is real, same side of concave mirror.
(2) Image is virtual, opposite side of concave mirror.
(3) Image is real, same side of convex mirror.
(4) Image is virtual, opposite side of convex mirror.

4. Given below are two statements : one is labelled as Assertion A and the other is labelled as Reason R.

Assertion A : For a simple microscope, the angular size of the object equals the angular size of the image.

Reason R : Magnification is achieved as the small object can be kept much closer to the eye than 25 cm and hence it subtends a large angle.

In the light of the above statements, choose the most appropriate answer from the options given below :

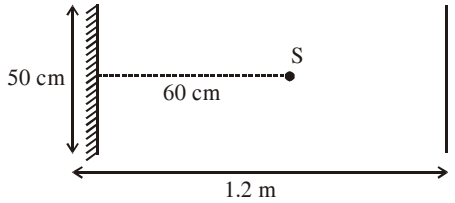
(1) A is true but R is false
(2) Both A and R are true but R is NOT the correct explanation of A.
(3) Both A and R are true and R is the correct explanation of A
(4) A is false but R is true

5. The incident ray, reflected ray and the outward drawn normal are denoted by the unit vectors $\vec{a}$, $\vec{b}$ and $\vec{c}$ respectively. Then choose the correct relation for these vectors.

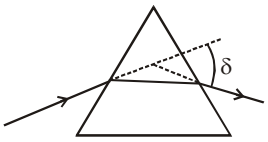
(1) $\vec{b} = \vec{a} + 2\vec{c}$ (2) $\vec{b} = 2\vec{a} + \vec{c}$

(3) $\vec{b} = \vec{a} - 2(\vec{a}.\vec{c})\vec{c}$ (4) $\vec{b} = \vec{a} - \vec{c}$

6. A point source of light S, placed at a distance 60 cm infront of the centre of a plane mirror of width 50 cm, hangs vertically on a wall. A man walks infront of the mirror along a line parallel to the mirror at a distance 1.2 m from it (see in the figure). The distance between the extreme points where he can see the image of the light source in the mirror is ..... cm.



7. The angle of deviation through a prism is minimum when



(A) Incident ray and emergent ray are symmetric to the prism
(B) The refracted ray inside the prism becomes parallel to its base
(C) Angle of incidence is equal to that of the angle of emergence
(D) When angle of emergence is double the angle of incidence

Choose the correct answer from the options given below :

(1) Statements (A), (B) and (C) are true
(2) Only statement (D) is true
(3) Only statements (A) and (B) are true
(4) Statements (B) and (C) are true

8. The refractive index of a converging lens is 1.4. What will be the focal length of this lens if it is placed in a medium of same refractive index ? (Assume the radii of curvature of the faces of lens are R_1 and R_2 respectively)

(1) 1 (2) Infinite

(3) $\frac{R_1R_2}{R_1 - R_2}$ (4) Zero

9. Red light differs from blue light as they have :

(1) Different frequencies and different wavelengths
(2) Different frequencies and same wavelengths
(3) Same frequencies and same wavelengths
(4) Same frequencies and different wavelengths

10. A deviation of 2° is produced in the yellow ray when prism of crown and flint glass are achromatically combined. Taking dispersive powers of crown and flint glass are 0.02 and 0.03 respectively and refractive index for yellow light for these glasses are 1.5 and 1.6 respectively. The refracting angles for crown glass prism will be _____° (in degree) (Round off to the Nearest Integer)

11. The thickness at the centre of a plano convex lens is 3 mm and the diameter is 6 cm. If the speed of light in the material of the lens is 2×10^8 ms^{-1}. The focal length of the lens is _____.

(1) 0.30 cm (2) 15 cm
(3) 1.5 cm (4) 30 cm

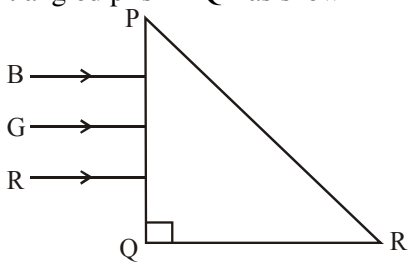
12. The radius in kilometer to which the present radius of earth (R = 6400 km) to be compressed so that the escape velocity is increased 10 time is _____.

13. The image of an object placed in air formed by a convex refracting surface is at a distance of 10 m behind the surface. The image is real and is at of the distance of the object from the surface $\frac{2^{rd}}{3}$.The wavelength of light inside the surface is $\frac{2}{3}$ times the wavelength in air. The radius of the curved surface is $\frac{x}{13}$m. the value of 'x' is_____.

14. Your friend is having eye sight problem. She is not able to see clearly a distant uniform window mesh and it appears to her as non-uniform and distorted. The doctor diagnosed the problem as :

(1) Astigmatism
(2) Myopia with Astigmatism
(3) Presbyopia with Astigmatism
(4) Myopia and hypermetropia

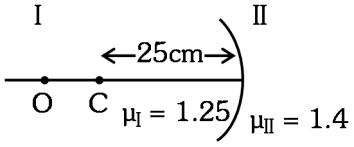
15. Three rays of light, namely red (R), green (G) and blue (B) are incident on the face PQ of a right angled prism PQR as shown in figure.



The refractive indices of the material of the prism for red, green and blue wavelength are 1.27, 1.42 and 1.49 respectively. The colour of the ray(s) emerging out of the face PR is :

(1) green (2) red
(3) blue and green (4) blue

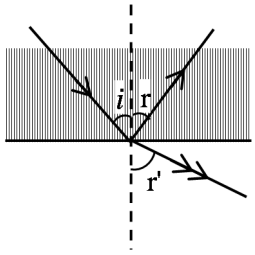
16. Region I and II are separated by a spherical surface of radius 25 cm. An object is kept in region I at a distance of 40 cm from the surface. The distance of the image from the surface is :



(1) 55.44 cm (2) 9.52 cm
(3) 18.23 cm (4) 37.58 cm

17. An object viewed from a near point distance of 25 cm, using a microscopic lens with magnification '6', gives an unresolved image. A resolved image is observed at infinite distance with a total magnification double the earlier using an eyepiece along with the given lens and a tube of length 0.6 m, if the focal length of the eyepiece is equal to _____ cm.

18. A ray of light passes from a denser medium to a rarer medium at an angle of incidence *i*. The reflected and refracted rays make an angle of 90° with each other. The angle of reflection and refraction are respectively r and r'. The critical angle is given by :



(1) $\sin^{-1}$ (cotr) (2) $\tan^{-1}$ (sin*i*)
(3) $\sin^{-1}$ (tanr') (4) $\sin^{-1}$ (tanr)

19. A ray of light passing through a prism ($\mu = \sqrt{3}$) suffers minimum deviation. It is found that the angle of incidence is double the angle of refraction within the prism. Then, the angle of prism is _____ (in degrees)

20. A ray of laser of a wavelength 630 nm is incident at an angle of 30° at the diamond-air interface. It is going from diamond to air. The refractive index of diamond is 2.42 and that of air is 1. Choose the correct option.

(1) angle of refraction is 24.41°

(2) angle of refraction is 30°

(3) refraction is not possible

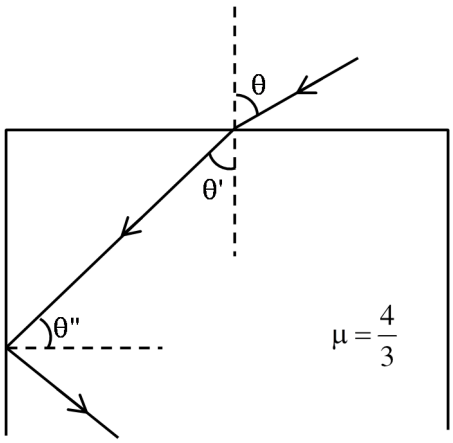
(4) angle of refraction is 53.4°

21. A prism of refractive index μ and angle of prism A is placed in the position of minimum angle of deviation. If minimum angle of deviation is also A, then in terms of refractive index :

(1) $2\cos^{-1}\left(\frac{\mu}{2}\right)$ (2) $\sin^{-1}\left(\frac{\mu}{2}\right)$

(3) $\sin^{-1}\left(\sqrt{\frac{\mu-1}{2}}\right)$ (4) $\cos^{-1}\left(\frac{\mu}{2}\right)$

22. A ray of light entering from air into a denser medium of refractive index $\frac{4}{3}$, as shown in figure. The light ray suffers total internal reflection at the adjacent surface as shown. The maximum value of angle θ should be equal to :

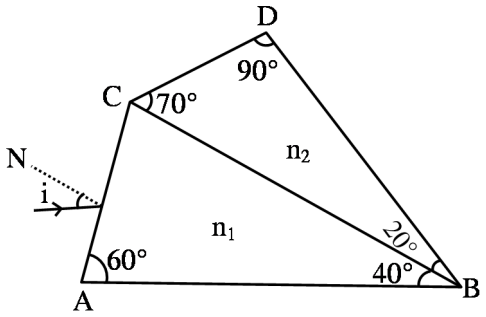


(1) $\sin^{-1}\frac{\sqrt{7}}{3}$ (2) $\sin^{-1}\frac{\sqrt{5}}{4}$

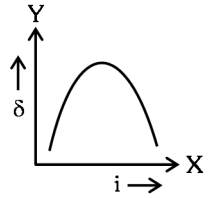
(3) $\sin^{-1}\frac{\sqrt{7}}{4}$ (4) $\sin^{-1}\frac{\sqrt{5}}{3}$

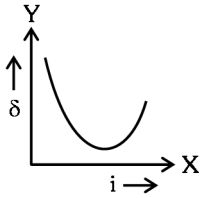
23. A prism of refractive index n_1 and another prism of refractive index n_2 are stuck together (as shown in the figure). n_1 and n_2 depend on λ, the wavelength of light, according to the relation $n_1 = 1.2 + \frac{10.8\times10^{-14}}{\lambda^2}$ and $n_2 = 1.45 + \frac{1.8\times10^{-14}}{\lambda^2}$

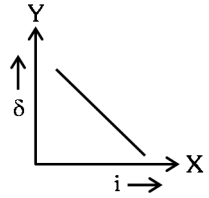
The wavelength for which rays incident at any angle on the interface BC pass through without bending at that interface will be _____ nm.

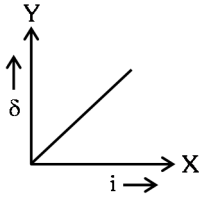


24. The expected graphical representation of the variation of angle of deviation 'δ' with angle of incidence 'i' in a prism is :

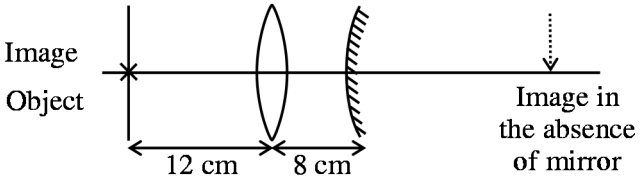
(1)


(2)


(3)


(4)


25. An object is placed at a distance of 12 cm from a convex lens. A convex mirror of focal length 15 cm is placed on other side of lens at 8 cm as shown in the figure. Image of object coincides with the object. When the convex mirror is removed, a real and inverted image is formed at a position. The distance of the image from the object will be .....(cm)

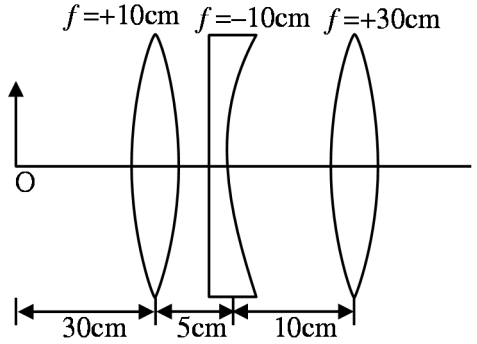


26. An object is placed beyond the centre of curvature C of the given concave mirror. If the distance of the object is d_1 from C and the distance of the image formed is d_2 from C, the radius of curvature of this mirror is :

(1) $\frac{2d_1d_2}{d_1 - d_2}$ (2) $\frac{2d_1d_2}{d_1 + d_2}$

(3) $\frac{d_1d_2}{d_1 + d_2}$ (4) $\frac{d_1d_2}{d_1 - d_2}$

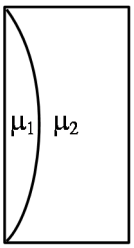
27. Find the distance of the image from object O, formed by the combination of lenses in the figure :



(1) 75 cm (2) 10 cm

(3) 20 cm (4) infinity

28. Curved surfaces of a plano-convex lens of refractive index μ_1 and a plano-concave lens of refractive index μ_2 have equal radius of curvature as shown in figure. Find the ratio of radius of curvature to the focal length of the combined lenses.



(1) $\frac{1}{\mu_2 - \mu_1}$ (2) $\mu_1 - \mu_2$

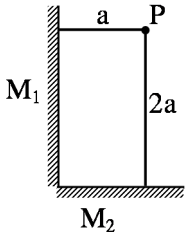
(3) $\frac{1}{\mu_1 - \mu_2}$ (4) $\mu_2 - \mu_1$

29. An object is placed at the focus of concave lens having focal length *f*. What is the magnification and distance of the image from the optical centre of the lens?

(1) 1, ∞ (2) Very high, ∞

(3) $\frac{1}{2}, \frac{f}{2}$ (4) $\frac{1}{4}, \frac{f}{4}$

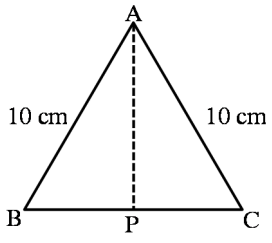
30. Two plane mirrors M_1 and M_2 are at right angle to each other shown. A point source 'P' is placed at 'a' and '2a' meter away from M_1 and M_2 respectively. The shortest distance between the images thus formed is : (Take $\sqrt{5}$ = 2.3)



(1) 3a (2) 4.6 a

(3) 2.3 a (4) $2\sqrt{10}$ a

31. Cross–section view of a prism is the equilateral triangle ABC in the figure. The minimum deviation is observed using this prism when the angle of incidence is equal to the prism angle. The time taken by light to travel from P (midpoint of BC) to A is_____ × 10^{-10} s. (Given, speed of light in vacuum = 3 × 10^8 m/s and cos30° = $\frac{\sqrt{3}}{2}$)



32. Car B overtakes another car A at a relative speed of 40 ms^{-1}. How fast will the image of car B appear to move in the mirror of focal length 10 cm fitted in car A, when the car B is 1.9 m away from the car A?

(1) 4 ms^{-1} (2) 0.2 ms^{-1}

(3) 40 ms^{-1} (4) 0.1 ms^{-1}

33. A glass tumbler having inner depth of 17.5 cm is kept on a table. A student starts pouring water (μ = 4/3) into it while looking at the surface of water from the above. When he feels that the tumbler is half filled, he stops pouring water. Up to what height, the tumbler is actually filled ?

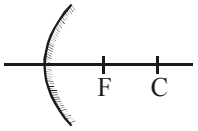
(1) 11.7 cm (2) 10 cm

(3) 7.5 cm (4) 8.75 cm

SOLUTION

1. Official Ans. by NTA (1)

Sol. For convex mirror, focus is behind the mirror.



$\Rightarrow f = +\frac{r}{2}$

2. Official Ans. by NTA (15)

Sol. $m = \frac{f}{u+f}$

$+ m = \frac{f}{-10+f}$ ... (1)

$- m = \frac{f}{-20+f}$ ... (2)

(1) / (2)

$-1 = \frac{f-20}{f-10}$

$10 - f = f - 20$

$30 = 2f$

$f = 15$ cm

3. Official Ans. by NTA (4)

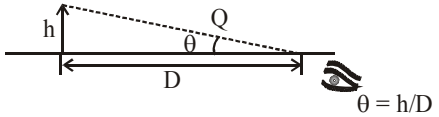
Sol. Since orientation is same image is virtual. Since image is smaller the mirror has to be convex

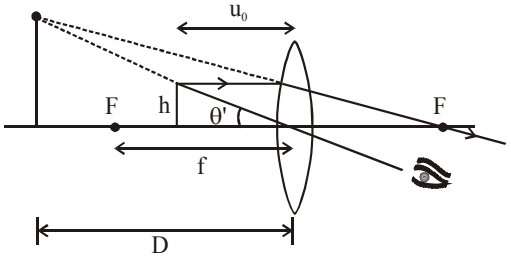
Ans. (4)

4. Official Ans. by NTA (3)

Allen Ans. (2)

Sol.





$\theta' = \frac{h}{u_0}$; θ' is same for both object and image

$m = \frac{\theta'}{\theta} = \frac{D}{\mu_0}$

$u_0 < D$

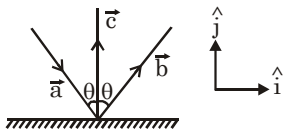
Hence $m > 1$

5. Official Ans. by NTA (3)

Sol. $\vec{a} = \sin\theta\hat{i} - \cos\theta\hat{j}$

$\vec{b} = \sin\theta\hat{i} + \cos\theta\hat{j}$

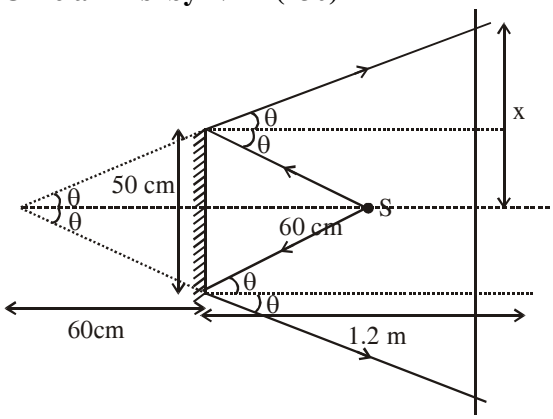
$\vec{c} = \hat{j}$



$\vec{a} - 2(\vec{a}.\vec{c})\vec{c} = \sin\theta\hat{i} + \cos\theta\hat{j}$

6. Official Ans. by NTA (150)

Sol.



$\tan\theta = \frac{25}{60} = \frac{x}{180}$

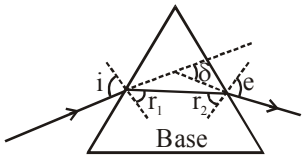
$x = 75$ cm

so distance between extreme point = $2x = 2 \times 75 = 150$ cm

7. Official Ans. by NTA (1)

Sol. Deviation is minimum in a prism when :

$i = e$, $r_1 = r_2$ and ray (2) is parallel to base of prism.



8. Official Ans. by NTA (2)

Sol. $\frac{1}{F} = \left[\frac{\mu_L}{\mu_S} - 1\right]\left[\frac{1}{R_1} - \frac{1}{R_2}\right]$

If $\mu_L = \mu_S \Rightarrow \frac{1}{F} = 0 \Rightarrow F = \infty$

9. Official Ans. by NTA (1)

Sol. Red light and blue light have different wavelength and different frequency.

10. Official Ans. by NTA (12)

Sol. Ans. (12)

$\omega_1 = 0.02$; $\mu_1 = 1.5$; $\omega_2 = 0.03$; $\mu_2 = 1.6$

Achromatic combination

$\therefore \theta_{net} = 0$

$\theta_1 - \theta_2 = 0$

$\theta_1 = \theta_2$

$\omega_1 \delta_1 = \omega_2 \delta_2$

& $\delta_{net} = \delta_1 - \delta_2 = 2°$

$$\delta_1 - \frac{\omega_1 \delta_1}{\omega_2} = 2°$$

$$\delta_1 \left(1 - \frac{\omega_1}{\omega_2}\right) = 2°$$

$$\delta_1 \left(1 - \frac{2}{3}\right) = 2°$$

$\delta_1 = 6°$

$\delta_1 = (\mu_1 - 1)\, A_1$

$6° = (1.5 - 1)\, A_1$

$A_1 = 12°$

11. Official Ans. by NTA (4)

Sol. $R^2 = r^2 + (R - t)^2$

$R^2 = r^2 + R^2 + t^2 - 2Rt$

Neglecting t^2, we get

$$R = \frac{r^2}{2t}$$

$$\therefore \frac{1}{f} = (\mu - 1)\left(\frac{1}{R} - \frac{1}{\infty}\right) = \frac{\mu - 1}{R}$$

$$f = \frac{R}{\mu - 1} = \frac{r^2}{2t(\mu - 1)} = \frac{(3\times10^{-2})^2}{2\times3\times10^{-3}\times\left(\frac{3}{2} - 1\right)}$$

$$= \frac{9\times10^{-4}}{6\times10^{-3}\times1} \times 2$$

$f = 0.3$ m $= 30$ cm

12. Official Ans. by NTA (64)

Sol. $$V_e = \sqrt{\frac{2Gm}{R}} \quad \text{.... (1)}$$

$$10V_e = \sqrt{\frac{2Gm}{R'}} \quad \text{... (2)}$$

$$\therefore 10 = \sqrt{\frac{R}{R'}}$$

$$\Rightarrow R' = \frac{R}{100} = \frac{6400}{100} = 64 \text{ km}$$

13. Official Ans. by NTA (30)

Sol. $$\lambda_m = \frac{\lambda_a}{\mu} \Rightarrow \mu = \frac{3}{2}$$

$$\frac{\mu}{v} - \frac{1}{u} = \frac{\mu - 1}{R}$$

$$\frac{3}{2\times10} + \frac{1}{15} = \frac{\frac{3}{2} - 1}{R}$$

$$R = \frac{30}{13} = 30$$

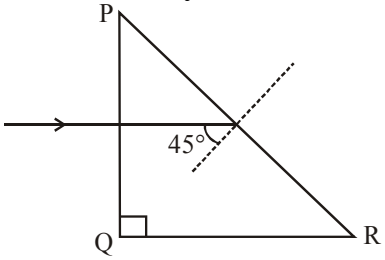
14. Official Ans. by NTA (2)

Sol. If distant objects are blurry then problem is Myopia.

If objects are distorted then problem is Astigmatism

15. Official Ans. by NTA (2)

Sol.



Assuming that the right angled prism is an isoceles prism, so the other angles will be 45° each.

$\Rightarrow$ Each incident ray will make an angle of 45° with the normal at face PR.

$\Rightarrow$ The wavelength corresponding to which the incidence angle is less than the critical angle, will pass through PR.

$\Rightarrow \theta_C$ = critical angle

$$\Rightarrow \theta_C = \sin^{-1}\left(\frac{1}{\mu}\right)$$

$\Rightarrow$ If $\theta_C \geq 45°$

the light ray will pass

$$\Rightarrow (\theta_C)_{Red} = \sin^{-1}\left(\frac{1}{1.27}\right) = 51.94°$$

Red will pass.

$$\Rightarrow (\theta_C)_{Green} = \sin^{-1}\left(\frac{1}{1.42}\right) = 44.76°$$

Green will not pass

$$\Rightarrow (\theta_C)_{Blue} = \sin^{-1}\left(\frac{1}{1.49}\right) = 42.15°$$

Blue will not pass

$\Rightarrow$ So only red will pass through PR.

16. Official Ans. by NTA (4)

Sol. $\frac{\mu_2}{v}-\frac{\mu_1}{u}=\frac{\mu_2-\mu_1}{R}$

$\frac{1.4}{v}-\frac{1.25}{-40}=\frac{1.4-1.25}{-25}$

$\frac{1.4}{v}=-\frac{0.15}{25}-\frac{1.25}{40}$

$v = -37.58$ cm

Hence option (4)

17. Official Ans. by NTA (25)

Sol. For simple microscope,

$m=1+\frac{D}{f_0}$

$6=1+\frac{D}{f_0}$

$5=\frac{25}{f_0}$

$f_0 = 5$ cm

For compound microscope,

$m=\frac{\ell\cdot D}{f_0\cdot f_e}$

$12=\frac{60\times 25}{5\cdot f_e}$

$f_e = 25$ cm

18. Official Ans. by NTA (4)

Sol. $r + r' + 90° = 180° \Rightarrow r' = 90 - r = 90 - i$

$n_1 \sin i = n_2 \sin r' = n_2 \sin (90 - i)$

$n_1 \sin i = n_2 \cos i \Rightarrow \tan i = \frac{n_2}{n_1}$

Now $\sin C = \frac{n_2}{n_1} = \tan i$

$\Rightarrow C = \sin^{-1}(\tan i) = \sin^{-1}(\tan r)$

19. Official Ans. by NTA (60)

Sol. At minimum deviation $r_1 = r_2 = \frac{A}{2}$

Also given $i = 2r_1 = A$

Now $1.\sin i = \sqrt{3}\sin r_1$

$1\sin A = \sqrt{3}\sin\frac{A}{2}$

$\Rightarrow \quad 2\sin\frac{A}{2}\cos\frac{A}{2}=\sqrt{3}\sin\frac{A}{2}$

$\Rightarrow \quad \cos\frac{A}{2}=\frac{\sqrt{3}}{2}\Rightarrow\frac{A}{2}=30°$

$\Rightarrow \quad A = 60°$

20. Official Ans. by NTA (3)

Sol. $\sin\theta_C=\frac{1}{\mu}=\frac{1}{2\mu_2}<\sin\theta_C$

$\sin\theta > \sin\theta_C$

$\theta > \theta_C$

Total internal reflection will happen

21. Official Ans. by NTA (1)

Sol. $\mu=\frac{\sin\left(\frac{A+\delta_{min}}{2}\right)}{\sin\left(\frac{A}{2}\right)}$

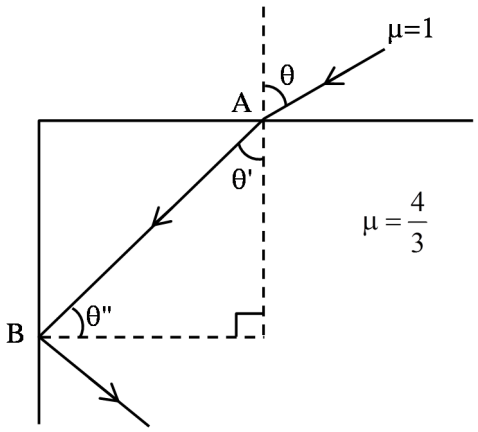
$\mu=\frac{\sin\left(\frac{A+A}{2}\right)}{\sin\left(\frac{A}{2}\right)}$

$\mu=\frac{\sin A}{\sin\frac{A}{2}}=2\cos\frac{A}{2}$

$A=2\cos^{-1}\left(\frac{\mu}{2}\right)$

22. Official Ans. by NTA (1)

Sol.



At maximum angle θ ray at point B goes in gazing emergence, at all less values of θ, TIR occurs.

At point B

$$\frac{4}{3}\times\sin\theta'' = 1\times\sin 90°$$

$$\theta'' = \sin^{-1}\left(\frac{3}{4}\right)$$

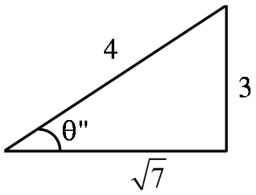
$$\theta' = \left(\frac{\pi}{2}-\theta''\right)$$

At point A

$$1\times\sin\theta = \frac{4}{3}\times\sin\theta'$$

$$\sin\theta = \frac{4}{3}\times\sin\left(\frac{\pi}{2}-\theta''\right)$$

$$\sin\theta = \frac{4}{3}\cos\left[\cos^{-1}\frac{\sqrt{7}}{4}\right]$$



$$\sin\theta = \frac{4}{3}\times\frac{\sqrt{7}}{4}$$

$$\theta = \sin^{-1}\left(\frac{\sqrt{7}}{3}\right)$$

23. Official Ans. by NTA (600)

Sol. For no bending, $n_1 = n_2$

$$1.2+\frac{10.8\times10^{-14}}{\lambda^2} = 1.45+\frac{1.8\times10^{-4}}{\lambda^2}$$

On solving,

$9\times10^{-14} = 25\,\lambda^2$

$\lambda = 6\times10^{-7}$

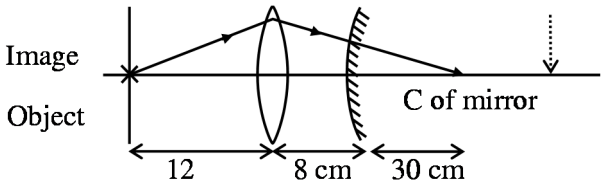
$\lambda = 600$ nm

24. Official Ans. by NTA (2)

Sol. Standard graph between angle of deviation and incident angle.

25. Official Ans. by NTA (50)

Sol.



For the object to coincide with image, the light must fall perpendicularly to mirror. Which means that the light will have to converge at C of mirror.

Without the mirror also, the light would coverage at C.

So the distance is : 12 + 8 + 30 = 50 cm

26. Official Ans. by NTA (1)

Sol. Using Newton"s formula

$$(f+d_1)(f-d_2) = f^2$$

$$f^2 + fd_1 - fd_2 - d_1d_2 = f^2$$

$$f = \frac{d_1d_2}{d_1-d_2} \quad \therefore R = \frac{2d_1d_2}{d_1-d_2}$$

27. Official Ans. by NTA (1)

Sol. $\frac{1}{V_1}+\frac{1}{30}=\frac{1}{10}$

$$\frac{1}{V_1}=\frac{2}{30} \Rightarrow V_1 = 15 \text{ cm}$$

$$\frac{1}{V_2}-\frac{1}{10}=-\frac{1}{10}$$

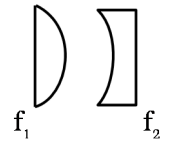
$$\frac{1}{V_2}=0 \quad V_2=\infty$$

$V_3 = 30$ cm

$OV_3 = 75$ cm

28. Official Ans. by NTA (2)

Sol.



$$\frac{1}{f_1}=(\mu_1-1)\left(\frac{1}{R}\right)$$

$$\frac{1}{f_2}=(\mu_2-1)\left(-\frac{1}{R}\right)$$

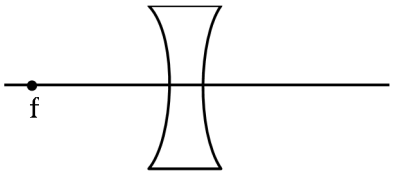
$$\frac{1}{f_1}+\frac{1}{f_2}=\frac{1}{f_{eq}}=\frac{(\mu_1-1)-(\mu_2-1)}{R}$$

$$\frac{1}{f_{eq}}=\frac{(\mu_1-\mu_2)}{R}$$

$$\frac{R}{f_{eq}}=(\mu_1-\mu_2)$$

29. Official Ans. by NTA (3)

Sol.



$U=-f$

$$\frac{1}{V}-\frac{1}{U}=\frac{1}{-f}\Rightarrow\frac{1}{V}=-\frac{2}{f}$$

$$V=\frac{-f}{2}$$

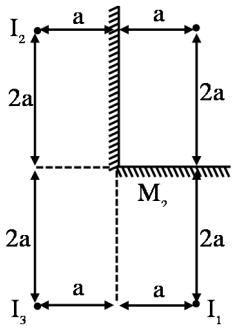
$$m=\frac{V}{U}=\frac{1}{2}$$

$$\text{distance}=\frac{f}{2}$$

Option (3)

30. Official Ans. by NTA (2)

Sol.



Shortest distance is 2a between I_1 & I_3

But answer given is for I_1 & I_2

$$\sqrt{(4a)^2+(2a)^2}$$

$a\sqrt{20}$; 4.47 a

Option (2)

31. Official Ans. by NTA (5)

Sol. $i = A = 60°$

$\underline{\delta}_{min} = 2i - A$

$= 2 \times 60° - 60° = 60°$

$$\mu=\frac{\sin^{-1}\left(\frac{\delta_{min}+A}{2}\right)}{\sin^{-1}\left(\frac{A}{2}\right)}=\sqrt{3}$$

$$V_{prism}=\frac{3\times10^8}{\sqrt{3}}$$

$$AP=10\times10^{-2}\times\frac{\sqrt{3}}{2}$$

$$\text{time}=\frac{5\times10^{-2}}{3\times10^8}\times\sqrt{3}\times\sqrt{3}$$

$= 5 \times 10^{-10}$ sec Ans = 5

32. Official Ans. by NTA (4)

Sol.

Mirror used is convex mirror (rear-view mirror)

$\therefore V_{I/m}=-m^2V_{O/m}$

Given,

$V_{O/m}=40m/s$

$$m=\frac{f}{f-u}=\frac{10}{10+190}=\frac{10}{200}$$

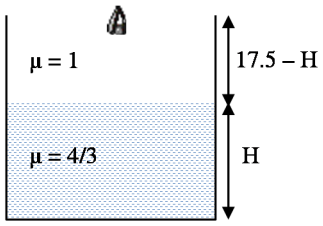
$$\therefore V_{I/m}=-\frac{1}{400}\times40=-0.1m/s$$

$\therefore$ Car will appear to move with speed 0.1 m/s.

Hence option (4)

33. Official Ans. by NTA (2)

Sol.



Height of water observed by observer

$$=\frac{H}{\mu_w}=\frac{H}{(4/3)}=\frac{3H}{4}$$

Height of air observed by observer = 17.5 – H

According to question, both height observed by observer is same.

$$\frac{3H}{4}=17.5-H$$

$\Rightarrow H = 10$ cm

Option (2)