DPP - Daily Practice Problems

Chapter-wise Sheets

Date : Start Time : End Time :

PHYSICS CP23

SYLLABUS : Ray Optics and Optical Instruments

Max. Marks : 180 **Marking Scheme :** (+4) for correct & (–1) for incorrect answer **Time : 60 min.**

INSTRUCTIONS : This Daily Practice Problem Sheet contains 45 MCQs. For each question only one option is correct. Darken the correct circle/ bubble in the Response Grid provided on each page.

1. A double convex lens is made of glass which has its refractive index 1.45 for violet rays and 1.50 for red rays. If the focal length for violet ray is 20cm, the focal length for red ray will be

(a) 9 cm (b) 18 cm (c) 20 cm (d) 22 cm

2. If the refractive index of the material of a prism is $\cot\frac{A}{2}$ and the angle of prism is A, then angle of minimum deviation is

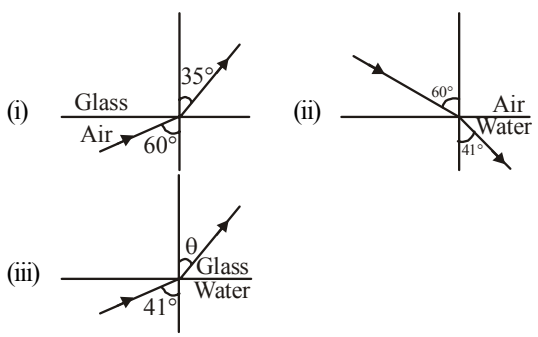
(a) $\pi - 2A$ (b) $\pi - A$ (c) $\frac{\pi}{2} - 2A$ (d) $\frac{\pi}{2} - A$

3. If two + 5 diopter lenses are mounted at some distance apart, the equivalent power will always be negative if the distance is

(a) greater than 40 cm (b) equal to 40 cm

(c) equal to 10 cm (d) less than 10 cm

4. Refraction of light from air to glass and from air to water are shown in figure (i) and figure (ii) below. The value of the angle θ in the case of refraction as shown in figure (iii) will be



(a) 30° (b) 35° (c) 60° (d) 41°

5. A fish looking up through the water sees the outside world contained in a circular horizon. If the refractive index of water is $\frac{4}{3}$ and the fish is 12 cm below the surface, the radius of this circle in cm is

(a) $36\sqrt{5}$ (b) $4\sqrt{5}$ (c) $36\sqrt{7}$ (d) $36/\sqrt{7}$

6. If f_V and f_R are the focal lengths of a convex lens for violet and red light respectively and F_V and F_R are the focal lengths of concave lens for violet and red light respectively, then we have

(a) $f_V < f_R$ and $F_V > F_R$ (b) $f_V < f_R$ and $F_V < F_R$

(c) $f_V > f_R$ and $F_V > F_R$ (d) $f_V > f_R$ and $F_V < F_R$

RESPONSE GRID	1. ⓐⓑⓒⓓ 2. ⓐⓑⓒⓓ 3. ⓐⓑⓒⓓ 4. ⓐⓑⓒⓓ 5. ⓐⓑⓒⓓ 6. ⓐⓑⓒⓓ

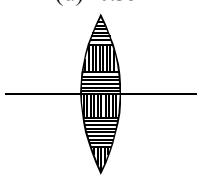
Space for Rough Work

7. Spherical aberration in a lens :
(a) is minimum when most of the deviation is at first surface
(b) is minimum when most of the deviation is at the second surface
(c) is minimum when the total deviation is equally distributed over the two surfaces
(d) does not depend on the above considerations

8. A rod of length 10 cm lies along the principal axis of a concave mirror of focal length 10 cm in such a way that its end closer to the pole is 20 cm away from the mirror. The length of the image is :
(a) 10 cm (b) 15 cm (c) 2.5 cm (d) 5 cm

9. A telescope consists of two thin lenses of focal lengths, 0.3 m and 3 cm respectively. It is focused on moon which subtends an angle of 0.5° at the objective. Then the angle subtended at the eye by the final image will be
(a) 5° (b) 0.25° (c) 0.5° (d) 0.35°

10. The layered lens as shown is made of two types of transparent materials-one indicated by horizontal lines and the other by vertical lines. The number of images formed of an object will be



(a) 1 (b) 2 (c) 3 (d) 6

11. A man's near point is 0.5 m and far point is 3 m. Power of spectacle lenses required for (i) reading purposes, (ii) seeing distant objects, respectively, are
(a) –2 D and + 3 D (b) +2 D and –3 D
(c) +2 D and –0.33 D (d) –2 D and + 0.33 D

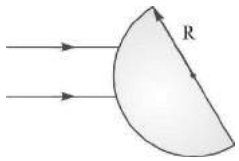
12. A ray of light falls on a transparent glass slab of refractive index 1.62. If the reflected ray and the refracted ray are mutually perpendicular, the angle of incidence is
(a) $\tan^{-1}(1.62)$ (b) $\tan^{-1}\left(\frac{1}{1.62}\right)$
(c) $\tan^{-1}(1.33)$ (d) $\tan^{-1}\left(\frac{1}{1.33}\right)$

13. A telescope has an objective of focal length 100 cm and an eyepiece of focal length 5 cm. What is the magnifying power of the telescope when the final image is formed at the least distance of distinct vision ?
(a) 20 (b) 24 (c) 28 (d) 32

14. Which light rays undergoes two internal reflection inside a raindrop, which of the rainbow is formed?
(a) Primary rainbow (b) Secondary rainbow
(c) Both (a) and (b) (d) Can't say

15. When a plane mirror is placed horizontally on a level ground at a distance of 60 *m* from the foot of a tower, the top of the tower and its image in the mirror subtend an angle of 90° at the eye. The height of the tower will be
(a) 30 m (b) 60 m (c) 90 m (d) 120 m

16. A parallel beam of light is incident on the surface of a transparent hemisphere of radius *R* and refractive index 2.0 as shown in figure. The position of the image formed by refraction at the first surface is :
(a) *R*/2
(b) *R*
(c) 2*R*
(d) 3*R*



17. A lens made of glass whose index of refraction is 1.60 has a focal length of + 20 cm in air. Its focal length in water, whose refractive index is 1.33, will be
(a) three times longer than in air
(b) two times longer than in air
(c) same as in air
(d) None of these

18. A compound microscope has an eye piece of focal length 10 cm and an objective of focal length 4 cm. Calculate the magnification, if an object is kept at a distance of 5 cm from the objective so that final image is formed at the least distance vision (20 cm) :
(a) 12 (b) 11 (c) 10 (d) 13

19. For a prism kept in air it is found that for an angle of incidence 60°, the angle of Prism A, angle of deviation δ and angle of emergence 'e' become equal. Then the refractive index of the prism is
(a) 1.73 (b) 1.15 (c) 1.5 (d) 1.33

20. A person can see clearly only upto a distance of 30 cm. He wants to read a book placed at a distance of 50 cm from his eyes. What is the power of the lens of his spectacles ?
(a) –1.0 D (b) –1.33 D (c) –1.67 D (d) –2.0 D

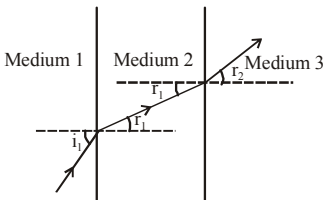
21. An object is placed at a distance of 40 cm in front of a concave mirror of focal length 20 cm. The image produced is
(a) real, inverted and smaller in size
(b) real, inverted and of same size
(c) real and erect
(d) virtual and inverted

22. A vessel of depth *x* is half filled with oil of refractive index μ_1 and the other half is filled with water of refractive index μ_2. The apparent depth of the vessel when viewed from above is
(a) $\frac{x(\mu_1+\mu_2)}{2\mu_1\mu_2}$ (b) $\frac{x\mu_1\mu_2}{2(\mu_1+\mu_2)}$
(c) $\frac{x\mu_1\mu_2}{(\mu_1+\mu_2)}$ (d) $\frac{2x(\mu_1+\mu_2)}{\mu_1\mu_2}$

RESPONSE GRID					
	7. (a)(b)(c)(d)	8. (a)(b)(c)(d)	9. (a)(b)(c)(d)	10. (a)(b)(c)(d)	11. (a)(b)(c)(d)
	12. (a)(b)(c)(d)	13. (a)(b)(c)(d)	14. (a)(b)(c)(d)	15. (a)(b)(c)(d)	16. (a)(b)(c)(d)
	17. (a)(b)(c)(d)	18. (a)(b)(c)(d)	19. (a)(b)(c)(d)	20. (a)(b)(c)(d)	21. (a)(b)(c)(d)
	22. (a)(b)(c)(d)				

Space for Rough Work

23. The following figure shows refraction of light at the interface of three media Correct the order of optical density (d) of the media is



(a) $d_1 > d_2 > d_3$ (b) $d_2 > d_1 > d_3$
(c) $d_3 > d_3 > d_2$ (d) $d_2 > d_3 > d_1$

24. Light travels in two media A and B with speeds 1.8×10^8 m s^{-1} and 2.4×10^8 m s^{-1} respectively. Then the critical angle between them is

(a) $\sin^{-1}\left(\frac{2}{3}\right)$ (b) $\tan^{-1}\left(\frac{3}{4}\right)$
(c) $\tan^{-1}\left(\frac{2}{3}\right)$ (d) $\sin^{-1}\left(\frac{3}{4}\right)$

25. The refractive index of a glass is 1.520 for red light and 1.525 for blue light. Let D_1 and D_2 be angles of minimum deviation for red and blue light respectively in a prism of this glass. Then,
(a) $D_1 < D_2$ (b) $D_1 = D_2$
(c) D_1 can be less than or greater than D_2 depending upon the angle of prism
(d) $D_1 > D_2$

26. Which of the following is not due to total internal reflection?
(a) Working of optical fibre
(b) Difference between apparent and real depth of pond
(c) Mirage on hot summer days
(d) Brilliance of diamond

27. A body is located on a wall. Its image of equal size is to be obtained on a parallel wall with the help of a convex lens. The lens is placed at a distance 'd' ahead of second wall, then the required focal length will be

(a) only $\frac{d}{4}$
(b) only $\frac{d}{2}$
(c) more than $\frac{d}{4}$ but less than $\frac{d}{2}$
(d) less than $\frac{d}{4}$

28. A concave mirror forms the image of an object on a screen. If the lower half of the mirror is covered with an opaque card, the effect would be to make the
(a) image less bright.
(b) lower half of the image disappear.
(c) upper half of the image disappear.
(d) image blurred.

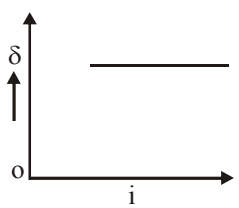
29. A ray of light passes through an equilateral prism such that the angle of incidence is equal to the angle of emergence and the latter is equal to $\frac{3}{4}$ th of angle of prism. The angle of deviation is
(a) 25° (b) 30° (c) 45° (d) 35°

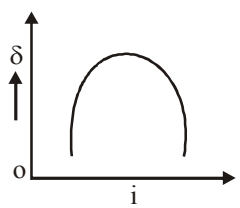
30. The power of a biconvex lens is 10 dioptre and the radius of curvature of each surface is 10 cm. Then the refractive index of the material of the lens is
(a) $\frac{3}{2}$ (b) $\frac{4}{3}$ (c) $\frac{9}{8}$ (d) $\frac{5}{3}$

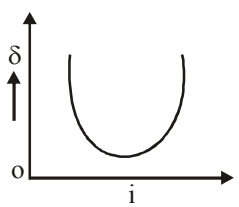
31. A microscope is focussed on a mark on a piece of paper and then a slab of glass of thickness 3 cm and refractive index 1.5 is placed over the mark. How should the microscope be moved to get the mark in focus again ?
(a) 4.5 cm downward (b) 1 cm downward
(c) 2 cm upward (d) 1 cm upward

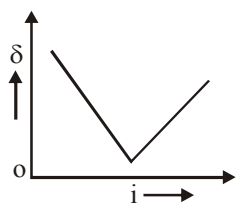
32. What causes chromatic aberration?
(a) Marginal rays
(b) Central rays
(c) Difference in radii of curvature of its surfaces
(d) Variation of focal length of lens with colour

33. The graph between angle of deviation (δ) and angle of incidence (i) for a triangular prism is represented by

(a)


(b)


(c)


(d)


34. The ratio of thickness of plates of two transparent medium A and B is 6 : 4. If light takes equal time in passing through them, then refractive index of A with respect to B will be
(a) 1.33 (b) 1.75 (c) 1.4 (d) 1.5

35. A rectangular block of glass is placed on a mark made on the surface of the table and it is viewed from the vertical position of eye. If refractive index of glass be μ and its thickness d, then the mark will appear to be raised up by

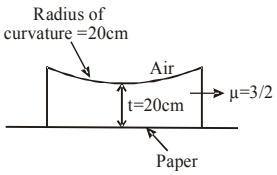
(a) $\frac{(\mu+1)d}{\mu}$ (b) $\frac{(\mu-1)d}{\mu}$ (c) $\frac{(\mu+1)}{\mu d}$ (d) $\frac{(\mu-1)\mu}{d}$

RESPONSE GRID					
	23. ⓐⓑⓒⓓ	24. ⓐⓑⓒⓓ	25. ⓐⓑⓒⓓ	26. ⓐⓑⓒⓓ	27. ⓐⓑⓒⓓ
	28. ⓐⓑⓒⓓ	29. ⓐⓑⓒⓓ	30. ⓐⓑⓒⓓ	31. ⓐⓑⓒⓓ	32. ⓐⓑⓒⓓ
	33. ⓐⓑⓒⓓ	34. ⓐⓑⓒⓓ	35. ⓐⓑⓒⓓ		

Space for Rough Work

36. If a glass prism is dipped in water, its dispersive power
(a) increases
(b) decreases
(c) does not change
(d) may increase or decrease depending on whether the angle of the prism is less than or greater than 60°

37. A planoconcave lens is placed on a paper on which a flower is drawn. How far above its actual position does the flower appear to be?



(a) 10 cm (b) 15 cm
(c) 50 cm (d) None of these

38. To get three images of a single object, one should have two plane mirrors at an angle of
(a) 60° (b) 90° (c) 120° (d) 30°

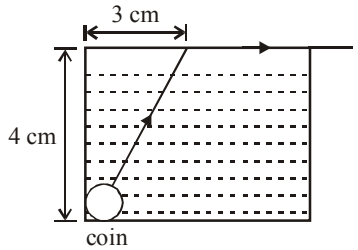
39. Light propagates with speed of 2.2×10^8 m/s and 2.4×10^8 m/s in the media P and Q respectively. The critical angle of incidence for light undergoing reflection from P and Q is

(a) $\sin^{-1}\left(\frac{1}{11}\right)$ (b) $\sin^{-1}\left(\frac{11}{12}\right)$
(c) $\sin^{-1}\left(\frac{5}{12}\right)$ (d) $\sin^{-1}\left(\frac{5}{11}\right)$

40. A thin convergent glass lens (μ_g = 1.5) has a power of +5.0 D. When this lens is immersed in a liquid of refractive index μ, it acts as a divergent lens of focal length 100 cm. The value of μ must be
(a) 4/3 (b) 5/3 (c) 5/4 (d) 6/5

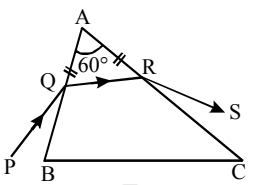
41. A ray of light travelling inside a rectangular glass block of refractive index $\sqrt{2}$ is incident on the glass-air surface at an angle of incidence of 45°. The refractive index of air is one. Under these conditions the ray will
(a) emerge into the air without any deviation
(b) be reflected back into the glass
(c) be absorbed
(d) emerge into the air with an angle of refraction equal to 90°

42. A small coin is resting on the bottom of a beaker filled with liquid. A ray of light from the coin travels upto the surface of the liquid and moves along its surface. How fast is the light travelling in the liquid?



(a) 2.4×10^8 m/s (b) 3.0×10^8 m/s
(c) 1.2×10^8 m/s (d) 1.8×10^8 m/s

43. A ray PQ incident on the refracting face BA is refracted in the prism BAC as shown in the figure and emerges from the other refracting face AC as RS such that AQ = AR. If the angle of prism A = 60° and the refractive index of the material of prism is $\sqrt{3}$, then the angle of deviation of the ray is



(a) 60° (b) 45°
(c) 30° (d) None of these

44. When a biconvex lens of glass having refractive index 1.47 is dipped in a liquid, it acts as a plane sheet of glass. This implies that the liquid must have refractive index.
(a) equal to that of glass
(b) less then one
(c) greater than that of glass
(d) less then that of glass

45. If a thin prism of glass is dipped in water then minimum deviation (with respect to air) of light produced by prism will be $\left({}_w\mu_g=\frac{3}{2},\ {}_a\mu_w=\frac{4}{3}\right)$

(a) $\frac{1}{5}$ (b) $\frac{1}{4}$ (c) $\frac{1}{2}$ (d) $\frac{1}{3}$

RESPONSE GRID					
	36. ⓐⓑⓒⓓ	37. ⓐⓑⓒⓓ	38. ⓐⓑⓒⓓ	39. ⓐⓑⓒⓓ	40. ⓐⓑⓒⓓ
	41. ⓐⓑⓒⓓ	42. ⓐⓑⓒⓓ	43. ⓐⓑⓒⓓ	44. ⓐⓑⓒⓓ	45. ⓐⓑⓒⓓ

DAILY PRACTICE PROBLEM DPP CHAPTERWISE CP23 - PHYSICS			
Total Questions	45	Total Marks	180
Attempted		Correct	
Incorrect		Net Score	
Cut-off Score	45	Qualifying Score	60
Success Gap = Net Score – Qualifying Score			
Net Score = (Correct × 4) – (Incorrect × 1)			

Space for Rough Work

DAILY PRACTICE PROBLEMS — PHYSICS SOLUTIONS — DPP/CP23

1. (b) $\frac{1}{f_R} = (1.5-1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

$\frac{1}{f_v} = (1.45-1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

$\frac{f_v}{f_R} = \frac{0.5}{0.45} = \frac{10}{9}$

$f_R = \frac{9}{10} f_v = \frac{9}{10} \times 20 \text{ cm} = 18 \text{ cm}.$

2. (a) We have,

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

$\Rightarrow \cot\frac{A}{2} = \frac{\sin\left(\frac{A+\delta_m}{2}\right)}{\sin\left(\frac{A}{2}\right)}$

or $\sin\frac{A}{2} \cdot \cot\frac{A}{2} = \sin\left(\frac{A+\delta_m}{2}\right)$

or $\sin\frac{A}{2} \cdot \frac{\cos\frac{A}{2}}{\sin\frac{A}{2}} = \sin\left(\frac{A+\delta_m}{2}\right)$

or $\cos\frac{A}{2} = \cos\left[\frac{\pi}{2} - \left(\frac{A+\delta_m}{2}\right)\right]$

$\Rightarrow \frac{A}{2} = \frac{\pi}{2} - \left(\frac{A+\delta_m}{2}\right)$

or $A = \pi - A - \delta_m \Rightarrow \delta_m = \pi - 2A$.

3. (a) Let the distance between the lenses be d.

Then, equivalent power is

$P = P_1 + P_2 - d\,P_1\,P_2$

Given $P_1 = P_2 = +5$ D

$\therefore \quad P = (10 - 25d)$ D

For P to be –ve,

$10 - 25d < 0 \Rightarrow d > \frac{2}{5}$ m

or, $d > 0.4$ m or $d > 40$ cm

4. (b) ${}^a\mu_g = \frac{\sin 60°}{\sin 35°}$ ... (i)

${}^a\mu_w = \frac{\sin 60°}{\sin 41°}$ ... (ii)

${}^w\mu_g = \frac{\sin 41°}{\sin\theta}$ ... (iii)

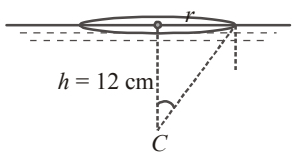
${}^a\mu_w \times {}^w\mu_g = {}^a\mu_g$

$\frac{\sin 60°}{\sin 41°} \times \frac{\sin 41°}{\sin\theta} = \frac{\sin 60°}{\sin 35°}$

(Using (i), (ii) and (iii))

$= \sin\theta = \sin 35° \qquad \theta = 35°$

5. (d)



$\sin C = \frac{1}{\mu} = \frac{1}{4/3} = \frac{3}{4}$.

Now $r = h \tan C$

$= 12 \times \frac{3}{\sqrt{7}} = \frac{36}{\sqrt{7}}$ cm

6. (a) $\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

According to Cauchy relation

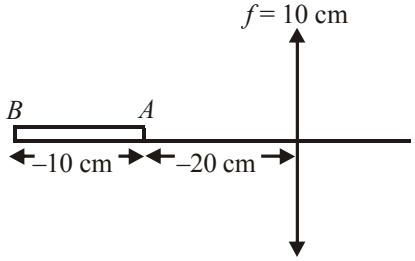
$\mu = A + \frac{B}{\lambda^2} + \frac{C}{\lambda^4} \cdots$ Hence $f \propto \lambda$.

Hence, red light having maximum wavelength has maximum focal length.

$\therefore \quad f_v < f_r$ and also $F_v > F_r$ as focal length is negative for a concave lens.

7. (c) To minimise spherical aberration in a lens, the total deviation should be equally distributed over the two surfaces.

8. (d)



The focal length of the mirror

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

For A end of the rod the image distance

When $u_1 = -20$ cm

$\Rightarrow \frac{-1}{10} = \frac{1}{v_1} - \frac{1}{20}$

$$\frac{1}{v_1}=\frac{-1}{10}+\frac{1}{20}=\frac{-2+1}{20}$$

$v_1=-20$ cm

For when $u_2=-30$ cm

$$\frac{1}{f}=\frac{1}{v_2}-\frac{1}{30}$$

$$\frac{1}{v_2}=\frac{-1}{10}+\frac{1}{30}=\frac{-30+10}{300}=\frac{-20}{300}$$

$v_2=-15$ cm

$L=v_2-v_1=-15-(-20)$

$L=5$ cm

9. (a) Magnification

$$=\frac{f_0}{f_e}=\frac{\text{Angle subtended by final image on the eye}}{\text{Angle subtended by the object on eye (or objective)}}$$

$$\Rightarrow \frac{0.3\text{m}}{3\text{cm}}=\frac{\beta}{0.5^\circ} \Rightarrow \frac{30\,\text{cm}}{3\text{cm}}=\frac{\beta}{0.5^\circ}$$

$\Rightarrow \beta=5^\circ$

10. (b) Due to difference in refractive indices images obtained will be two. Two media will form images at two different points due to difference in focal lengths.

11. (c) For reading purposes :

u = – 25 cm, v = – 50 cm, f = ?

$$\frac{1}{\text{f}}=\frac{1}{\text{v}}-\frac{1}{\text{u}}=-\frac{1}{50}+\frac{1}{25}=\frac{1}{50}\ ;$$

$$\text{P}=\frac{100}{\text{f}}=+2\,\text{D}$$

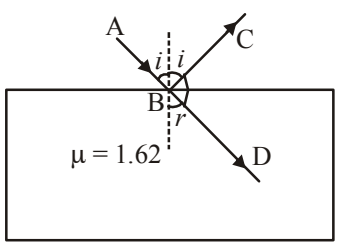
For distant vision, f' = distance of far point = –3 m

$$\text{P}=\frac{1}{\text{f}'}=-\frac{1}{3}\text{D}=-0.33\ \text{D}$$

12. (a) Clearly,

$i+r+90^\circ=180^\circ$

$\Rightarrow \quad i+r=90^\circ$ ...(i)



Now, $\frac{\sin i}{\sin r}=\mu$

$\Rightarrow \frac{\sin i}{\sin(90^\circ-i)}=\mu$, from (1)

or $\frac{\sin i}{\cos i}=\mu \Rightarrow \tan i=\mu$

or $i=\tan^{-1}(\mu)$ i.e., $i=\tan^{-1}(1.62)$

13. (b) $f_0=100$ cm, $f_e=5$ cm

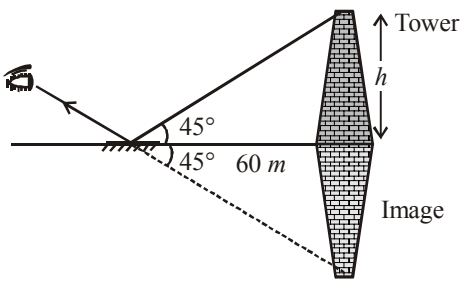
When final image is formed at least distance of distinct vision (d), then

$$\text{M}=\frac{\text{f}_0}{\text{f}_\text{e}}\left(1+\frac{\text{f}_\text{e}}{\text{d}}\right)=\frac{100}{5}\left(1+\frac{5}{25}\right) \quad [\because \text{D}=25\ \text{cm}]$$

$$\text{M}=20\times\frac{6}{5}=24$$

14. (b) Secondary rainbow is formed by rays undergoing internal reflection twice inside the drop.

15. (b) $\tan 45^\circ=\frac{h}{60}\Rightarrow h=60m$



16. (c) Using, $\frac{\mu}{v}-\frac{1}{u}=\frac{\mu-1}{R}$

or $\frac{2}{v}-\frac{1}{\infty}=\frac{2-1}{R}$

$\therefore \quad v=2R$

17. (a) ${}_a\text{n}_\ell=1.6$, ${}_a\text{n}_\text{w}=1.33$

f = 20 cm

We have,

$$\frac{1}{\text{f}}=\left({}_a\text{n}_\ell-1\right)\left(\frac{1}{\text{R}_1}-\frac{1}{\text{R}_2}\right)$$

$$\frac{1}{20}=(1.6-1)\left(\frac{1}{\text{R}_1}-\frac{1}{\text{R}_2}\right) \quad \text{.....(1)}$$

Also, $\frac{1}{\text{f}'}=\left({}_\text{w}\text{n}_\ell-1\right)\left(\frac{1}{\text{R}_1}-\frac{1}{\text{R}_2}\right)$

$$=\left(\frac{{}_a\text{n}_\ell}{{}_a\text{n}_\text{w}}-1\right)\left(\frac{1}{\text{R}_1}-\frac{1}{\text{R}_2}\right)$$

$$\frac{1}{\text{f}'}=\left(\frac{1.6}{1.33}-1\right)\left(\frac{1}{\text{R}_1}-\frac{1}{\text{R}_2}\right) \quad \text{.....(2)}$$

Dividing equation (1) by (2)

$$\Rightarrow \quad \frac{\text{f}'}{20}=\frac{0.6}{(1.2-1)}$$

$$\text{f}'=\frac{0.6\times 20}{0.2}=60\ \text{cm}.$$

Hence it's focal length is three times longer than in air.

18. (a) $m = \frac{v_0}{|u_0|}\left(1+\frac{d}{f_e}\right) = \frac{20}{5}\left(1+\frac{20}{10}\right)$

$= 4\left(\frac{10+20}{10}\right) = \frac{4\times 30}{10} = 12$

19. (a) Given $i = 60°$

$A = \delta = e$

$\delta = i + e - A \Rightarrow \delta = i \quad (\because e = A)$

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

Here angle of deviation is min. ($\because$ i = e)

$$\mu = \frac{\sin\left(\frac{60°+60°}{2}\right)}{\sin\frac{60°}{2}} = 1.73$$

20. (b) $u = -50\text{ cm} = -0.5\text{ m}$

$v = -30\text{ cm} = -0.3\text{ m}$

$$P = \frac{1}{f} = \frac{1}{v} - \frac{1}{u} = \frac{-1}{0.3} + \frac{1}{0.5} = \frac{-0.2}{0.15} = -1.33\text{ D}$$

21. (b) Object distance $u = -40$ cm

Focal length $f = -20$ cm

According to mirror formula

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

or $\frac{1}{v}+\frac{1}{-20}-\frac{1}{(-40)}=\frac{1}{-20}+\frac{1}{40}$

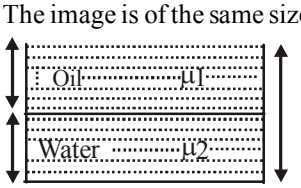
$\frac{1}{v}=\frac{-2+1}{40}=-\frac{1}{40}$ or $v = -40$ cm.

Negative sign shows that image is infront of concave mirror. The image is real.

Magnification, $m = \frac{-v}{u} = -\frac{(-40)}{(-40)} = -1$

The image is of the same size and inverted.

22. (a)



As refractive index, $\mu = \frac{\text{Real depth}}{\text{Apparent depth}}$

$\therefore$ Apparent depth of the vessel when viewed from above is

$$d_{\text{apparent}} = \frac{x}{2\mu_1}+\frac{x}{2\mu_2} = \frac{x}{2}\left(\frac{1}{\mu_1}+\frac{1}{\mu_2}\right)$$

$$= \frac{x}{2}\left(\frac{\mu_2+\mu_1}{\mu_1\mu_2}\right) = \frac{x(\mu_1+\mu_2)}{2\mu_1\mu_2}$$

23. (d) As $r_1 < i_1$ i.e., the incident ray bends towards the normal $\Rightarrow$ medium 2 is denser than medium 1.

Or $r_2 < i_1 \Rightarrow$ medium 3 is denser than medium 1.

Also, $r_2 > r_1 \Rightarrow$ medium 2 is denser than medium 3.

24. (d) Here, $v_A = 1.8 \times 10^8$ m s^{-1}

$v_B = 2.4 \times 10^8$ m s^{-1}

Light travels slower in denser medium. Hence medium A is a denser medium and medium B is a rarer medium. Here, Light travels from medium A to medium B. Let C be the critical angle between them.

$\therefore \quad \sin C = {}^A\mu_B = \frac{1}{{}_B\mu_A}$

Refractive index of medium B w.r.t. to medium A is

$${}^A\mu_B = \frac{\text{Velocity of light in medium } A}{\text{Velocity of light in medium } B} = \frac{v_A}{v_B}$$

$\therefore \quad \sin C = \frac{v_A}{v_B} = \frac{1.8\times10^8}{2.4\times10^8} = \frac{3}{4}$ or $C = \sin^{-1}\left(\frac{3}{4}\right)$

25. (a) For a thin prism, $D = (\mu - 1)A$

Since $\lambda_b < \lambda_r \Rightarrow \mu_r < \mu_b \Rightarrow D_1 < D_2$

26. (b) Difference between apparent and real depth of a pond is due to the refraction of light, not due to the total internal reflection. Other three phenomena are due to the total internal reflection.

27. (b) Using the lens formula $\frac{1}{f}=\frac{1}{v}-\frac{1}{u}$

Given $v = d$, for equal size image $|v| = |u| = d$

By sign convention $u = -d$

$\therefore \quad \frac{1}{f}=\frac{1}{d}+\frac{1}{d}$ or $f = \frac{d}{2}$

28. (a) Due to covering the reflection from lower part is not there so it makes the image less bright.

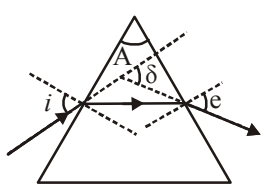
29. (b) From the fig.

Angle of deviation,

$\delta = i + e - A$

Here, $e = i$

and $e = \frac{3}{4}A$



$\therefore \quad \delta = \frac{3}{4}A + \frac{3}{4}A - A = \frac{A}{2}$

For equilateral prism, $A = 60°$

$\therefore \quad \delta = \frac{60°}{2} = 30°$

30. (a) Power of lens, P (in dioptre)

$$= \frac{100}{\text{focal length f (in cm)}}$$

$$\therefore \quad f = \frac{100}{10} = 10 \text{ cm}$$

By lens maker's formula, $\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

For biconvex lens, $R_1 = +R$, and $R_2 = -R$

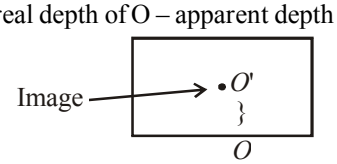
$$\therefore \quad \frac{1}{f} = (\mu - 1)\left(\frac{1}{R} + \frac{1}{R}\right)$$

$$\frac{1}{f} = (\mu - 1)\left(\frac{2}{R}\right)$$

$$\frac{1}{10} = (\mu - 1)\left(\frac{2}{10}\right)$$

$$(\mu - 1) = \frac{1}{2} \text{ or } \mu = \frac{1}{2} + 1 = \frac{3}{2}$$

31. (d) In the later case microscope will be focussed for O'. So, it is required to be lifted by distance OO'.
OO' = real depth of O – apparent depth of O.



$$= 3 - \frac{3}{1.5} \quad \left[\mu = \frac{\text{real depth}}{\text{apparent depth}}\right]$$

$$= 3\left[\frac{1.5 - 1}{1.5}\right] = \frac{3 \times .5}{1.5} = 1 \text{ cm}$$

32. (d) The cause of chromatic aberration is that lens focusses different colours at different points.

33. (c) For the prism as the angle of incidence (i) increases, the angle of deviation (δ) first decreases goes to minimum value and then increases.

34. (d) $d_A : d_B = 6 : 4$
$\because$ Time taken $\propto$ thickness

and time taken $\propto \frac{1}{\text{velocity}}$

$$\therefore \quad \text{Thickness} \propto \frac{1}{\text{velocity}}$$

$$\therefore \quad \frac{d_A}{d_B} = \frac{v_B}{v_A}$$

Also, $\mu = \frac{c}{v} \quad \therefore \quad \frac{\mu_A}{\mu_B} = \frac{v_B}{v_A}$

$$\therefore \quad \frac{d_A}{d_B} = \frac{\mu_A}{\mu_B} = \frac{6}{4} = \frac{3}{2} = 1.5$$

$$\therefore \quad {}_B\mu_A = 1.5$$

35. (b) Since $\frac{\text{Apparent depth}}{\text{Real depth}} = \frac{1}{\mu}$

$\Rightarrow$ Apparent depth = d/μ
So mark raised up = Real depth – Apparent depth

$$= d - \frac{d}{\mu} = d\left(1 - \frac{1}{\mu}\right) = \left(\frac{\mu - 1}{\mu}\right)d$$

36. (b) Dispersive power of a prism $\omega = \frac{\mu_V - \mu_R}{\mu_y - 1} = \frac{d\mu}{\mu - 1}$,

where $\mu = \mu_y = \frac{\mu_V + \mu_R}{2}$

37. (a) Considering refraction at the curved surface,

$u = -20, \ \mu_2 = 1$

$\mu_1 = 3/2, \ R = +20$

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

$$\Rightarrow \frac{1}{v} - \frac{3/2}{-20} = \frac{1 - 3/2}{20} \Rightarrow v = -10$$

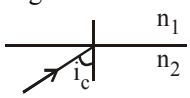
i.e., 10 cm below the curved surface or 10 cm above the actual position of flower.

38. (b) When $\theta = 90°$ then $\frac{360}{\theta} = \frac{360}{90} = 4$

is an even number. The number of images formed is given by

$$n = \frac{360}{\theta} - 1 = \frac{360}{90} - 1 = 4 - 1 = 3$$

39. (b) The critical angle of incidence is that angle at which angle of refraction is 90°.



$$\sin i_c = \frac{n_1}{n_2} \text{ where } n_2 > n_1$$

As, refractive index $= \frac{\text{velocity (air)}}{\text{velocity (medium)}}$

$$\therefore \ \sin i_c = \frac{2.2 \times 10^8 \text{ m/sec}}{2.4 \times 10^8 \text{ m/sec}} = \frac{11}{12}$$

$$\Rightarrow \ i_C = \sin^{-1}\left(\frac{11}{12}\right)$$

40. (b) $\frac{P_a}{P_l} = \frac{\left(\frac{\mu_g}{\mu_a} - 1\right)}{\left(\frac{\mu_g}{\mu_l} - 1\right)} = \frac{+5}{-100/100} = -5$

$$-5\left(\frac{\mu_g}{\mu_l} - 1\right) = \frac{\mu_g}{\mu_a} - 1$$

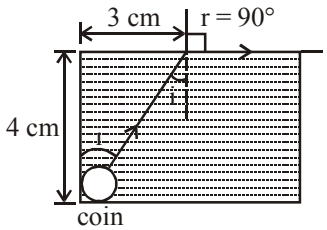
$$\frac{1.5}{\mu_1} - 1 = \frac{-1}{5}(1.5-1) = -0.1\,;\ \mu_1 = \frac{1.5}{0.9} = \frac{5}{3}$$

41. (d) $\sin C = \frac{1}{\mu} = \frac{1}{\sqrt{2}} \quad \therefore\ C = \sin^{-1}\left(\frac{1}{\sqrt{2}}\right) = 45°$

Now $\frac{\sin C}{\sin r} = \frac{1}{\mu}$ or $\frac{\sin 45°}{\sin r} = \frac{1}{\sqrt{2}}$

$\sin r = 1$ or $r = 90°$

42. (d)



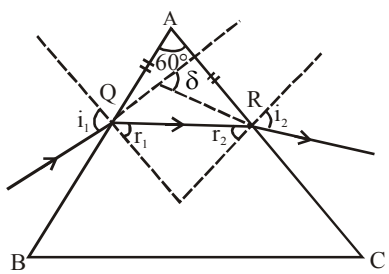
Hypotenuse comes out to be 5 cm.

Since, $\frac{1}{\mu} = \frac{\sin i}{\sin 90°}$

$\mu = \frac{1}{\sin i} = \frac{5}{3}$

Speed, $v = \frac{c}{\mu} = \frac{3\times10^8}{5/3} = 1.8\times10^8$ m/s

43. (a)



Given AQ = AR and $\angle A = 60°$

$\therefore\ \angle AQR = \angle ARQ = 60°$

$\therefore\ r_1 = r_2 = 30°$

Applying Snell's law on face AB.

$\sin i_1 = \mu \sin r_1$

$\Rightarrow\ \sin i_1 = \sqrt{3}\sin 30° = \sqrt{3}\times\frac{1}{2} = \frac{\sqrt{3}}{2}$

$\therefore\ i_1 = 60°$

Similarly, $i_2 = 60°$

In a prism, deviation

$\delta = i_1 + i_2 - A = 60° + 60° - 60° = 60°$

44. (a) $\frac{1}{f} = \left(\frac{\mu_g}{\mu_m} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

If $\mu_g = \mu_m$, then $\frac{1}{f} = (1-1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

$\Rightarrow\ \frac{1}{f} = 0$

$\boxed{f = \frac{1}{0} = \infty}$

This implies that the liquid must have refractive index equal to glass.

45. (b) Minimum deviation of the prism when it is dipped in water $= \delta_m' = ({}_w\mu_g - 1)A$

$$= \left(\frac{{}_a\mu_g}{{}_a\mu_\omega} - 1\right)A = \left(\frac{\frac{3}{2}}{\frac{4}{3}} - 1\right)A = \frac{1}{8}A$$

Minimum deviation of the prism with respect to air

$= \delta_m = (\mu - 1)A = \left(\frac{3}{2} - 1\right)A = \frac{1}{2}A$

$\frac{\delta_m'}{\delta_m} = \frac{\frac{1}{8}A}{\frac{1}{2}A} = \frac{1}{4}$