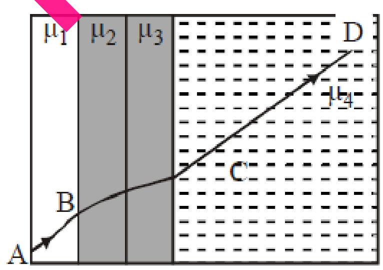
T.Vediyappan.,M.Sc.,B.Ed.,M.Phil., Department of Physics
Jayam Vidhyalaya Matric Hr Sec School, HARUR

STD : XII Unit-6 Optics PHYSICS

Creative One Mark Questions and Answers

1. In image formation from spherical mirrors, only paraxial rays are considered because they
   (a) are easy to handle geometrically
   (b) contain most of the intensity of the incident light
   (c) form nearly a point image of a point source
   (d) show minimum dispersion effect
2. Critical angle of light passing from glass to water is minimum for
   (a) red colour (b) green colour
   (c) yellow colour (d) violet colour
3. The angular dispersion produced by a prism
   (a) increases if the average refractive index increases
   (b) increases if the average refractive index decreases
   (c) remains constant whether the average refractive index increases or decreases
   (d) has no relation with average refractive index.
4. If the focal length of objective lens is increased then magnifying power of :
   (a) microscope will increase but that of telescope decrease.
   (b) microscope and telescope both will increase.
   (c) microscope and telescope both will decrease
   (d) microscope will decrease but that of telescope increase.
5. A ray of light passes through four transparent media with refractive indices μ_1, μ_2, μ_3 and μ_4 as shown in the figure. The surfaces of all media are parallel. If the emergent ray CD is parallel to the incident ray AB, we must have
   (a) $\mu_1 = \mu_2$
   (b) $\mu_2 = \mu_3$
   (c) $\mu_3 = \mu_4$
   (d) $\mu_4 = \mu_1$



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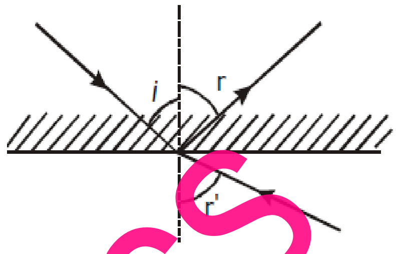
6. A ray of light from a denser medium strike a rarer medium at an angle of incidence i (see Fig). The reflected and refracted rays make an angle of 90° with each other. The angles of reflection and refraction are r and r'. The critical angle is

(a) $\sin^{-1}(\tan r)$
(b) $\sin^{-1}(\tan i)$
(c) $\sin^{-1}(\tan r)$
(d) $\tan^{-1}(\tan i)$



7. 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

8. A ray of light travelling in the direction $\frac{1}{2}(\hat{i} + \sqrt{3}\,\hat{j})$ is incident on a plane mirror. After reflection, it travels along the direction $\frac{1}{2}(\hat{i} - \sqrt{3}\,\hat{j})$. The angle of incidence is
(a) 30° (b) 45°
(c) 60° (d) 75°

9. The index of refraction of diamond is 2.0. The velocity of light in diamond is approximately
(a) 1.5×10^{10} cm/sec (b) 2×10^{10} cm/sec
(c) 3.0×10^{10} cm/sec (d) 6×10^{10} cm/sec

10. A beam of monochromatic blue light of wavelength 420 nm in air travels in water ($\mu = 4/3$). Its wavelength in water will be
(a) 280 nm (b) 560 nm
(c) 315 nm (d) 400 nm

11. The frequency of a light wave in a material is 2×10^{14} Hz and wavelength is 5000 Å. The refractive index of material will be
(a) 1.50 (b) 3.00
(c) 1.33 (d) 1.40

12. 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

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

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

13. A ray of light travelling in a transparent medium of refractive index μ, falls on a surface separating the medium from air at an angle of incidence of 45°. For which of the following value of μ the ray can undergo total internal reflection?

(a) $\mu = 1.33$ (b) $\mu = 1.40$

(c) $\mu = 1.50$ (d) $\mu = 1.25$

14. A thin glass (refractive index 1.5) lens has optical power of – 5 D in air. Its optical power in a liquid medium with refractive index 1.6 will be

(a) – 1D (b) 1 D

(c) – 25 D (d) 25 D

15. A double convex lens of focal length 6 cm is made of glass of refractive index 1.5. The radius of curvature of one surface is double that of other surface. The value of small radius of curvature is

(a) 6 cm (b) 4.5 cm

(c) 9 cm (d) 4 cm

16. An achromatic convergent doublet of two lenses in contact has a power of + 2D. The convex lens has power + 5D. What is the ratio of dispersive powers of convergent and divergent lenses ?

(a) 2 : 5 (b) 3 : 5

(c) 5 : 2 (d) 5 : 3

17. The dispersive power of material of a lens of focal length 20 cm is 0.08. What is the longitudinal chromatic aberration of the lens ?

(a) 0.08 cm (b) 0.08/20 cm

(c) 1.6 cm (d) 0.16 cm

18. A prism has a refracting angle of 60º. When placed in the position of minimum deviation, it produces a deviation of 30º. The angle of incidence is

(a) 30º (b) 45º

(c) 15º (d) 60º

19. 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 3/4th of the angle of prism. The angle of deviation is

(a) 45º (b) 39º

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(c) 20º (d) 30º

20. A telescope has an objective lens of 10 cm diameter and is situated at a distance of one kilometer from two objects. The minimum distance between these two objects, which can be resolved by the telescope, when the mean wavelength of light is 5000 Å, is of the order of

(a) 5 cm (b) 0.5 m

(c) 5 m (d) 5 mm

21. Wavelength of light used in an optical instrument are λ_1 =4000 Å and λ_2 =5000Å , then ratio of their respective resolving powers (corresponding to λ_1 and λ_2) is

(a) 16 : 25 (b) 9 : 1

(c) 4 : 5 (d) 5 : 4.

22. The magnifying power of a telescope is 9. When it is adjusted for parallel rays, the distance between the objective and the eye piece is found to be 20 cm. The focal length of lenses are

(a) 18 cm, 2 cm (b) 11 cm, 9 cm

(c) 10 cm, 10 cm (d) 15 cm, 5 cm

23. The focal length of the objective of a telescope is 60 cm. To obtain a magnification of 20, the focal length of the eye piece should be

(a) 2 cm (b) 3 cm

(c) 4 cm (d) 5 cm

24. The focal lengths of objective and eye lens of an astronomical telelscope are respectively 2 meter and 5 cm. Final image is formed at (i) least distance of distinct vision (ii) infinity Magnifying power in two cases will be

(a) – 48, – 40 (b) – 40, – 48

(c) – 40, + 48 (d) – 48, + 40

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25. A simple telescope, consisting of an objective of focal length 60 cm and a single eye lens of focal length 5 cm is focussed on a distant object in such a way that parallel rays emerge from the eye lens. If the object subtends an angle of 2º at the objective, the angular width of the image is

(a) 10º (b) 24º

(c) 50º (d) (1/6)º

26. A double slit is illuminated by light of wave length 6000Å. The slit are 0.1 cm apart and the screen is placed one mete away calculate

[a] $6\times 10^{-3} rad$ [b] $6\times 10^{3} rad$

[c] $5\times 10^{-3} rad$ [d] $6\times 10^{3} rad$

27. In Young's double slit experiment the fringes are formed at a distance of 1m from double slit of separation 0.12. The distance of 3rd dark band from the centre of the screen given $\lambda = 6000$Å

[a]0.12 mm [b]0.12cm

[c]0.12m [d]0.12km

28. In Young's double slit experiment the fringes are formed at a distance of 1m from double slit of separation 0.12. The distance of 3rd bright band from the centre of the screen given $\lambda = 6000$Å

[a] 1.5 cm [b] 1.5 m

[c] $1.5\times 10^{-2} cm$ [d] $1.5\times 10^{-3} cm$

29. In young's double slit experiment the two slits are illuminated by light of wavelength 5890Å and the distance between the fringes obtained on the screen is 0.2. The whole apparatus is immersed in water then find out angular fringe width (refractive index of water $= \frac{4}{3}$)

[a] 0.15 [b] 1.5

[c] 15 [d] 0.0015

30. The path difference between two interfering waves at a point on screen is 171.5 times the wavelength. If the path difference is 0.01029 cm. Find the wavelength.

[a] 6000Å [b] 6×10^{-7}Å

[c] 5000 Å [d] 5×10^{-7}Å

31. A whose biperiment is experiment is immersed in water. if the fringe width in air is β and refractive index of biprism material and water are 1.5 and 1.33 respectively find the value of the fringe width

[a] 3 β_a [b] $4\beta_a$

[c] 1.5 β_a [d] $1.33\beta_a$

32. Light of wavelength 6000Å is incident on a thin glass plate of refractive index 1.5 such angle of refraction into the plate is 60 . Calculate the smallest thickness of plate which will make it appear dark by reflection

[a] $4\times 10^{-7} m$ [b] 400 mm

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[c] 400Å [d] $0.4\times 10^{-7} m$

33. An extended object is placed perpendicular to the principal axis of a concave mirror of radius of curvature 20 cm at a distance of 15 cm from the pole. Find the lateral magnification produced.

[a]-2 [b] -4

[c] -2 [d] 4

34. A point object is placed 60 cm from the pole of a concave mirror of focal length 10 cm on the principal axis.

[a] -12cm [b] 12 cm

[c] -12 mm [d] 12 mm

35. A person looks into a spherical mirror. The size of image his face is twice the actual size of his face. it the face is at a distance of 20 cm, then find the radius of curvature of the mirror .

[a] 80 cm [b] 80 mm

[c] 80m [d] 0.8 m

36. The distance between a real object and its image in a convex mirror of focal length 12 cm is 32 cm. Find the size of image if the object size is 1 cm

[a] $\frac{+1}{3} cm$ [b] $\frac{-1}{3}$ cm

[c] $\frac{1}{3} cm$ [d] $\frac{-1}{3} cm$

37. Find the maximum angle that can be made in glass medium $(\mu = 1.5)$ if a light ray is refracted from glass to vacuum

[a] $sin^{-1}\left(\frac{2}{3}\right)$ [b] $sin^{-1}\left(\frac{3}{2}\right)$

[c] $cos^{-1}\left(\frac{2}{3}\right)$ [d] $cos^{-1}\left(\frac{3}{2}\right)$

38. Find the angle of refraction in a medium $(u = 2) if$ light is incident in vacuum, making an angle equal to twice the critical angle

[a] $sin^{-1}\left(\frac{\sqrt{3}}{4}\right)$ [b] $cos^{-1}\left(\frac{\sqrt{3}}{4}\right)$

[c] $sin^{-1}\left(\frac{4}{\sqrt{3}}\right)$ [d] $cos^{-1}\left(\frac{4}{\sqrt{3}}\right)$

39. Find apparent height of the bird

[a] 48 m [b] 48 mm

[c] 48 cm [d] 0.48 m

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40. Find apparent depth of the fish

[a]27 m [b] 27 mm

[c] 27cm [d] 0.27 m

41. At what distance will the bird appear to the fish ?

[a] 84 [b] 84 mm

[c] 84 cm [d] 0.84 m

42. At what distance will the fish appear to the bird?

[a] 66 m [b] 84 mm

[c] 0.66 m [d] 0.63 m

43. Find the apparent depth of are object seen below surface AB.

[a] 36 m [b] 0.36 m

[c] 36 mm [d] 0.36 mm

44. In determine the apparent shift in the position of the coin. Also find the effective refractive index of the combination of the glass and water slab

[a] 1.39 [b] 1.40

[c] 1.3 [d] 1.49

45. Calculate the dispersive power for crown glass from the given data

[a] 0.1639 [b] 0.6139

[c] 1.639 [d] 6.139

46. A point object is placed on the principal axis of a thin with parallel curved boundaries i.e having same radii of curvature. Discuss about the position of the image formed

[a] V = 4 [b] V≠ 4

[c] $V = 0$ [d] $u = 0$

47. Find focal length of the lens shown in

[a] + 10 cm [b] -10 cm

[c] +20 cm [d]-20 cm

48. A glass or glycerin convex lens refractive index 3/2 has got a focal length of the lens if it is in immersed in ethyl alcohol of refractive index 1.36

[a] 243.75 cm [b] 342. 75 cm

[c] 136.75 cm [d] 263.50 cm

49. To increase the angular magnification of a simple microscope one should increase

[a] the focal length of the lens [b] the power of the lens

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[c]the aperture of the lens [d] the object size

50. Two thin lenses are in contact and the focal length of the combination is 80 cm. If the focal length of one lens is 20 cm then the power of the other lens will be

[a] 1.66 D [b] 4.00 D

[c] -100 D [d] -3.75 D

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6.OPTICS

ONE-MARK KEY ANSWER

S.NO	SOLUTIONS
1	**(c)** Because they form nearly point image of point source.
2	(d) Violet colour
3	**(a)** The angular dispersion θ i.e., the angle between the extreme rays of light, $\theta = (\delta_V - \delta_R)$ where $\delta_V = (\mu_V-1)A$, $\delta_R = (\mu_V-1)A$ & A is angle of prism. So if refractive index increases, then δ increases & hence θ increases.
4	**(d)** Magnifying power of microscope $= \frac{LD}{f_0 f_e} \propto \frac{1}{f_0}$ Hence with increase f_0 magnifying power of microscope decreases. $\text{Magnifying power of telescope} = \frac{f_0}{f_e} \propto f_0$ Hence with increase f0 magnifying power of telescope increases.
5	(d) $\mu_4 = \mu_1$

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(a) $_{2}^{1}\mu = \frac{\sin 90°}{\sin C} = \frac{1}{\sin C}$ [For critical angle]

$\therefore \quad C = \sin^{-1}\left(\frac{1}{_{2}^{1}\mu}\right)$ ...(i)

Applying Snell's law at P, we get

$_{2}^{1}\mu = \frac{\sin r'}{\sin i} = \frac{\sin(90-r)}{\sin r}$ $[\because i = r; r' + r = 90°]$

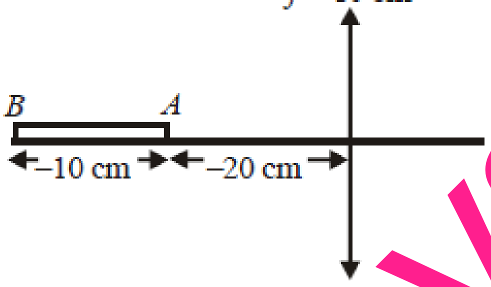
$_{2}^{1}\mu = \frac{\cos r}{\sin r}$ ...(ii)

From (i) and (ii)

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

7

(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

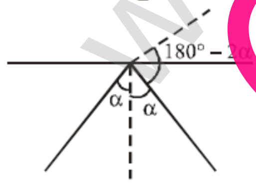
$L = v_2 - v_1 = -15 - (-20)$

$L = 5$ cm

8

(a) $\cos(180° - 2\alpha) = \frac{\left(\frac{i}{2} + \frac{\sqrt{3}}{2}j\right)\cdot\left(\frac{i}{2} - \frac{\sqrt{3}}{2}j\right)}{\sqrt{\left(\frac{1}{2}\right)^2 + \left(\frac{\sqrt{3}}{2}\right)^2}\sqrt{\left(\frac{1}{2}\right)^2 + \left(-\frac{\sqrt{3}}{2}\right)^2}}$

$\therefore \cos(180° - 2\alpha) = -\frac{1}{2}$



$\therefore 180° - 2\alpha = 120° \quad \therefore \alpha = 30°$

Option (a) is correct.

9

(a) 1.5×10^{10} cm/sec

10

(c) $v = \frac{c}{\mu}$ or $\lambda_m = \frac{\lambda_0}{\mu}$ $\therefore \lambda_m = \frac{420}{(4/3)} = 315$ nm

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11	**(b)** $\mu = \frac{\text{velocity of light in vacuum (c)}}{\text{velocity of light in medium (v)}}$ But $v = \upsilon\lambda = 2\times10^{14}\times5000\times10^{-10}$ In the medium, $v = 10^8$ m/s. $\therefore\ \mu = \frac{v_{vac}}{v_{med}} = \frac{3\times10^8}{10^8} = 3.$
12	**(d)** Here, $v_A = 1.8\times10^8\ m\ s^{-1}$ $v_B = 2.4\times10^8\ m\ s^{-1}$ 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. $\therefore\ \sin C = {}^A\mu_B = \frac{1}{{}^B\mu_A}$ Refractive index of medium B w.r.t. to medium A is ${}^A\mu_B = \frac{\text{Velocity of light in medium } A}{\text{Velocity of light in medium } B} = \frac{v_A}{v_B}$ $\therefore\ \sin C = \frac{v_A}{v_B} = \frac{1.8\times10^8}{2.4\times10^8} = \frac{3}{4}$ or $C = \sin^{-1}\left(\frac{3}{4}\right)$
13	**(c)** For total internal reflection, $\mu \ge \frac{1}{\sin C} \ge \sqrt{2} \ge 1.414 \Rightarrow \mu = 1.50$
14	**(b)** $\frac{1}{f_a} = \left(\frac{1.5}{1}-1\right)\left(\frac{1}{R_1}-\frac{1}{R_2}\right)$ $\frac{1}{f_m} = \left(\frac{\mu_g}{\mu_m}-1\right)\left(\frac{1}{R_1}-\frac{1}{R_2}\right)$ $\frac{1}{f_m} = \left(\frac{1.5}{1.6}-1\right)\left(\frac{1}{R_1}-\frac{1}{R_2}\right)$ Dividing (i) by (ii), $\frac{f_m}{f_a} = \left[\frac{1.5-1}{\frac{1.5}{1.6}-1}\right] = -8$ $P_a = -5 = \frac{1}{f_a} \Rightarrow f_a = -\frac{1}{5} \Rightarrow f_m = -8\times f_a = -8\times-\frac{1}{5} = \frac{8}{5}$ $P_m = \frac{\mu}{f_m} = \frac{1.6}{8}\times5 = 1D$
15	**(b)** If $R_1 = R, R_2 = -2R$, $\frac{1}{f} = (\mu-1)\left(\frac{1}{R_1}-\frac{1}{R_2}\right)$, $\frac{1}{6} = (1.5-1)\left(\frac{1}{R}+\frac{1}{2R}\right)$, $= \frac{0.5\times3}{2R}$, $R = 4.5$ cm
16	**(b)** Here, $P_1 = 5$ D $P_2 = P - P_1 = 2 - 5 = -3$ D $\frac{\omega_1}{\omega_2} = -\frac{f_1}{f_2} = \frac{-P_2}{P_1} = \frac{3}{5}$
17	**(c)** Longitudinal chromatic aberration $= \omega f$ $= 0.08\times20 = 1.6$ cm
18	**(b)** $i = \frac{A+\delta_m}{2} = \frac{60+30}{2} = 45^\circ$
19	**(d)** $i_1 = i_2 = \frac{3}{4}A$ As $A+\delta = i_1+i_2$ $\therefore\ \delta = i_1+i_2-A = \frac{3}{4}A+\frac{3}{4}A-A = \frac{A}{2} = \frac{60^\circ}{2} = 30^\circ$

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20	**(d)** Here $\frac{x}{1000} = \frac{1.22\lambda}{D}$ or $x = \frac{1.22\times5\times10^{3}\times10^{-10}\times10^{3}}{10\times10^{-2}}$ or $x = 1.22\times5\times10^{-3}\,m = 6.1\,m$ x is of the order of 5 mm.
21	**(d)** Resolving power $\alpha(1/\lambda)$. Hence, $\frac{(R.P)_1}{(R.P)_2} = \frac{\lambda_2}{\lambda_1} = \frac{5}{4}$
22	**(a)** $\frac{f_0}{f_e} = 9$, $\therefore\ f_0 = 9f_e$ Also $f_0 + f_e = 20$ ($\because$ final image is at infinity) $9f_e + f_e = 20$, $f_e = 2$ cm, $\therefore\ f_0 = 18$ cm
23	**(b)** In normal adjustment, $M = \frac{f_0}{f_e} = 20$, $f_e = \frac{f_0}{20} = \frac{60}{20} = 3$ cm
24	**(a)** (i) $M = -\frac{f_0}{f_e}\left(1+\frac{f_e}{d}\right) = -\frac{200}{5}\left(1+\frac{5}{25}\right) = -48$ (since least distance d = 25cm) (ii) $M = -\frac{f_0}{f_e} = -\frac{200}{5} = -40$
25	**(b)** $M = \frac{\beta}{\alpha} = \frac{f_0}{f_e}$ $\therefore\ \beta = \frac{f_0}{f_e}\alpha = \frac{60}{5}\times2° = 24°$
26	(i) $\lambda = 6000\ Å = 6\times10^{-7}$ m, $d = 0.1$ cm $= 1\times10^{-3}$ m, D = 1m, n = 10 Angular position $\theta_n = \frac{n\lambda}{d} = \frac{10\times6\times10^{-7}}{10^{-3}} = 6\times10^{-3}$ rad.
27	(i) For m[th] dark fringe $x'_m = (2m-1)\frac{D\lambda}{2d}$ given, D = 1m = 100 cm, d = 0.12 mm = 0.012 cm $x'_3 = \frac{(2\times3-1)\times100\times6\times10^{-7}}{2\times0.012} = 1.25$ cm [$\because$ m = 3 and $\lambda = 6\times10^{-7}$ m]
28	(ii) For n[th] bright fringe $x_n = \frac{nD\lambda}{d} \Rightarrow x_3 = \frac{3\times100\times6\times10^{-7}}{0.012} = 1.5\times10^{-2}$ m = 1.5 cm [$\because$n = 3]

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$$\alpha_{air} = \frac{\lambda}{d} \Rightarrow \alpha_{air} = 0.2 \Rightarrow \alpha \propto \lambda \Rightarrow \frac{\alpha_w}{\alpha_{air}} = \frac{\lambda_w}{\lambda_{air}} \Rightarrow \lambda_w = \frac{\lambda_{air}}{\mu} \Rightarrow \alpha_w = \frac{\alpha_{air}\ \lambda}{\mu.\lambda} = \frac{0.2 \times 3}{4} = 0.15$$

30

Path difference = 171.5 λ = $\frac{343}{2}\lambda$ = odd multiple of half wavelength . It means dark finge is observed

According to question $0.01029 = \frac{343}{2}\lambda \Rightarrow \lambda = \frac{0.01029 \times 2}{343} = 6 \times 10^{-5}\,\text{cm} \Rightarrow \lambda = 6000\ \text{Å}$

31

$$\beta_w = \frac{\mu_g - 1}{\mu_g - \mu_w}\beta_a = \frac{\frac{3}{2} - 1}{\frac{3}{2} - \frac{4}{2}} = 3\beta_a$$

32

$$2\mu t \cos r = n\lambda \Rightarrow t = \frac{n\lambda}{2\mu \cos r} = \frac{1 \times 6 \times 10^{-7}}{2 \times 1.5 \times \cos 60} = \frac{6 \times 10^{-7}}{1.5} = 4 \times 10^{-7}\ \text{m}$$

33

Sol. Given $u = -15$ cm, $f = -10$ cm

Using $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$, we get $v = -30$ cm

$\therefore\ m = -\frac{u}{v} = -2$

Aliter: Using direct formula:

$$m = \frac{f}{f-u} = \frac{-10}{-10-(-15)} = -2$$

34

a. $u = -60$ cm

$f = -10$ cm

$$v = \frac{fu}{u-f} = \frac{-10(-60)}{-60-(-10)} = \frac{600}{-50} = -12\ \text{cm}$$

35

Sol. The person will see his face only when the image is virtual.
Virtual image of a real object is erect. Therefore,

$m = 2$

$\therefore\ \frac{-v}{u} = 2$ (Here $u = -20$ cm)

$\Rightarrow\ v = 40$ cm

Aliter: $m = \frac{f}{f-u}$

$\Rightarrow\ 2 = \frac{f}{f-(-20)}$

$\Rightarrow\ f = -40$ cm or $R = 80$ cm

36

Sol. Let x and y be the magnitudes of object and image distances.

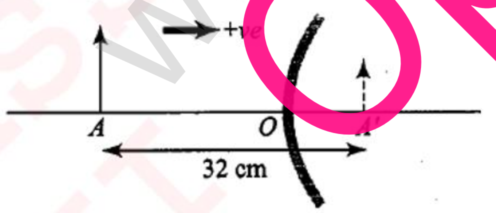

Fig. 1.53

We have $AA' = 32$ cm

$\Rightarrow\ AO + A'O = 32$ cm

$\Rightarrow\ (x + y) = 32$ (i)

And also, $u = -x,\ v = +y$

$$\frac{1}{-x} + \frac{1}{y} = \frac{1}{+12} \quad \text{(ii)}$$

Solving (i) and (ii) simultaneously, we can get u and v.
The relevant answers are $u = -24$ cm, $v = +8$ cm

Using $I = -1\left(\frac{+8}{-24}\right) = +\frac{1}{3}$

So, the image size is 1/3 cm.

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37	**Sol.** Maximum angle of refraction from denser medium to rarer medium is the critical angle. Hence, $1.5 \sin C = 1 \sin 90°$, where C = critical angle. $\sin C = 2/3$ $C = \sin^{-1} 2/3$
38	**Sol.** Since the incident light is in rarer medium, total internal reflection cannot take place. $C = \sin^{-1}\frac{1}{\mu} = 30°$ ∴ $i = 2C = 60°$ Applying Snell's law, $1 \sin 60° = 2 \sin r$ $\sin r = \frac{\sqrt{3}}{4} \Rightarrow r = \sin^{-1}\left(\frac{\sqrt{3}}{4}\right)$
39	(i) Here, bird is an object and fish is an observer. Hence, apparent height observed by the fish $d'_B = \frac{d}{n_{rel}} = \frac{d}{\left(\frac{n_{air}}{n_{water}}\right)} \Rightarrow d'_B = \frac{36}{\frac{1}{\left(\frac{4}{3}\right)}} = \frac{36}{3/4} = 48$ m
40	(ii) Here, the fish is an object and the bird is an observer. Hence, apparent height observed by the bird $d'_F = \frac{d}{n_{rel}} = \frac{d}{\left(\frac{n_{water}}{n_{air}}\right)} \Rightarrow d'_F = \frac{36}{4/3} = 27$ m
41	(iii) For the fish, the bird will be observed at a distance d_B from the fish: $d_B = 36 + 48 = 84$ m
42	(iv) For the bird, the fish will be observed at a distance 'd_F' from the bird: $d_F = 27 + 36 = 63$ m
43	**Sol.** $D_{app} = \sum\frac{d}{\mu} = \frac{20}{\left(\frac{2}{1.8}\right)} + \frac{15}{\left(\frac{1.5}{1.8}\right)} = 18 + 18 = 36$ cm

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44	**Sol.** Total apparent shift is $s = t_1\left(1-\frac{1}{\mu_1}\right)+t_2\left(1-\frac{1}{\mu_2}\right)$ or $s = 8\left(1-\frac{1}{\frac{4}{3}}\right)+4.5\left(1-\frac{1}{\frac{3}{2}}\right)$ or $s = 2 + 1.5 = 3.5$ cm The apparent depth of the coin from the top is $t = (8 + 4.5) - 3.5 = 9$ cm and, the real depth of the coin is $t_1 + t_2 = 8 + 4.5 = 12.5$ Therefore, the effective refractive index is $\mu_{eff} = \frac{\text{Real depth}}{\text{Apparent depth}}$ $= \frac{t_1+t_2}{t} = \frac{12.5}{9}$ $= 1.39$
45	**Sol.** Here, $\mu_v = 1.523$ and $\mu_r = 1.5145$ Mean refractive index, $\mu = \frac{1.523+1.5145}{2} = 1.51875$ Dispersive power is given by, $\omega = \frac{\mu_v - \mu_r}{(\mu-1)} = \frac{1.523-1.5145}{(1.51875-1)} = 0.1639$
46	**Sol.** $\frac{1}{f} = (n_{rel}-1)\left(\frac{1}{R_1}-\frac{1}{R_2}\right) = 0$ $[\because R_1 = R_2]$ $\frac{1}{v}-\frac{1}{u} = 0$ or $v = u$, i.e., rays pass without appreciable bending.
47	**Sol.** $\frac{1}{f} = (n_{rel}-1)\left(\frac{1}{R_1}-\frac{1}{R_2}\right)$ $\frac{1}{f} = (3/2-1)\left(\frac{1}{10}-\frac{1}{(-10)}\right)$ $\Rightarrow$ $\frac{1}{f} = \frac{1}{2}\times\frac{2}{10}$ $\Rightarrow$ $f = 10$ cm.

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48	**Sol.** According to lensmakers formula $$\frac{1}{f}=\left(\frac{\mu_2}{\mu_1}-1\right)\left(\frac{1}{R_1}-\frac{1}{R_2}\right)$$ $$\Rightarrow \quad \frac{1}{f}=(1.5-1)\left(\frac{1}{R_1}-\frac{1}{R_2}\right) \quad \text{(i)}$$ In ethyl alcohol, $\frac{1}{f_{\text{liquid}}}=\left(\frac{1.5}{1.36}-1\right)\left(\frac{1}{R_1}-\frac{1}{R_2}\right)$ (ii) Dividing (i) and (ii), we get $$\frac{f_{\text{liquid}}}{f}=\frac{(1.5-1)\left(\frac{1}{R_1}-\frac{1}{R_2}\right)}{\left(\frac{1.5}{1.36}-1\right)\left(\frac{1}{R_1}-\frac{1}{R_2}\right)}$$ $$\Rightarrow \quad f_{\text{liquid}}=242.75\text{ cm}$$
49	**(b)** One should increase the power of lens i.e., decrease the focal length of a lens.
50	**(d)** $P_2=P-P_1=\frac{100}{80}-\frac{100}{20}=-3.75\text{ D}$

…….All the best…….

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T.Vediyappan.,M.Sc.,M.Phil.,B.Ed.,