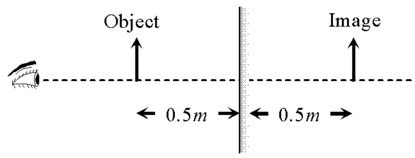
(1) **(B).** Distance between object and image
$= 0.5 + 0.5 = 1\text{m}$



(2) **(A).** When a mirror is rotated by an angle θ, the reflected ray deviate from its original path by angle 2θ.

(3) **(C).** $\frac{I}{O} = \frac{f}{(f-u)} \Rightarrow \frac{I}{+5} = \frac{-10}{-10-(-100)}$

$\Rightarrow I = 0.55$ cm

(4) **(D).** Virtual image is seen on the photograph.

(5) **(B).** When object is placed. Between focus and pole, image formed is erect, virtual and enlarged.

(6) **(C).** $u = -20\text{cm}, f = +10\text{cm}$ also $\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$

$\Rightarrow \frac{1}{+10} = \frac{1}{v} + \frac{1}{(-20)} \Rightarrow v = \frac{20}{3}$ cm;

Virtual image.

(7) **(A).** $\lambda_{medium} = \frac{\lambda_{air}}{\mu} = \frac{6000}{1.5} = 4000$ Å

(8) **(B).** $\mu = \frac{c}{v} = \frac{\sin i}{\sin r} = \frac{\sin 45^o}{\sin 30^o}$

$\Rightarrow \quad v = \frac{3\times10^8}{\sqrt{2}} = 2.12\times10^8 \text{ m/s}$

(9) **(C).** Frequency remain unchanged.

(10) **(C).** In this case, for seeing distant objects the far point is 40 cm. Hence the required focal length is

f = –d (distance of far point) = – 40 cm

Power $P = \frac{100}{f}\text{cm} = \frac{100}{-40} = -2.5$ D

(11) **(C).** For correcting myopia, concave lens is used and for lens.

u = wants to see = – 50cm

v = can see = – 25cm

From $\frac{1}{f} = \frac{1}{v} - \frac{1}{u} \Rightarrow \frac{1}{f} = \frac{1}{-25} - \frac{1}{(-50)}$

$\Rightarrow$ f = – 50cm

So power $P = \frac{100}{f} = \frac{100}{-50} = -2\text{D}$

(12) **(B).** For objective lens $\frac{1}{f_o} = \frac{1}{v_o} - \frac{1}{u_o}$

$\Rightarrow \frac{1}{(+4)} = \frac{1}{v_o} - \frac{1}{(-4.5)} \Rightarrow v_o = 36$ cm

$\therefore |m_D| = \frac{v_o}{u_o}\left(1 + \frac{D}{f_e}\right) = \frac{36}{4.5}\left(1 + \frac{24}{8}\right) = 32$

(13) **(A).** When final image is formed at infinity, length of the tube = $v_o + f_e$

$\Rightarrow 15 = v_o + 3 \Rightarrow v_o = 12$ cm

For objective lens $\frac{1}{f_o} = \frac{1}{v_o} - \frac{1}{u_o}$

$\Rightarrow \frac{1}{(+2)} = \frac{1}{(+12)} - \frac{1}{u_o} \Rightarrow u_o = -2.4\text{cm}$

(14) **(D).** Dispersion will not occur for a light of single wavelength $\lambda = 4000$ Å

(15) **(D).** Two objects whose images are closer than the distance $\left[v\theta = v\left(\frac{1.22\lambda}{D}\right)\right]$ will not be resolved, they will be seen as one.

The corresponding minimum separation, d_{min}, in the object plane is given by

$$d_{min} = \frac{v\left(\frac{1.22\lambda}{D}\right)}{m} = \frac{1.22\lambda}{D}\cdot\frac{v}{m} = \frac{1.22f\lambda}{D}$$

$$d_{min} = \frac{1.22\lambda}{2\tan\beta} = \frac{1.22\lambda}{2\sin\beta}$$

(16) **(C).** Dispersive power is the property of material.

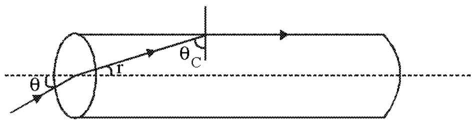
(17) **(C).** Here, $[n] = 5\ n - 1 \le 5 \le n$

$$\therefore \quad \frac{360}{\theta} - 1 \le 5 \le \frac{360}{\theta} \text{ or, } \theta \ge \frac{360}{6}$$

or $\quad \theta \le \frac{360}{5} \quad \therefore 60° \le \theta \le 72°$

(18) **(C).** Small and erect image is formed only by convex mirror. Plane mirror from images equal to object and concave mirror form images bigger than object.

(19) **(D).** $\sin\theta_C = \frac{\sqrt{3}}{2}$

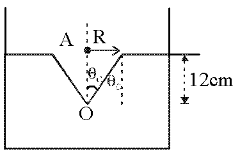


$$1 \sin\theta = \mu \sin r = \frac{2}{\sqrt{3}} \sin(90 - \theta_C)$$

$$= \frac{2}{\sqrt{3}}\sqrt{1 - \frac{3}{4}} = \frac{2}{\sqrt{3}} \times \frac{1}{2}$$

$$\theta = \sin^{-1}\frac{1}{\sqrt{3}}$$

(20) **(B).** The situation is shown in figure.



$$\sin\theta_C = \frac{1}{\mu}\ ;\ \tan\theta_C = \frac{AB}{AO}$$

$\therefore \quad AB = OA \tan\theta_C$

or $\quad AB = \frac{OA}{\sqrt{\mu^2 - 1}} = \frac{12}{\sqrt{\left(\frac{4}{3}\right)^2 - 1}} = \frac{36}{\sqrt{7}}$

(21) **(A).** We know $\frac{Y}{D} \ge 1.22\frac{\lambda}{d}$

$$\Rightarrow D \ge \frac{Yd}{1.22\lambda} = \frac{10^{-3} \times 3 \times 10^{-3}}{1.22 \times 5 \times 10^{-7}} = \frac{30}{6.1} = 5m$$

$D_{max} = 5m$

(22) **(D).** A vernier scale provided on the microscope.

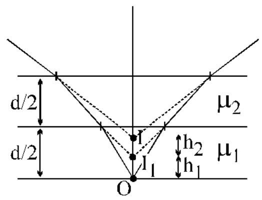
(23) **(D).** $\frac{f_m}{f} = \frac{(\mu - 1)}{\left(\frac{\mu}{\mu_m} - 1\right)}$

$$\frac{f_1}{f} = \frac{\left(\frac{3}{2} - 1\right)}{\left(\frac{3/2}{4/3} - 1\right)} = 4 \Rightarrow f_1 = 4f$$

$$\frac{f_2}{f} = \frac{\left(\frac{3}{2} - 1\right)}{\left(\frac{3/2}{5/3} - 1\right)} = -5 \Rightarrow f_2 < 0$$

(24) **(D).** As frequency of visible light increases refractive index increases. With the increase of refractive index critical angle decreases. So that light having frequency greater than green will get total internal reflection and the light having frequency less than green will pass to air.

(25) **(A).** $h_2 = d/(2\mu_2)\ ;\ h_1 = d/(2\mu_1)$
O — Initial object position
I — Final image position.



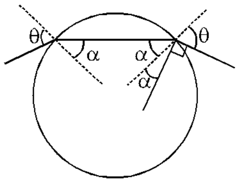
(26) **(D).** $\Delta t = t\left(1 - \frac{1}{\mu_{rel}}\right)$

$\Delta t = t\ (\mu - 1)$
Hence, $0.4 + 0.2\ [\mu - 1] = 0.5$

$\mu - 1 = \frac{1}{2}$

(27) **(C).** A secondary rainbow is formed when light rays coming from the sun undergo a refraction, IR, again IR and then refraction.

(28) **(A).** $\alpha + 90° + \theta = 180° \Rightarrow \alpha = 90 - \theta$



$\Rightarrow \quad 1 \sin\theta = \sqrt{3}\sin(90-\theta)\,;\ \theta = 60°$

(29) **(C).** $\dfrac{1}{f_1} = (\mu_1 - 1)\left(\dfrac{1}{\infty} + \dfrac{1}{R}\right) = \dfrac{\mu_1 - 1}{R}$

$$\frac{1}{f_2} = (\mu_3 - 1)\left(-\frac{1}{R} + \frac{1}{R}\right) = 0$$

$$\frac{1}{f_3} = (\mu_2 - 1)\left(-\frac{1}{R} - \frac{1}{\infty}\right) = -\frac{(\mu_2 - 1)}{R}$$

$$\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2} + \frac{1}{f_3}$$

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

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

(30) **(C).** $m = \dfrac{-2.4}{160} = \dfrac{v}{u}\ ;\ v = \dfrac{2.4}{168}$

$$-\frac{70}{u} - \frac{1}{u} = \frac{1}{5.5}$$

$u = -71 \times 5.5$ cm $= -3.9$ m

(31) **(C).** Interference is explained by wave nature of light.

(32) **(D).** The refractive index of air is slightly more than 1. When chamber is evacuated, refractive index decreases and hence the wavelength increases and fringe width also increases.

(33) **(D).** $\beta = \dfrac{\lambda D}{d} \Rightarrow \dfrac{\beta_2}{\beta_1} = \dfrac{\lambda_2 D_2 d_1}{\lambda_1 D_1 d_2}$

$$\Rightarrow \beta_2 = 2.5 \times 10^{-4}\,\text{m}$$

(34) **(D).** $\beta \propto \dfrac{\lambda}{d}$

(35) **(B).** The separation between the successive bright fringes is

$$\beta = \frac{D\lambda}{d} = \frac{1 \times 600 \times 10^{-9}}{1 \times 10^{-3}} = 6.0\text{ mm.}$$

(36) **(C).** From Brewster's law

$$\mu = \tan i_p \ \Rightarrow \frac{c}{v} = \tan 60° = \sqrt{3}$$

$$\Rightarrow v = \frac{c}{\sqrt{3}} = \frac{3 \times 10^8}{\sqrt{3}} = \sqrt{3} \times 10^8\text{ m/sec.}$$

(37) **(C).** $\dfrac{I_{max}}{I_{min}} = \left(\dfrac{\dfrac{a_1}{a_2} + 1}{\dfrac{a_1}{a_2} - 1}\right)^2 = \left(\dfrac{\dfrac{4}{3} + 1}{\dfrac{4}{3} - 1}\right)^2 = \dfrac{49}{1}$

(38) **(B).** $\phi = \pi/3,\ a_1 = 4,\ a_2 = 3$

$$A = \sqrt{a_1^2 + a_2^2 + 2a_1.a_2\cos\varphi} \Rightarrow A \approx 6$$

(39) **(C).** Distance of n^{th} bright fringe

$$y_n = \frac{n\lambda D}{d}\text{ i.e. } y_n \propto \lambda$$

$$\therefore \frac{x_{n_1}}{x_{n_2}} = \frac{\lambda_1}{\lambda_2} \Rightarrow \frac{x(\text{Blue})}{x(\text{Green})} = \frac{4360}{5460}$$

$\therefore$ x (Green) > x (Blue).

(40) **(D).** $(n_1\lambda_1 = n_2\lambda_2)$

$$\frac{n_1}{n_2} = \frac{\lambda_2}{\lambda_1} \Rightarrow \frac{n_1}{92} = \frac{5898}{5461} \Rightarrow n_1 = 99$$

(41) **(C).** Width of central bright fringe.

$$= \frac{2\lambda D}{d} = \frac{2 \times 500 \times 10^{-9} \times 80 \times 10^{-2}}{0.20 \times 10^{-3}}$$

$$= 4 \times 10^{-3}\,\text{m} = 4\text{mm.}$$

(42) **(B).** $\theta = a + \dfrac{b}{\lambda^2}$

$$30 = a + \frac{b}{(5000)^2}\ \text{ and }\ 50 = a + \frac{b}{(4000)^2}$$

Solving for a, we get $a = -\dfrac{50°}{9}$ per mm

(43) **(B).** Fringe width, $\beta = \frac{\lambda D}{d}$

According to de Broglie,

Wavelength $\lambda = \frac{h}{p} = \frac{h}{\sqrt{2meV}}$

As V decreases, λ increases, β increases.

(44) **(D).** If unpolarised light is passed through a polariod P_1, its intensity will become half.

So $I_1 = \frac{1}{2} I_0$ with vibrations parallel to the axis of P_1. Now this light will pass through second polaroid P_2 whose axis is inclined at an a angle of 30° to the axis of P_1 and hence, vibrations of I_1. So in accordance with Malus law, the intensity of light emerging from P_2 will be

$$I_2 = I_1 \cos^2 30° = \left(\frac{1}{2} I_0\right)\left(\frac{\sqrt{3}}{2}\right)^2 = \frac{3}{8} I_0$$

$$\frac{I_2}{I_0} = \frac{3}{8} = 37.5\ \%$$

(45) **(D).** $\frac{ax}{f} = n\lambda$

$$\lambda = \frac{ax}{f} = \frac{0.3 \times 10^{-3} \times 5 \times 10^{-3}}{3 \times 1}$$

$\lambda = 5 \times 10^{-7}$ m ; $\lambda = 5000$Å