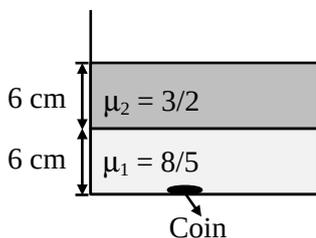


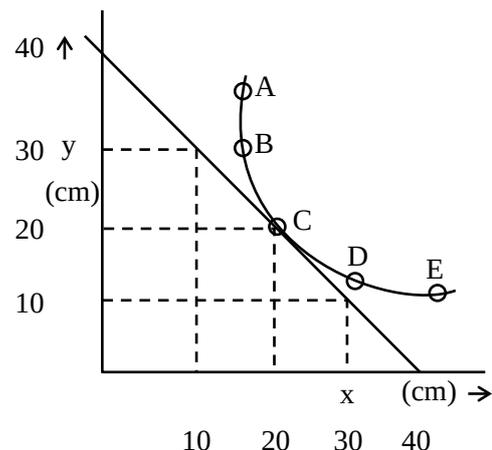
**GEOMETRICAL OPTICS**

1. If the refractive index of the material of a prism is  $\cot\left(\frac{A}{2}\right)$ , where A is the angle of prism then the angle of minimum deviation will be
- (1)  $\pi - 2A$                       (2)  $\frac{\pi}{2} - 2A$
- (3)  $\pi - A$                          (4)  $\frac{\pi}{2} - A$
2. Two immiscible liquids of refractive indices  $\frac{8}{5}$  and  $\frac{3}{2}$  respectively are put in a beaker as shown in the figure. The height of each column is 6 cm. A coin is placed at the bottom of the beaker. For near normal vision, the apparent depth of the coin is  $\frac{\alpha}{4}$  cm. The value of  $\alpha$  is \_\_\_\_\_.



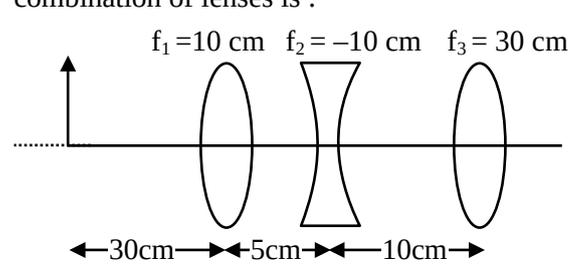
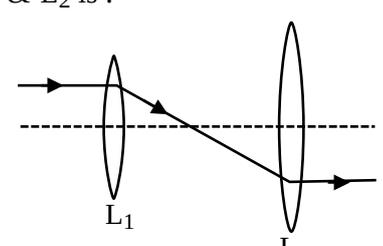
3. A convex mirror of radius of curvature 30 cm forms an image that is half the size of the object. The object distance is :
- (1) -15 cm                      (2) 45 cm
- (3) -45 cm                      (4) 15 cm
4. A biconvex lens of refractive index 1.5 has a focal length of 20 cm in air. Its focal length when immersed in a liquid of refractive index 1.6 will be:
- (1) -16 cm                      (2) -160 cm
- (3) +160 cm                      (4) +16 cm

5. If the distance between object and its two times magnified virtual image produced by a curved mirror is 15 cm, the focal length of the mirror must be :
- (1) 15 cm                      (2) -12 cm
- (3) -10 cm                      (4) 10/3 cm
6. The distance between object and its two times magnified real image as produced by a convex lens is 45 cm. The focal length of the lens used is \_\_\_\_\_ cm.
7. In an experiment to measure the focal length (f) of a convex lens, the magnitude of object distance (x) and the image distance (y) are measured with reference to the focal point of the lens. The y-x plot is shown in figure. The focal length of the lens is \_\_\_\_\_ cm.



8. The refractive index of a prism with apex angle A is  $\cot A/2$ . The angle of minimum deviation is :
- (1)  $\delta_m = 180^\circ - A$
- (2)  $\delta_m = 180^\circ - 3A$
- (3)  $\delta_m = 180^\circ - 4A$
- (4)  $\delta_m = 180^\circ - 2A$
9. Light from a point source in air falls on a convex curved surface of radius 20 cm and refractive index 1.5. If the source is located at 100 cm from the convex surface, the image will be formed at \_\_\_\_\_ cm from the object.

## GEOMETRICAL OPTICS

10. The distance between object and its 3 times magnified virtual image as produced by a convex lens is 20 cm. The focal length of the lens used is \_\_\_\_\_ cm.
11. An effective power of a combination of 5 identical convex lenses which are kept in contact along the principal axis is 25 D. Focal length of each of the convex lens is :  
 (1) 20 cm (2) 50 cm  
 (3) 500 cm (4) 25 cm
12. A light ray is incident on a glass slab of thickness  $4\sqrt{3}$  cm and refractive index  $\sqrt{2}$ . The angle of incidence is equal to the critical angle for the glass slab with air. The lateral displacement of ray after passing through glass slab is \_\_\_\_ cm. (Given  $\sin 15^\circ = 0.25$ )
13. Given below are two statements :  
**Statement I** : When the white light passed through a prism, the red light bends lesser than yellow and violet.  
**Statement II** : The refractive indices are different for different wavelengths in dispersive medium. In the light of the above statements, choose the correct answer from the options given below :  
 (1) Both Statement I and Statement II are true.  
 (2) Statement I is true but Statement II is false.  
 (3) Both Statement I and Statement II are false.  
 (4) Statement I is false but Statement II is true.
14. The refractive index of prism is  $\mu = \sqrt{3}$  and the ratio of the angle of minimum deviation to the angle of prism is one. The value of angle of prism is \_\_\_\_\_°.
15. For the thin convex lens, the radii of curvature are at 15 cm and 30 cm respectively. The focal length the lens is 20 cm. The refractive index of the material is :  
 (1) 1.2 (2) 1.4  
 (3) 1.5 (4) 1.8
16. Critical angle of incidence for a pair of optical media is  $45^\circ$ . The refractive indices of first and second media are in the ratio:  
 (1)  $\sqrt{2} : 1$  (2) 1 : 2  
 (3) 1 :  $\sqrt{2}$  (4) 2 : 1
17. The position of the image formed by the combination of lenses is :  
  
 (1) 30 cm (right of third lens)  
 (2) 15 cm (left of second lens)  
 (3) 30 cm (left of third lens)  
 (4) 15 cm (right of second lens)
18. Given below are two statements:  
**Statement (I)**: When an object is placed at the centre of curvature of a concave lens, image is formed at the centre of curvature of the lens on the other side.  
**Statement (II)**: Concave lens always forms a virtual and erect image.  
 In the light of the above statements, choose the **correct** answer from the options given below:  
 (1) **Statement I** is false but **Statement II** is true.  
 (2) Both **Statement I** and **Statement II** are false.  
 (3) **Statement I** is true but **Statement II** is false.  
 (4) Both **Statement I** and **Statement II** are true.
19. The following figure represents two biconvex lenses  $L_1$  and  $L_2$  having focal length 10 cm and 15 cm respectively. The distance between  $L_1$  &  $L_2$  is :  
  
 (1) 10 cm (2) 15 cm  
 (3) 25 cm (4) 35 cm

**SOLUTIONS**

1. **Ans. (1)**

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

$$\Rightarrow \cos \frac{A}{2} = \sin \left( \frac{A + \delta_{\min}}{2} \right)$$

$$\frac{A + \delta_{\min}}{2} = \frac{\pi}{2} - \frac{A}{2}$$

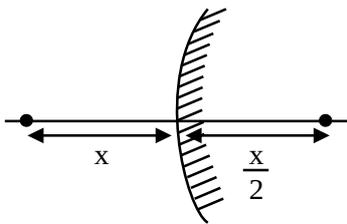
$$\delta_{\min} = \pi - 2A$$

2. **Ans. (31)**

**Sol.** 
$$h_{\text{app}} = \frac{h_1}{\mu_1} + \frac{h_2}{\mu_2} = \frac{6}{3/2} + \frac{6}{8/5}$$

3. **Ans. (1)**

**Sol.**



Given  $R = 30 \text{ cm}$

$$f = R/2 = +15 \text{ cm}$$

$$\text{Magnification (m)} = \pm \frac{1}{2}$$

For convex mirror, virtual image is formed for real object.

Therefore, m is +ve

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

$$u = -15 \text{ cm}$$

4. **Ans. (2)**

**Sol.**  $\mu_1 = 1.5$

$$\mu_m = 1.6$$

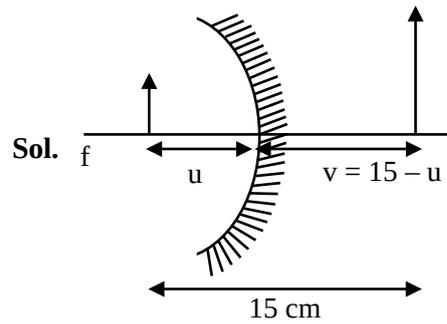
$$f_a = 20 \text{ cm}$$

$$\text{As } \frac{f_m}{f_a} = \frac{(\mu_1 - 1)\mu_m}{(\mu_1 - \mu_m)}$$

$$\frac{f_m}{20} = \frac{(1.5 - 1)1.6}{(1.5 - 1.6)}$$

$$f_m = -160 \text{ cm}$$

5. **Ans. (3)**



**Sol.** 
$$m = 2 = \frac{-v}{u}; \quad 2 = \frac{-(15 - u)}{-u}$$

$$2u = 15 - u$$

$$3u = 15 \Rightarrow u = 5 \text{ cm}$$

$$v = 15 - u = 15 - 5 = 10 \text{ cm}$$

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

$$= \frac{1}{10} + \frac{1}{(-5)} = \frac{1 - 2}{10} = \frac{-1}{10}$$

$$f = -10 \text{ cm}$$

6. **Ans. (10)**

**Sol.** 
$$\frac{v}{u} = -2$$

$$v = -2u \quad \dots(i)$$

$$v - u = 45 \quad \dots(ii)$$

$$\Rightarrow u = -15 \text{ cm}$$

$$v = 30 \text{ cm}$$

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

$$f = +10 \text{ cm}$$

7. **Ans. (20)**

**Sol.** 
$$\frac{1}{f + 20} - \frac{1}{-(f + 20)} = \frac{1}{f}$$

$$\frac{2}{f + 20} = \frac{1}{f} \quad f = 20 \text{ cm}$$

$$\text{Or } x_1 x_2 = f^2 \text{ gives } f = 20 \text{ cm}$$

8. **Ans. (4)**

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

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

**GEOMETRICAL OPTICS**

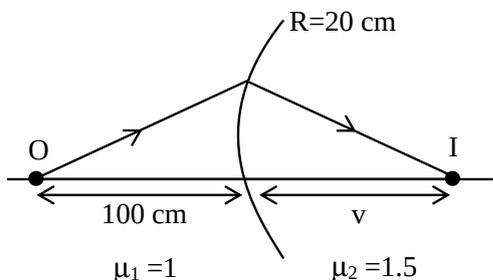
$$\sin\left(\frac{\pi}{2} - \frac{A}{2}\right) = \sin\left(\frac{A + \delta_m}{2}\right)$$

$$\frac{\pi}{2} - \frac{A}{2} = \frac{A}{2} + \frac{\delta_m}{2}$$

$$\delta_m = \pi - 2A$$

9. **Ans. (200)**

Sol.



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

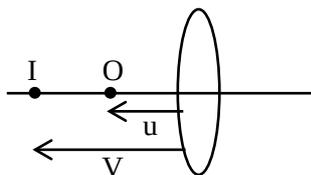
$$\frac{1.5}{v} - \frac{1}{-100} = \frac{1.5 - 1}{20}$$

$$v = 100 \text{ cm}$$

Distance from object = 100 + 100 = 200 cm

10. **Ans. (15)**

Sol.



$$v = 3u$$

$$v - u = 20 \text{ cm}$$

$$2u = 20 \text{ cm}$$

$$u = 10 \text{ cm}$$

$$\frac{1}{(-30)} - \frac{1}{(-10)} = \frac{1}{f}; f = 15 \text{ cm}]$$

11. **Ans. (1)**

Sol. We know that  $P_{eq} = \Sigma P_i$

$\therefore$  given all lenses are identical

$$\therefore 5P = 25D$$

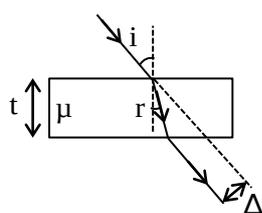
$$\therefore P = 5D$$

$$\therefore \frac{1}{f} = 5 \Rightarrow \frac{1}{5} \text{ m} = 20 \text{ cm}$$

Hence option (1)

12. **Ans. (2)**

Sol.



$$i = \theta_c$$

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

$$\Rightarrow i = 45^\circ$$

and according to snell's law

$$1 \sin 45^\circ = \sqrt{2} \sin r$$

$$\Rightarrow r = 30^\circ$$

$$\text{Lateral displacement } \Delta = \frac{t \sin(i - r)}{\cos r}$$

$$\Rightarrow \Delta = \frac{4\sqrt{3} \cdot \sin 15^\circ}{\cos 30^\circ}$$

$$\Rightarrow \Delta = 2 \text{ cm}$$

13. **Ans. (1)**

Sol. As  $\lambda_{\text{red}} > \lambda_{\text{yellow}} > \lambda_{\text{violet}}$

Light ray with longer wavelength bends less.

14. **Ans. (60)**

Sol. For  $\delta_{\min}$

$$i = e$$

$$r_1 = r_2 = \frac{A}{2}$$

$$\frac{\delta_{\min}}{A} = 1$$

$$\frac{2i - A}{A} = 1$$

$$2i = 2A$$

$$i = A$$

Snell's law

$$1 \times \sin i = \mu \sin r$$

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

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

$$2 \sin \frac{A}{2} \cos \frac{A}{2} = \sqrt{3} \sin\left(\frac{A}{2}\right)$$

$$\cos\left(\frac{A}{2}\right) = \frac{\sqrt{3}}{2}$$

$$\therefore \frac{A}{2} = 30^\circ \therefore A = 60^\circ$$

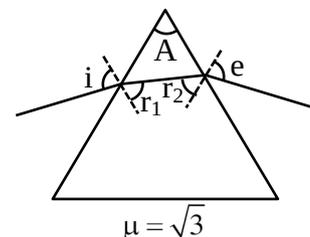
15. **Ans. (3)**

$$\text{Sol. } \frac{1}{f} = \left(\frac{\mu_{\text{lens}}}{\mu_{\text{air}}} - 1\right) \left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

$$\Rightarrow \frac{1}{+20} = \left(\frac{\mu}{1} - 1\right) \left(\frac{1}{+15} - \frac{1}{(-30)}\right)$$

$$\Rightarrow \frac{1}{20} = (\mu - 1) \left(\frac{3}{30}\right) \Rightarrow \mu - 1 = \frac{1}{2}$$

$$\Rightarrow \mu = 1 + \frac{1}{2} = \frac{3}{2} = 1.5$$



16. Ans. (1)

Sol.  $\sin\theta_c = \frac{\mu_R}{\mu_d} = \frac{\mu_2}{\mu_1}$

$$\sin 45^\circ = \frac{\mu_2}{\mu_1}$$

$$\Rightarrow \frac{1}{\sqrt{2}} = \frac{\mu_2}{\mu_1} \Rightarrow \frac{\mu_1}{\mu_2} = \frac{\sqrt{2}}{1}$$

17. Ans. (1)

Sol. For lens 1 :  $f_1 = 10, u = -30, v = ?$

$$v = \frac{uf}{u+f} = \frac{-30 \cdot 10}{-30+10} = 15$$

For lens 2 :  $f_1 = -10, u = 10, v = ?$

$$v = \frac{uf}{u+f} = \frac{10 \cdot -10}{10-10} = \infty$$

For lens 3 :  $f = 30, u = -\infty, v = ?$

So v will be 30.

18. Ans. NTA (1)

Allen (2)

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

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

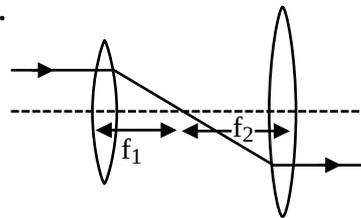
$$\Rightarrow \frac{1}{v} = \frac{-1}{2f} \Rightarrow v = -2f$$

$$\frac{1}{v} = \frac{1}{u} + \frac{1}{f} \Rightarrow \text{Virtual image of Real object.}$$

In statement II, it is not mentioned that object is real or virtual hence Statement II is false.

19. Ans. (3)

Sol.



$$D = f_1 + f_2 = 25 \text{ cm}$$

Paraxial parallel rays pass through focus and ray from focus of convex lens will become parallel