DAY THIRTY

Unit Test 6

(Optics)

1 Sun is visible a little before the actual sunrise and until a little after the actual sunset. This is due to

(a) total internal reflection (b) reflection
(c) refraction (d) polarisation

2 The magnification of a compound microscope is 30 and the focal length of its eye piece is 5cm. The magnification produced by the objective, when the image is to be formed at least distance of distinct vision (25 cm), is

(a) 5 (b) 6 (c) 8 (d) 10

3 A simple microscope consists of a concave lens of power −10 D and a convex lens of power +20 D in contact. If the image is formed at infinity, then the magnifying power ($D = 25$ cm) is

(a) 2.5 (b) 3.5 (c) 2.0 (d) 3.0

4 Interference is possible in

(a) light waves only
(b) sound waves only
(c) both light and sound waves
(d) neither light nor sound waves

5 The axes of the polariser and analyser are inclined to each other at 45°. If the amplitude of the unpolarised light incident on the polariser is a, then what is the amplitude of the light transmitted through the analyser?

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

6 A ray is incident at an angle of incidence i on one surface of a prism of small angle A and emerges normally from opposite surface. If the refractive index of the material of prism is μ, the angle of incidence i is nearly equal to

(a) $\frac{A}{\mu}$ (b) $\frac{A}{2\mu}$ (c) μA (d) $\frac{\mu A}{2}$

7 A beam of monochromatic light is refracted from vacuum into a medium of refractive index 1.5. The wavelength of refracted light will be

(a) dependent on intensity of refracted light
(b) same
(c) smaller
(d) larger

8 There is a prism with refractive index equal to $\sqrt{2}$ and the refracting angle equal to 30°. One of the refracting surface of the prism is polished. A beam of monochromatic light will retrace its path, its angle of incidence over the refracting surface of the prism is

(a) 0° (b) 30° (c) 45° (d) 60°

9 What is Brewster angle for air to glass transition? (μ of glass is 1.5)

(a) 56.3° (b) 57.5° (c) 59.1° (d) 83°

10 In a double slit experiment 5th dark fringe is formed opposite to one of the slits. The wavelength of light is

(a) $\frac{d^2}{6D}$ (b) $\frac{d^2}{5D}$ (c) $\frac{d^2}{15D}$ (d) $\frac{d^2}{9D}$

11 Angle of deviation (δ) by a prism (refractive index $= \mu$, and supposing the angle of prism A to be small) can be given by

(a) $\delta = (\mu - 1)A$ (b) $\delta = (\mu + 1)A$
(c) $\mu = \dfrac{\sin\frac{A+\delta}{2}}{\sin\frac{A}{2}}$ (d) $\delta = \frac{\mu - 1}{\mu + 1}A$

12 The illuminance of a surface 2 m away from a point source is 4 Wm^{-2}. It will be 2 Wm^{-2} when the distance of the point from the source is

(a) $2\sqrt{2}$ m (b) $2/\sqrt{2}$ m
(c) $\sqrt{2}$ m (d) $1/\sqrt{2}$ m

13 A wavefront is represented by the plane $y = 3 - x$. The propagation wave takes place at

(a) 45° with the +ve x -direction
(b) 135° with the +ve x-direction
(c) 60° with the +ve x-direction
(d) no sufficient data

14 In Young's double slit experiment with monochromatic light of wavelength 600 nm, the distance between slits is 10^{-3} m. For changing fringe width by 3×10^{-5} m

(a)the screen is moved away from the slits by 5 cm
(b)the screen is moved by 5 cm towards the slits
(c)the screen is moved by 3 cm towards the slits
(d)Both (a) and (b) be correct

15 A lens is placed between a source of light and wall. It forms images of area A_1 and A_2 on the wall, for its two different positions, the area of the source of light is

(a) $\sqrt{A_1 A_2}$ (b) $\frac{A_1 + A_2}{2}$ (c) $\frac{A_1 - A_2}{2}$ (d) $\frac{1}{A_1} + \frac{1}{A_2}$

16 A convex lens of focal length 80 cm and a concave lens of focal length 50 cm are combined together. What will be their resulting power?

(a) + 6.5 D (b) – 6.5 D (c) + 7.5 D (d) – 0.75 D

17 Unpolarised light of intensity 32 Wm^{-2} is incident on the combination of three polaroids. The first and last polaroids are crossed. If the intensity of the light transmitted through the combination be 3 Wm^{-2}, then what is the angle between the transmission axes of first two polaroids?

(a) 0° (b) 30° (c) 45° (d) 60°

18 Two lamps of powers P_1 and P_2 are placed on either side of a paper having an oil spot. The lamps are at 1m and 2m respectively, on either side of the paper and the oil spot is invisible. What is the value of P_1/P_2 ?

(a) 0.25 (b) 0.40 (c) 0.50 (d) 0.60

19 An astronomical telescope of ten-fold angular magnification has a length of 44 cm. The focal length of the objective is

(a) 440 cm (b) 44 cm (c) 40 cm (d) 4 cm

20 The wavefront due to a source situated at infinity is

(a) spherical (b) cylindrical
(c) planar (d) None of these

21 The refractive index of the material of an equilateral prism is $\sqrt{3}$, then the angle of minimum deviation of the prism is

(a) 30° (b) 45° (c) 60° (d) 75°

22 A parallel beam of light of wavelength 500 nm falls on a narrow slit and the resulting diffraction pattern is observed on a screen 1m away. It is observed that the first minimum is at a distance of 2.5 mm from the centre of the screen . Find the width of the slit.

(a) 0.2 mm (b) 1.0 mm (c) 4.1 mm (d) 0.6 mm

23 A transparent cube contains small air bubble. Its apparent distance is 2cm when seen through one face and 5 cm when seen through other face. If the refractive index of the material of the cube is 1.5, the real length of the edge of cube must be

(a) 7 cm (b) 7.5 cm (c) 10.5 cm (d) $\frac{14}{3}$ cm

24 Transmission of light in optical fibre is due to

(a) scattering (b) diffraction
(c) polarisation
(d) multiple total internal reflections

25 Diameter of human eye lens is 2 mm. What will be the minimum distance between two points to resolve them, which are situated at a distance of 50 m from eye? (The wavelength of light is 500 Å)

(a) 2.32 m (b) 4.28 mm (c) 1.25 cm (d) 12.48 cm

26 Two nicol prisms are placed with their principal planes at 60°. What percentage of light incident on the combination is transmitted?

(a) 75% (b) 60% (c) 25% (d) 12.5%

27 In Young's double slit experiment, if the slit widths are in the ratio 1 : 9, the ratio of the intensity at minima to that at maxima will be

(a) 1 (b) 1/9 (c) 1/4 (d) 1/3

28 Two coherent light sources S_1 and S_2 (λ = 6000 Å) are 1 mm apart from each other. The screen is placed at a distance of 25 cm from the sources. The width of the fringes on the screen should be

(a) 0.015 cm (b) 0.025 cm (c) 0.010 cm (d) 0.030 cm

29 Light from two coherent sources of same amplitude (A) and wavelength (λ) illuminates the screen. The intensity of central maximum is I_0. If the source were incoherent, the intensity at the same point will be

(a) $I_0/2$ (b) I_0 (c) $2I_0$ (d) $4I_0$

30 What will be the angle of diffraction for the first minimum due to Fraunhoffer diffraction with sources of light of wavelength 550 nm and slit of width 0.55 mm?

(a) 1 rad (b) 0.1 rad (c) 0.01 rad (d) 0.001 rad

31 Young's double slit experiment is performed with light of wavelength 550 nm. The separation between the slits is 1.10 mm and the screen is placed at a distance of 1m. What is the distance between the consecutive bright and dark fringes ?

(a) 0.5 mm (b) 1.0 mm
(c) 1.5 mm (d) None of these

32 To produce an achromatic combination, a convex lens of focal length 42 cm and dispersive power 0.14 is placed in contact with a concave lens of dispersive power 0.21. The focal length of the concave lens is

(a) 21 cm (b) 42 cm (c) 63 cm (d) 84 cm

33 The focal length of a lens for red and violet colours are 16.4 cm and 16 cm. What is its dispersive power?

(a) 0.050 (b) 0.025 (c) 0.012 (d) 0.006

34 A concave mirror of focal length 20cm produces an image twice the size of the object. If the image is real, then the distance of the object from the mirror is

(a) 10 cm (b) 20 cm (c) –30 cm (d) 60 cm

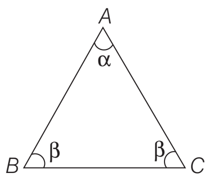
35 The luminous efficiency of the lamp is 5 lm W^{-1}. If the luminous intensity of the lamp be 35 Cd, then power of the lamp is

(a) 28 W (b) 88 W (c) 112 W (d) 140 W

36 A ray of light passes through an equilateral prism, such that an angle of incidence is equal to the angle of emergence and the latter is equal to 3/4 th the angle of prism. The angle of deviation is

(a) 45° (b) 39° (c) 20° (d) 30°

37 One face *AC* of the glass prism is silvered as shown and the principle section of the glass prism is an isosceles triangle *ABC* with *AB* = *AC*. The ∠*BAC*, if the ray incident normally on the face *AB* and after two reflections, it emerges from the base *BC*, perpendicular to it, is

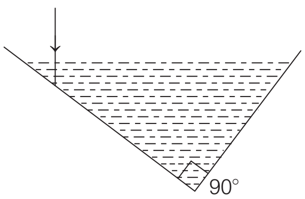


(a) 70° (b) 36° (c) 72° (d) 44°

38 A man having height 6 m, observes image of 2 m height erect, then mirror used is

(a) concave (b) convex
(c) plane (d) None of these

39 A vessel consists of two plane mirrors at right angle (as shown in the figure). The vessel is filled with water. The total deviation in incident ray is

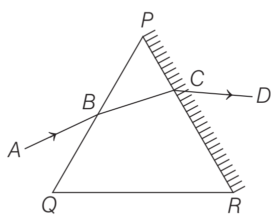


(a) 0° (b) 90°
(c) 180° (d) None of these

40 An object is placed at a distance equal to focal length of convex mirror. If the focal length of the mirror be *f*, then the distance of the image from the pole of the mirror is

(a) less than *f* (b) equal to *f* (c) more than *f* (d) infinity

41 If a ray light is incident on an equilateral glass prism *PQR* placed on a horizontal table, then for the minimum deviation which of the following is true?



(a) *AB* is horizontal
(b) *CD* is horizontal
(c) Either *AB* or *CD* is horizontal
(d) *BC* is horizontal

42 If the refractive index of a glass prism is $\cot\left(\frac{A}{2}\right)$ and *A* is angle of prism, then angle of minimum deviation is

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

43 If a convex lens of focal length 80 cm and a concave lens of focal length 50 cm are combined together, what will be their resultant power?

(a) + 0.65 D (b) – 0.65 D (c) + 0.75 D (d) – 0.75 D

44 A convex lens forms a full image of the object on a screen. If half of the lens is covered with an opaque object, then

(a) the image disappears (b) half of the image is seen
(c) full image is seen and of same intensity
(d) full image is seen and of decreased intensity

45 What is the focal length of a convex lens of focal length 30 cm in contact with a concave lens of focal length 20 cm. Is the system a converging or a diverging lens? (Ignore thickness of the lenses.)

(a) 60 cm, diverging (b) 40 cm, converging
(c) 50 cm, converging (d) 40 cm, diverging

Direction (Q. Nos. 46-50) *In each of the following questions a statement of Assertion is given followed by a corresponding statement of Reason just below it. Of the statements mark the correct answer as :*

(a) If both Assertion and Reason are true and the Reason is the correct explanation of the Assertion
(b) If both Assertion and Reason are true but the Reason is not correct explanation of the Assertion
(c) If Assertion is true but Reason is false
(d) If both Assertion and Reason are false

46 **Assertion** (A) The resolving power of a telescope is more, if the diameter of the objective lens is more.

Reason (R) Objective lens of large diameter collects more light.

47 **Assertion** (A) The focal length of the objective of the telescope is larger than that of eyepiece.

Reason (R) The resolving power of telescope increases when the aperture of objective is small.

48 **Assertion** (A) Convergent lens property of converging remain same in all mediums.

Reason (R) Property of lens whether the ray is diverging or converging is independent of the surrounding medium.

49 **Assertion** (A) If Brewster's angle be θ, then critical angle is $\sin^{-1}(\cot\theta)$.

Reason (R) The refractive index of medium $\mu = \frac{1}{\sin C}$, *C* being critical angle.

50 **Assertion** (A) In Young's double slit experiment interference pattern disappear when one of the slits is closed.

Reason (R) Interference occurs due to superimposition of light waves from two coherent sources.

ANSWERS

1 (c)	**2** (a)	**3** (a)	**4** (c)	**5** (a)	**6** (c)	**7** (c)	**8** (c)	**9** (a)	**10** (d)
11 (a)	**12** (a)	**13** (a)	**14** (d)	**15** (a)	**16** (d)	**17** (b)	**18** (a)	**19** (c)	**20** (c)
21 (c)	**22** (a)	**23** (c)	**24** (d)	**25** (c)	**26** (d)	**27** (c)	**28** (a)	**29** (a)	**30** (d)
31 (a)	**32** (c)	**33** (b)	**34** (c)	**35** (b)	**36** (d)	**37** (b)	**38** (b)	**39** (c)	**40** (a)
41 (d)	**42** (d)	**43** (d)	**44** (d)	**45** (a)	**46** (a)	**47** (c)	**48** (d)	**49** (b)	**50** (a)

Hints and Explanations

1 Sun is visible a little before the actual sunrise and until a little after the actual sunset. This is due to refraction.

2 When final image is formed at least distance of distinct vision, then the magnifying power

$$= M_o \times \left(1 + \frac{D}{f_e}\right)$$

$$30 = M_o\left(1 + \frac{25}{5}\right)$$

$$M_o = 5$$

3 Power of combination, $P = P_1 + P_2$

$$P = +20 - 10 = +10\,\text{D}$$

$$F = \frac{1}{P} = \frac{1}{10}\,\text{m} = \frac{100}{10}\,\text{cm} = 10\,\text{cm}$$

For final image at infinity

$$M = \frac{D}{F} = \frac{25}{10} = 2.5$$

4 Interference phenomenon is shown by both light and sound waves.

5 Amplitude of the light emerging from polariser $= a/\sqrt{2}$ and that through analyser $= (a/\sqrt{2})\cos 45° = a/2$.

6 Angle of prism is given by

$$A = r_1 + r_2$$

where, r_1 is refraction angle on incident face and r_2 is angle of incidence on second face of prism. As refracted ray emerges normally from opposite surface, $r_2 = 0$.

$\therefore \quad A = r_1$

Now, $\quad \mu = \dfrac{\sin i_1}{\sin r_1}$

If $\angle i_1$ and $\angle r_1$ are very small, then

$$\sin i_1 \approx i_1, \sin r_1 \approx r_1$$

$\therefore \quad \mu = \dfrac{i_1}{r_1} = \dfrac{i}{A}$

$\therefore \quad i = \mu A$

7 Refractive index, $\mu = \dfrac{c}{v} = \dfrac{v\lambda_v}{v\lambda_m}$

$\therefore \quad \lambda_m = \dfrac{\lambda_v}{\mu} \Rightarrow \lambda_m < \lambda_v \; [\because \mu = 1, \text{given}]$

Hence, the wavelength decreases in second medium. So, option (c) is correct.

8 The ray QR will retrace its path, when

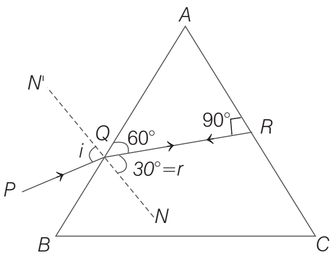
$$\angle ARQ = 90°, \angle r = 30°$$

$\therefore \quad \angle AQR = 90° - 30° = 60°$

As, from Snell's law,

$$\sin i = \mu \sin r = \sqrt{2}\sin 30°$$

$$= \sqrt{2} \times \frac{1}{2} = \frac{1}{\sqrt{2}}$$



$\therefore \quad \angle i = 45°$

9 $i_p = ?, \quad \mu = 1.5$

$$\tan i_p = \mu = 1.5$$

$\Rightarrow \quad i_p = \tan^{-1}(1.5) = 56.3°$

10 For dark fringe,

$$\frac{xd}{D} = (2m - 1)\frac{\lambda}{2}$$

Here, $\quad m = 5, x = \dfrac{d}{2}$

$\therefore \quad \dfrac{d}{2}\dfrac{d}{D} = (2 \times 5 - 1)\dfrac{\lambda}{2}$ or $\dfrac{d^2}{D} = 9\lambda$

$\therefore \quad \lambda = \dfrac{d^2}{9D}$

11 When refracting angle of a prism is small ($\angle 10°$), the deviation δ is calculated from the relation $\delta = (\mu - 1)A$. For prism with bigger refracting angles, we use the relation

$$\delta = (i_1 + i_2) - A$$

12

$$L_1 r_1^2 = L_2 r_2^2$$

$$r_2^2 = \frac{L_1 r_1^2}{L_2} = \frac{4 \times (2)^2}{2} = 8$$

or $\quad r_2 = \sqrt{8}\,\text{m} = 2\sqrt{2}\,\text{m}$

13 The propagation of ray takes place perpendicular direction of wavefront.

Here, $m_1 m_2 = -1$

Here, m_1 = slope of wavefront $= -1$

$\because \quad y = mx + c$

$\quad m_2$ = slope of ray

$\therefore \quad m_1 m_2 = -1$

or $\quad (-1)m_2 = -1$

$\therefore \quad m_2 = 1$ or $\tan\theta = 1 \Rightarrow \theta = 45°$

14

$$\beta = \frac{D}{d}\lambda$$

$$\Delta\beta = \frac{\Delta D}{d}\lambda$$

$$\Delta D = \frac{d\Delta\beta}{\lambda} = \frac{10^{-3} \times 3 \times 10^{-5}}{600 \times 10^{-9}}$$

$= 5\,\text{cm}$ away or towards the slits

15 In displacement method, total magnification

$m = \sqrt{m_1 m_2}$. Therefore, area of source

$= \sqrt{A_1 A_2}$.

16 Power of a lens is $P = \dfrac{1}{f}$

When f is in cm

$$P = \frac{100}{f}\text{D}$$

Here, $\quad f_1 = 80\,\text{cm}$ and $f_2 = -50\,\text{cm}$

$\therefore \quad P = \dfrac{100}{80} - \dfrac{100}{50} = -0.75\,\text{D}$

17

$$I = \frac{I_i}{2}\cos^2\theta\sin^2\theta$$

Here, $\quad \dfrac{2I}{I_i} = \dfrac{2 \times 3}{32} = \dfrac{\sin^2 2\theta}{4}$

Hence, $\quad \sin 2\theta = \dfrac{\sqrt{3}}{2}$

i.e. $\quad \theta = 30°$

18 Here, $\frac{P_1}{r_1^2} = \frac{P_2}{r_2^2}$

Hence, $\frac{P_1}{P_2} = \left(\frac{r_1}{r_2}\right)^2 = (1/2)^2 = 0.25$

19 For an astronomical telescope.

Magnification, $m = \frac{f_o}{f_e}$

Length of telescope tube $L = f_o + f_e$
Given, $m = 10$, $L = 44$ cm

$\therefore \quad \frac{f_o}{f_e} = 10$ and $f_o + f_e = 44$

$\Rightarrow \quad f_e = \frac{f_o}{10}$

So, $\quad f_o + \frac{f_o}{10} = 44$

or $\quad \frac{11 f_o}{10} = 44$

or $\quad f_o = 40$ cm

20 The wavefront due to a source situated at infinity is planar.

21 The refractive index of material of prism is

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

where, A is the angle of prism and δ_m the angle of minimum deviation.

Given, $\quad \mu = \sqrt{3}$, $A = 60°$ (for prism)

Thus, $\quad \sqrt{3} = \frac{\sin\left(\frac{60° + \delta_m}{2}\right)}{\sin 30°}$

or $\quad \sin\left(\frac{60° + \delta_m}{2}\right) = \frac{1}{2} \times \sqrt{3}$

or $\quad \sin\left(\frac{60° + \delta_m}{2}\right) = \sin 60°$

or $\quad \frac{60° + \delta_m}{2} = 60°$

or $\quad \delta_m = 2 \times 60° - 60° = 60°$

22 Here, $\lambda = 500$ nm $= 500 \times 10^{-9}$ m
$= 5 \times 10^{-7}$ m, $D = 1$ m, $n = 1$, $x = 2.5$ mm
$= 2.5 \times 10^{-3}$ m, $a = ?$

The condition for minima is $a\frac{x}{D} = n\lambda$

$$a = \frac{n\lambda D}{x} = \frac{1 \times 5 \times 10^{-7} \times 1}{2.5 \times 10^{-3}}$$

$= 2 \times 10^{-4}$ m $= 0.2$ mm

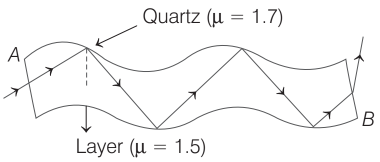
23 Refractive index $(\mu) = \frac{\text{Real depth}}{\text{Apparent depth}}$

Refractive index $(\mu) = 1.5$
Apparent depth $= 2 + 5 = 7$ cm

So, $\quad 1.5 = \frac{\text{Real depth}}{7}$

$\therefore$ Real depth $= 1.5 \times 7 = 10.5$ cm

24 It consists of very long and thin fibre of quartz glass.



When a light ray is incident at one end A of fibre making a small angle of incidence. It suffers multiple total internal reflections and finally, it reaches the point B.

25 Angular limit of resolution of eye

$$= \frac{\text{Wavelength of light}}{\text{Diameter of eye lens}}$$

i.e. $\quad \theta = \frac{\lambda}{d} \quad$ ...(i)

If y is the minimum resolution between two objects at distance D from eye, then

$\theta = \frac{y}{D} \quad$ ...(ii)

From Eqs. (i) and (ii), we have

$\frac{y}{D} = \frac{\lambda}{d}$ or $y = \frac{\lambda D}{d} \quad$ ...(iii)

Given,
$\lambda = 5000$ Å $= 5 \times 10^{-7}$ m, $D = 50$ m,
$d = 2$ mm $= 2 \times 10^{-3}$ m

On substituting in Eq. (iii), we get

$$y = \frac{5 \times 10^{-7} \times 50}{2 \times 10^{-3}}$$

$= 12.5 \times 10^{-3}$ m $= 1.25$ cm

26 Intensity of polarised light from first polariser $= \frac{I_0}{2}$

Intensity of polarised light from second polariser $= \frac{I_0}{2}\cos^2 60° = \frac{I_0}{8}$

$\therefore$ Percentage of transmitted light of incident light $= \frac{(I_0/8)}{I_0} \times 100 = 12.5\%$

27 Amplitude of the superimposing waves are $\quad a_1/a_2 = (1/9)^{1/2} = 1/3$

$$\frac{I_{\text{minima}}}{I_{\text{maxima}}} = \frac{(a_1 - a_2)^2}{(a_1 + a_2)^2} = \frac{\left(\frac{a_1}{a_2} - 1\right)^2}{\left(\frac{a_1}{a_2} + 1\right)^2} = \frac{1}{4}$$

28 $\beta = \frac{D}{d}\lambda$. Here, $D = 25$ cm, $d = 1$ mm, $\lambda = 6000$ Å. This gives $\beta = 0.015$ cm .

29 For coherent sources amplitudes are added. Hence, $I_0 \propto (A + A)^2 = 4A^2$. For incoherent sources intensity is added. i.e. $I \propto (A^2 + A^2) = 2A^2$. Hence, $I_0 = 2I$.

30 Here, $d\sin\theta = n\lambda$. For $n = 1$

We find, $\sin\theta = \frac{\lambda}{d}$

$$= \frac{550 \times 10^{-9}}{0.55 \times 10^{-3}} = 10^{-3} \text{ rad} = 0.001 \text{ rad}$$

31 $\therefore \beta = \frac{\lambda D}{d} = \frac{550 \times 10^{-9} \times 1}{1.1 \times 10^{-3}}$

$= 500 \times 10^{-6}$ m $\cong 0.5$ mm

32 Here, $\frac{f_2}{f_1} = \frac{\omega_2}{\omega_1}$

i.e. $\quad f_2 = \frac{0.21}{0.14} \times 42 = 63$ cm

33 Dispersive power,

$$\omega = \frac{df}{f} = \frac{16.4 - 16}{16} = \frac{0.4}{16} = 0.025$$

34 Given, $f = -20$ cm, $m = 2$

As, $\quad m = \frac{-v}{u}$

$\therefore \quad 2 = \frac{v}{u}$ or $v = 2u$

As, $\quad \frac{1}{u} + \frac{1}{v} = \frac{1}{f}$

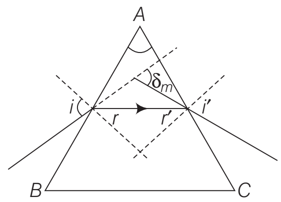
$\therefore \quad \frac{1}{u} + \frac{1}{2u} = \frac{1}{-20} \Rightarrow u = -30$ cm

35 $\phi = 4\pi I = 4\pi \times 35 = 140\pi$ lumen.

Also, $\eta = \frac{\phi}{P}$

i.e. $P = \frac{\phi}{\eta} = \frac{140\pi}{5} \approx 88$ W

36 The following ray diagram shows the angle of minimum deviation.



$\delta_m = i + i' - A$

Given, $i = \frac{3}{4}A$ and $i = i'$

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

$\delta_m = \frac{6A}{4} - A \Rightarrow \delta_m = \frac{A}{2}$

For equilateral prism $A = 60°$

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

37 From figure,

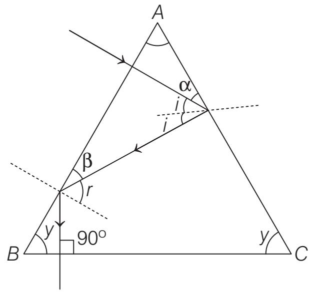
$\alpha = 90° - A$

$\Rightarrow \quad A = 90° - \alpha \quad$ ...(i)

and $\quad i = 90° - \alpha \quad$ ...(ii)

From Eqs. (i) and (ii), We get

$i = A \quad$ ...(iii)



Again, from figure,

$$\beta = 90° - 2i$$

$$\beta = 90° - 2A \quad [\because \text{ from Eq. (iii)}]$$

or $\quad 2A = 90° - \beta$

$$2A = \gamma \quad \ldots\text{(iv)}$$

Again, from figure,

$$\gamma = 90° - \beta = \gamma = 2A$$

$\therefore \quad \gamma = 2A \quad \ldots$(v)

$\therefore$ In ΔABC,

$$A + B + C = 180°$$

$$A + \gamma + \gamma = 180°$$

$$A + 2A + 2A = 180° \Rightarrow A = 36°$$

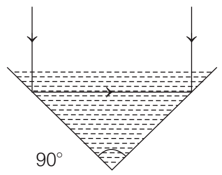
38 The magnification of image is less than 1, so mirror used is convex.

39 The deviation produced by combination of two plane mirrors is

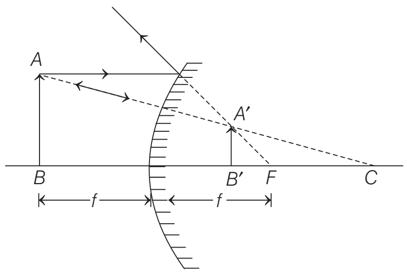
$$\delta = 2\pi - 2\theta = 2\pi - 2 \times \frac{\pi}{2} \quad [\theta = 90°]$$

$$\Rightarrow \quad \delta = \pi = 180°$$

Hence, total deviation in incidnet ray is 180°



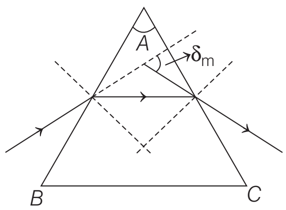
40 Image formed by convex mirror as shown in figure.



41 For minimum deviation the refracted ray passes parallel to the base of the prism. Hence, BC is horizontal.

42 The refractive index (μ) of a prism of angle A, and minimum deviation δ_m is given by

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



Given, $\quad \mu = \cot\frac{A}{2}$

$$\therefore \quad \cot\frac{A}{2} = \frac{\sin\frac{(A + \delta_m)}{2}}{\sin(A/2)}$$

$$\Rightarrow \quad \frac{\cos\frac{A}{2}}{\sin(A/2)} = \frac{\sin\frac{(A + \delta_m)}{2}}{\sin(A/2)}$$

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

$$\therefore \quad \sin\left(90° - \frac{A}{2}\right) = \sin\left(\frac{A + \delta_m}{2}\right)$$

$$\Rightarrow \quad 90° - \frac{A}{2} = \frac{A + \delta_m}{2}$$

$$\Rightarrow \quad 180° - A = A + \delta_m$$

$$\Rightarrow \quad \delta_m = 180° - 2A = \pi - 2A$$

43 Combined focal length

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

Given, $f_1 = 80$ cm, $f_2 = -50$ cm (concave)

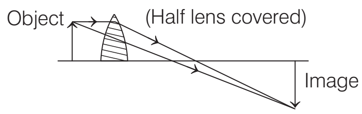
$$\therefore \quad \frac{1}{f} = \frac{1}{80} - \frac{1}{50}$$

$$= -\frac{30}{4000}$$

$$\therefore \quad P = \frac{1}{f} = \frac{-30 \times 100}{4000}$$

$$= \frac{-3}{4} = -0.75\,\text{D}$$

44 The various rays from the object, after refraction through different parts of the lens, will still converges at the point, only their number will be less. When half the lens is covered with an opaque object. Hence, still the full image of the object is obtained but its intensity will be less.



45 Here, $f_1 = 30$ cm, $f_2 = -20$ cm, $f = ?$

As, $\quad \frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}$

$$\therefore \quad \frac{1}{f} = \frac{1}{30} - \frac{1}{20} = \frac{2-3}{60} = -\frac{1}{60}$$

$$f = -60 \text{ cm}$$

$\therefore$ The combination of lenses behaves as a concave lens. The system is diverging.

46 Resolving power telescope is $= \frac{a}{1.22\lambda}$

where, a is the diameter of objective lens and λ is the wavelength of light used. It is obvious that on increasing a, more light is collected by objective lens and so, the image formed is more bright. Thus, resolving power telescope increases.

47 The magnifying power telescope in relaxed state is $m = \frac{f_o}{f_e}$

So, for high magnification, the focal length of objective length should be larger than that of eyepiece.

Resolving power of a telescope $= \frac{d}{1.22\lambda}$

For high resolving power, diameter (d) of objective should be higher.

48 In air or water, a convex lens made of glass behaves as a convergent lens but when it is placed is carbon disulphide, it behaves as a divergent lens. Therefore, when a convergent lens is placed inside a transparent medium of refractive index greater than that of material of lens, it behaves as a divergent lens.

It simply concludes that property of a lens whether the ray is diverging or converging depends on the surrounding medium.

49 According to Brewster's law

$$\mu = \tan\theta \quad \ldots\text{(i)}$$

where, μ is the refractive index of medium and $\tan\theta$ is the tangent of the angle of polarisation

$$\mu = \tan\theta = \frac{1}{\cot\theta} \quad \ldots\text{(ii)}$$

Also, we know that, $\mu = \frac{1}{\sin C} \quad \ldots$(iii)

From Eqs. (ii) and (iii), we get

$$\frac{1}{\sin C} = \frac{1}{\cot\theta} \text{ and } \sin C = \cot\theta$$

$$C = \sin^{-1}(\cot\theta)$$

50 Both Assertion and Reason are true and Reason is correct explanation.