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CLASS 12 PHYSICS · NCERT CHAPTER 9 · IMU CET PRACTICE

Ray Optics and Optical Instruments

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Questions: 46 MCQs

Each question has exactly one correct option. Attempt all questions first, then check the Answer Key and Solutions at the end.

- 1 The focal length of a spherical mirror of radius of curvature R is
 - (A) R
 - (B) $R/4$
 - (C) $R/2$
 - (D) $2R$
- 2 The mirror formula is
 - (A) $1/v + 1/u = 1/f$
 - (B) $1/v - 1/u = 1/f$
 - (C) $uv = f$
 - (D) $v + u = f$
- 3 An object is placed 30 cm in front of a concave mirror of focal length 15 cm. The image distance is
 - (A) 10 cm in front of the mirror
 - (B) 15 cm in front of the mirror
 - (C) 30 cm in front of the mirror
 - (D) 30 cm behind the mirror
- 4 A convex mirror always forms an image that is
 - (A) real and magnified
 - (B) real and inverted
 - (C) virtual, erect and diminished
 - (D) virtual and magnified
- 5 Rear-view mirrors in vehicles are
 - (A) plane
 - (B) concave
 - (C) parabolic concave
 - (D) convex
- 6 The magnification produced by a plane mirror is
 - (A) infinite
 - (B) $+1$
 - (C) 0
 - (D) -1
- 7 The refractive index of a medium is the ratio of
 - (A) frequency in vacuum to frequency in medium
 - (B) speed of light in vacuum to speed in the medium
 - (C) speed in medium to speed in vacuum
 - (D) wavelength in medium to wavelength in vacuum
- 8 Light travels from air into glass ($n = 1.5$). Its speed in glass is
 - (A) 3×10^8 m/s
 - (B) 4.5×10^8 m/s
 - (C) 1.5×10^8 m/s
 - (D) 2×10^8 m/s



- 9 When light passes from one medium to another, which quantity remains unchanged?
(A) Direction (B) Wavelength
(C) Speed (D) Frequency
-
- 10 Snell's law is
(A) $n_1/\sin i = n_2/\sin r$ (B) $n_1 \tan i = n_2 \tan r$
(C) $n_1 \sin i = n_2 \sin r$ (D) $n_1 \cos i = n_2 \cos r$
-
- 11 A coin at the bottom of a 12 cm deep water tank ($n = 4/3$) appears raised by
(A) 3 cm (B) 9 cm
(C) 6 cm (D) 4 cm
-
- 12 Total internal reflection occurs when light travels from
(A) a rarer to a denser medium
(B) a denser to a rarer medium at an angle greater than the critical angle
(C) denser to rarer at any angle
(D) a rarer to denser medium at angles greater than critical angle
-
- 13 The critical angle C for a medium of refractive index n (with respect to air) is given by
(A) $\sin C = 1/n$ (B) $\sin C = n$
(C) $\tan C = n$ (D) $\cos C = 1/n$
-
- 14 The critical angle for glass of $n = \sqrt{2}$ is
(A) 30° (B) 45°
(C) 90° (D) 60°
-
- 15 The sparkling of diamond is due to
(A) total internal reflection (B) diffraction
(C) dispersion only (D) polarisation
-
- 16 Optical fibres work on the principle of
(A) total internal reflection (B) diffraction
(C) refraction only (D) scattering
-
- 17 The lens maker's formula is
(A) $1/f = n(1/R_1 - 1/R_2)$ (B) $f = (n - 1)(R_1 - R_2)$
(C) $1/f = (n + 1)(1/R_1 + 1/R_2)$ (D) $1/f = (n - 1)(1/R_1 - 1/R_2)$
-
- 18 A biconvex lens of glass ($n = 1.5$) has both radii 20 cm. Its focal length is
(A) 10 cm (B) 40 cm
(C) 20 cm (D) 30 cm
-
- 19 The lens formula is
(A) $uv = f^2$ (B) $v - u = f$
(C) $1/v - 1/u = 1/f$ (D) $1/v + 1/u = 1/f$
-



- 20** An object is placed 20 cm in front of a convex lens of focal length 10 cm. The image is formed at
(A) 20 cm on the other side, real and inverted, same size
(B) 10 cm on the other side
(C) infinity
(D) 20 cm on the same side, virtual
- 21** The power of a lens of focal length 25 cm (convex) is
(A) -4 D
(B) +25 D
(C) +0.25 D
(D) +4 D
- 22** Two thin lenses of powers +5 D and -3 D are placed in contact. The focal length of the combination is
(A) 50 cm
(B) -50 cm
(C) 20 cm
(D) 12.5 cm
- 23** A convex lens of focal length 20 cm is immersed in water ($n_w = 4/3$). If glass has $n = 1.5$, its new focal length is
(A) 80 cm
(B) 60 cm
(C) 20 cm
(D) 40 cm
- 24** A convex lens forms a virtual image when the object is placed
(A) at 2F
(B) beyond 2F
(C) at infinity
(D) between the optical centre and focus
- 25** The angle of minimum deviation δ_m for a prism of angle A and refractive index n satisfies
(A) $n = \sin(A/2)/\sin((A + \delta_m)/2)$
(B) $n = \sin(A + \delta_m)/\sin A$
(C) $n = (A + \delta_m)/A$
(D) $n = \sin((A + \delta_m)/2)/\sin(A/2)$
- 26** For a thin prism of angle A and refractive index n, the deviation is
(A) $(n - 1)A$
(B) $(n + 1)A$
(C) A/n
(D) nA
- 27** A thin prism of angle 5° and $n = 1.6$ produces a deviation of
(A) 5°
(B) 8°
(C) 3°
(D) 1.6°
- 28** Dispersion of white light by a prism is due to
(A) scattering
(B) different refractive indices for different wavelengths
(C) diffraction
(D) total internal reflection
- 29** In a prism, which colour deviates the most?
(A) Violet
(B) Red
(C) Yellow
(D) Green

- 30** The blue colour of the sky is due to
 (A) total internal reflection
 (B) scattering of light (Rayleigh scattering $\propto 1/\lambda^4$)
 (C) reflection from oceans
 (D) dispersion
-
- 31** The Sun appears reddish at sunrise and sunset because
 (A) red light is scattered more
 (B) of total internal reflection
 (C) the Sun's temperature drops
 (D) blue light is scattered away over the long atmospheric path, leaving red
-
- 32** Clouds appear white because
 (A) they reflect only white light
 (B) large droplets scatter all wavelengths nearly equally
 (C) they absorb blue light
 (D) of dispersion
-
- 33** A rainbow is formed due to
 (A) polarisation
 (B) scattering only
 (C) diffraction only
 (D) dispersion, refraction and internal reflection in water droplets
-
- 34** The magnifying power of a simple microscope (image at near point $D = 25$ cm) of focal length f is
 (A) f/D
 (B) D/f
 (C) $1 - D/f$
 (D) $1 + D/f$
-
- 35** A simple microscope with $f = 5$ cm forms the image at the near point (25 cm). Its magnifying power is
 (A) 5
 (B) 6
 (C) 25
 (D) 4
-
- 36** In a compound microscope, the objective has
 (A) short focal length and small aperture
 (B) large aperture
 (C) long focal length
 (D) the same focal length as the eyepiece
-
- 37** In an astronomical telescope in normal adjustment, the magnifying power is
 (A) f_o/f_e
 (B) $f_o + f_e$
 (C) $f_o f_e$
 (D) f_e/f_o
-
- 38** In normal adjustment, the length of an astronomical telescope is
 (A) $f_o - f_e$
 (B) $f_o f_e$
 (C) $f_o + f_e$
 (D) f_o/f_e
-
- 39** An astronomical telescope has $f_o = 100$ cm and $f_e = 5$ cm. Its magnifying power in normal adjustment is
 (A) 105
 (B) 20
 (C) 95
 (D) 500
-

- 40 For an astronomical telescope, the objective should have
(A) small focal length and large aperture (B) large focal length and small aperture
(C) small focal length and small aperture (D) large focal length and large aperture
- 41 Reflecting telescopes are preferred over refracting ones because they
(A) are always smaller in size
(B) have chromatic aberration
(C) have no chromatic aberration and are easier to support
(D) use lenses only
- 42 A ray of light falls normally on one face of a glass slab. The angle of refraction is
(A) 45° (B) equal to the critical angle
(C) 0° (D) 90°
- 43 A person cannot see objects beyond 2 m clearly. The lens needed to correct the defect has power
(A) +0.5 D (B) -0.5 D
(C) -2 D (D) +2 D
- 44 The image formed by a concave lens is always
(A) virtual and magnified (B) virtual, erect and diminished
(C) real and magnified (D) real and inverted
- 45 The focal length of a plane mirror is
(A) equal to its size (B) zero
(C) infinite (D) 1 m
- 46 An object is placed 10 cm from a convex mirror of focal length 10 cm. The image distance is
(A) 10 cm behind the mirror (B) 5 cm behind the mirror
(C) at infinity (D) 20 cm in front

Answer Key

1	2	3	4	5	6	7	8	9	10
C	A	C	C	D	B	B	D	D	C
11	12	13	14	15	16	17	18	19	20
A	B	A	B	A	A	D	C	C	A
21	22	23	24	25	26	27	28	29	30
D	A	A	D	D	A	C	B	A	B
31	32	33	34	35	36	37	38	39	40
D	B	D	D	B	A	A	C	B	D
41	42	43	44	45	46				
C	C	B	B	C	B				

Hints & Solutions

- (C) $f = R/2$ for paraxial rays.
- (A) For spherical mirrors (Cartesian sign convention), $1/v + 1/u = 1/f$.
- (C) $1/v = 1/f - 1/u = -1/15 + 1/30 = -1/30 \rightarrow v = -30$ cm (real, at C).
- (C) Convex mirrors always give virtual, erect, diminished images behind the mirror.
- (D) Convex mirrors give a wider field of view.
- (B) Image is virtual, erect and same size.
- (B) $n = c/v$.
- (D) $v = c/n = 3 \times 10^8/1.5$.
- (D) Frequency is determined by the source.
- (C) Law of refraction.
- (A) Apparent depth = $12/(4/3) = 9$ cm $\rightarrow$ raised by 3 cm.
- (B) Both conditions are needed: denser $\rightarrow$ rarer and $i > C$.
- (A) At C, refraction angle is 90° : $n \sin C = 1$.
- (B) $\sin C = 1/\sqrt{2} \rightarrow C = 45^\circ$.
- (A) Diamond's high n (2.42) gives a small critical angle ($\sim 24^\circ$), causing multiple TIR.
- (A) Light is guided by repeated TIR at the core-cladding boundary.
- (D) For a thin lens in air.
- (C) $1/f = 0.5(1/20 + 1/20) = 0.05 \rightarrow f = 20$ cm.
- (C) For thin lenses with Cartesian signs: $1/v - 1/u = 1/f$.
- (A) $1/v = 1/10 - 1/20 = 1/20 \rightarrow v = +20$ cm; $m = -1$.
- (D) $P = 1/f(m) = 1/0.25 = +4$ D.
- (A) $P = +2$ D $\rightarrow f = 0.5$ m = 50 cm.
- (A) $f_w/f_a = (n - 1)/((n/n_w) - 1) = 0.5/(1.125 - 1) = 0.5/0.125 = 4 \rightarrow 80$ cm.

24. (D) For $u < f$, a convex lens acts as a magnifier, giving a virtual, erect, magnified image.
25. (D) Prism formula at minimum deviation.
26. (A) For small A , $\delta = (n - 1)A$.
27. (C) $\delta = (1.6 - 1) \times 5^\circ = 3^\circ$.
28. (B) n depends on wavelength, so colours deviate by different amounts.
29. (A) n is largest for violet (shortest λ), giving maximum deviation.
30. (B) Shorter wavelengths (blue) are scattered much more by air molecules.
31. (D) Long path through the atmosphere removes shorter wavelengths by scattering.
32. (B) Particles larger than λ scatter all colours almost equally (non-Rayleigh scattering).
33. (D) Sunlight refracts into droplets, reflects internally and disperses on emerging.
34. (D) $m = 1 + D/f$ when the final image is at the near point.
35. (B) $m = 1 + 25/5 = 6$.
36. (A) The objective is a short-focus lens to form a magnified real image.
37. (A) $m = f_o/f_e$ (final image at infinity).
38. (C) The image formed by the objective lies at the focus of the eyepiece.
39. (B) $m = 100/5 = 20$.
40. (D) Large f_o gives high magnification; large aperture collects more light and improves resolution.
41. (C) Mirrors do not disperse light, and large mirrors can be supported from the back.
42. (C) Normal incidence ($i = 0$) gives $r = 0$; the ray passes undeviated.
43. (B) Myopia: concave lens with $f = -2 \text{ m} \rightarrow P = -0.5 \text{ D}$.
44. (B) A diverging lens always gives a virtual, upright, smaller image for real objects.
45. (C) $R = \infty \rightarrow f = \infty$.
46. (B) $u = -10, f = +10: 1/v = 1/10 + 1/10 = 1/5 \rightarrow v = +5 \text{ cm}$ (virtual).

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