Ray Optics and Optical Instruments

Class 12 Physics · 24 NEET MCQs with answers & explanations

Ray Optics is one of NEET's highest-weightage Physics chapters. Reflection, refraction, lenses, mirrors, prisms, total internal reflection, optical instruments (microscope, telescope) and power of lens are all tested. Mirror and lens formula numericals, prism dispersion and TIR conditions dominate NEET questions.

Key Optics Formulas

Concept	Key Formula
Mirror formula	1/v + 1/u = 1/f; magnification m = −v/u
Lens formula	1/v − 1/u = 1/f; magnification m = v/u
Power of lens	P = 1/f (in metres); unit: dioptre (D); convex +, concave −
Snell's law	$n_1 \sin\theta_1 = n_2 \sin\theta_2$; n = c/v
Total internal reflection	$\sin\theta_c = n_2/n_1$ ($n_1 > n_2$); θ > θ_c → TIR; used in optical fibre
Prism	δ = (μ−1)A (thin prism); δ_min when i = e, $r_1 = r_2 = A/2$

Questions

Q1. A plane mirror forms an image of a real object. Which combination correctly describes the image?

(A) Real, inverted, diminished
(B) Virtual, inverted, diminished
(C) Virtual, erect, magnified
(D) Virtual, erect, same size

Q2. At minimum deviation through a prism of angle A, which of the following sets of conditions holds simultaneously?

(A) i = e and $r_1 = r_2 = A$
(B) i ≠ e and $r_1 = r_2 = A/2$
(C) i = e and $r_1 = r_2 = A/2$
(D) i = e and $r_1 \neq r_2$

Q3. A person can see clearly only up to 80 cm. The power of the corrective lens required to see distant objects clearly is

(A) +1.25 D
(B) -0.80 D
(C) +0.80 D
(D) -1.25 D

Q4. A ray is incident at angle i on one face of a small-angle prism of angle A and emerges normally from the opposite face. If the refractive index of the prism is μ, the approximate angle of incidence is

(A) A/μ
(B) μA/2
(C) μA
(D) A/(2μ)

Q5. An object is placed on the principal axis of a concave mirror at a distance of 1.5f, where f is the magnitude of the focal length. The image will be formed at

(A) -3f
(B) 1.5f
(C) -1.5f
(D) 3f

Q6. The graph of 1/v versus 1/u for a concave spherical mirror is best described as

(A) A straight line of slope +1 and positive y-intercept
(B) A straight line of slope -1 and positive y-intercept
(C) A straight line of slope -1 and negative y-intercept
(D) A rectangular hyperbola

Q7. At minimum deviation through a prism of angle A, which set of relations is correct?

(A) $i = e$ and $r_1 = r_2 = A/2$
(B) $i = 0$ and $e = A$
(C) $i = e = A$
(D) $i = A/2$ and $e = 0$

Q8. At minimum deviation through a prism, which of the following correctly describes the internal ray path?

(A) The ray bends only at the first surface; the second surface is perpendicular to it
(B) The ray travels parallel to the base of the prism and the path is symmetric about the bisector of the prism angle
(C) The ray undergoes total internal reflection at the second surface
(D) The ray travels parallel to the refracting edge of the prism

Q9. A person can see clearly only between 50 cm and 400 cm from his eyes. To extend the maximum distance of distinct vision to infinity, the type and power of corrective lens required is

(A) Convex lens, +0.25 D
(B) Concave lens, -0.25 D
(C) Convex lens, +0.50 D
(D) Concave lens, -0.50 D

Q10. For a normal eye, the cornea has converging power 40 D and the eye lens minimum converging power is 20 D. The distance between the retina and the cornea-eye-lens system is approximately

(A) 1.0 cm
(B) 2.5 cm
(C) 1.67 cm
(D) 5.0 cm

Q11. A compound microscope has an objective of focal length 2 cm, eyepiece of focal length 4 cm and tube length 40 cm. Taking D = 25 cm, its approximate magnifying power in normal adjustment (final image at infinity) is

(A) 100
(B) 125
(C) 150
(D) 250

Q12. A small astronomical telescope has an objective focal length of 140 cm and an eyepiece focal length of 5 cm. The magnitude of its angular magnifying power in normal adjustment is

(A) 28
(B) 14
(C) 35
(D) 70

Q13. An object is placed 20 cm in front of a convex lens of focal length 15 cm. The image distance is

(A) 60 cm
(B) 30 cm
(C) 20 cm
(D) 15 cm

Q14. A convex lens has radii of curvature R1 = +30 cm and R2 = -30 cm. If the refractive index of the lens is 1.5, its focal length is

(A) 15 cm
(B) 30 cm
(C) 60 cm
(D) 20 cm

Q15. Two thin lenses of focal lengths +10 cm and −30 cm are placed in contact. A real object is placed 20 cm in front of the combination. The image distance from the combination is

(A) 60 cm on the opposite side
(B) 30 cm on the opposite side
(C) 20 cm on the opposite side
(D) 15 cm on the same side

Q16. A convex lens of focal length 20 cm and a concave lens of focal length 40 cm are placed in contact. The focal length of the combination is

(A) 40 cm
(B) 20 cm
(C) 80 cm
(D) 120 cm

Q17. A biconvex glass lens has refractive index 1.5 and radii of curvature 20 cm each. Its power in air is

(A) +2 D
(B) +5 D
(C) +10 D
(D) +20 D

Q18. The power of an equiconvex lens is 10 D and the radius of curvature of each surface is 10 cm. The refractive index of the lens material is

(A) 4/5
(B) 9/8
(C) 5/3
(D) 3/2

Q19. Light travels from glass (refractive index 1.5) to air. The critical angle for the glass-air interface is approximately

(A) 30°
(B) 41.8°
(C) 48.8°
(D) 60°

Q20. For total internal reflection to occur at a boundary between two transparent media, which combination of conditions is necessary?

(A) Light travels from rarer to denser medium and i < C
(B) Light may travel in either direction provided i > C
(C) Light travels from denser to rarer medium and i > C
(D) Light travels from denser to rarer medium and i = C

Q21. A convex spherical refracting surface separates air (n_1 = 1) from glass (n_2 = 1.5), R = +10 cm. A point object in air is placed 30 cm in front of the surface. The image distance is

(A) 20 cm behind the surface
(B) 45 cm behind the surface
(C) 90 cm behind the surface
(D) 180 cm behind the surface

Q22. For refraction at a spherical surface, the formula is $n_2/v - n_1/u = (n_2 - n_1)/R$. If $n_1 = n_2$, this formula reduces to

(A) v = u, meaning the image coincides with the object
(B) 1/v + 1/u = 1/R
(C) v = −u, meaning the image is equidistant on the other side
(D) 1/v = 0, meaning the image is at infinity

Q23. A ray of light is incident from air on a glass slab at an angle of incidence 60°. If the angle of refraction is 45°, the refractive index of glass is

(A) √6/2
(B) √3
(C) 1/√2
(D) √3/2

Q24. A ray of light travels from air into a medium of refractive index √2 with an angle of incidence 45°. The angle of refraction is

(A) 60°
(B) 30°
(C) 45°
(D) 90°

Answer key

1-D	2-C	3-D	4-C	5-A	6-C	7-A	8-B
9-B	10-C	11-B	12-A	13-A	14-B	15-A	16-A
17-B	18-D	19-B	20-C	21-C	22-A	23-A	24-B

Answers with explanations

Q1 — Answer: (D) Virtual, erect, same size
A plane mirror forms a virtual, erect, laterally inverted image of the same size (m = +1) at equal distance behind the mirror. It can never form a real or diminished image. Option C trap: confusing plane mirror with concave mirror used as magnifier.

Q2 — Answer: (C) i = e and $r_1 = r_2 = A/2$
At minimum deviation, the ray traverses the prism symmetrically: angle of incidence equals angle of emergence (i = e) and each internal angle $r_1 = r_2 = A/2$. Option A is a trap where students correctly recall i = e but write r = A instead of A/2.

Q3 — Answer: (D) -1.25 D
For u = -∞ and v = -0.80 m, P = 1/v - 1/u = -1/0.80 = -1.25 D. A concave lens diverges rays to shift the far point to infinity.

Q4 — Answer: (C) μA
Since the ray emerges normally, r2 = 0 so r1 = A. Snell's law gives sin i = μ sin A. For small angles, i ≈ μA. Option A inverts the refractive index ratio.

Q5 — Answer: (A) -3f
With u = -1.5f and f_mirror = -f: 1/v = -1/f + 1/(1.5f) = -1/(3f), so v = -3f. Negative v confirms a real image in front of the mirror. Common error: using f positive for concave mirror gives v = +3f, a wrong virtual image.

Q6 — Answer: (C) A straight line of slope -1 and negative y-intercept
From 1/v = 1/f - 1/u, the graph of 1/v vs 1/u is a straight line with slope -1. For a concave mirror, f is negative, so the y-intercept 1/f is negative. Option B fails because the y-intercept is negative, not positive.

Q7 — Answer: (A) i = e and $r_1 = r_2 = A/2$
The ray path is symmetric at minimum deviation. Hence i = e and $r_1 = r_2$. Since $r_1 + r_2 = A$, each internal angle equals A/2. Options C and D are wrong because they set one or both surface angles equal to A, which is the prism angle, not the refraction angle.

Q8 — Answer: (B) The ray travels parallel to the base of the prism and the path is symmetric about the bisector of the prism angle
At minimum deviation $r_1 = r_2 = A/2$, making the internal ray symmetric. This means the ray inside the prism is parallel to the base. Option A is wrong because refraction occurs at both surfaces. Option C confuses TIR with minimum deviation.

Q9 — Answer: (B) Concave lens, -0.25 D
Far point is 4 m. For u=-infinity, corrective lens needs v=-4 m. P=1/f=1/(-4)=-0.25 D, so a concave lens of -0.25 D is needed. Option A is wrong as myopia needs a concave not convex lens.

Q10 — Answer: (C) 1.67 cm
Total minimum power for distant vision = 40+20 = 60 D. Focal length f = 1/60 m = 0.0167 m = 1.67 cm. For a distant object, image forms at retina, so retina is ~1.67 cm from the lens system.

Q11 — Answer: (B) 125
In normal adjustment, M = (L/f_o)(D/f_e) = (40/2)(25/4) = 20 × 6.25 = 125. If the final image were at the near point instead, the eyepiece magnification would be (1 + D/f_e) = 7.25, giving M ≈ 145.

Q12 — Answer: (A) 28
In normal adjustment, |M| = f_o/f_e = 140/5 = 28. Option B (14) is the trap from students who halve f_o incorrectly. Option C (35) arises from adding f_e to the numerator: (140+5)/5 = 29, rounded to 35 — a tube-length confusion error.

Q13 — Answer: (A) 60 cm
Using 1/v - 1/u = 1/f with u = -20 cm, f = +15 cm: 1/v = 1/15 - 1/20 = 1/60, so v = +60 cm. Option B (30 cm) is the trap from using f - u instead of the full formula.

Q14 — Answer: (B) 30 cm
Lens maker's equation: 1/f = (n-1)(1/R1 - 1/R2) = 0.5(1/30 - 1/(-30)) = 0.5(2/30) = 1/30, so f = +30 cm. Trap: students who forget the negative sign of R2 halve the answer and get 60 cm.

Q15 — Answer: (A) 60 cm on the opposite side
1/F = 1/10 − 1/30 = 2/30, so F = +15 cm. Lens formula: 1/v = 1/15 − 1/20 = 1/60, giving v = +60 cm. Trap: students use u = +20 cm instead of −20 cm, getting a wrong sign for v.

Q16 — Answer: (A) 40 cm
1/F = 1/20 − 1/40 = 1/40, so F = +40 cm. The combination remains converging. Trap: adding focal lengths directly gives 60 cm, which is wrong because reciprocals must be added.

Q17 — Answer: (B) +5 D
1/f = (0.5)(1/0.20 + 1/0.20) = 0.5 × 10 = 5 m^{-1}, so P = +5 D. Trap A (+2 D) comes from computing (0.5)(1/0.20) alone, forgetting the second surface contributes equally.

Q18 — Answer: (D) 3/2
1/f = (μ−1)(2/R): 10 = (μ−1)(2/0.10) = 20(μ−1) → μ−1 = 0.5 → μ = 1.5 = 3/2. Trap C (5/3 ≈ 1.67) arises from students computing 2/R first then forgetting to divide by the power correctly.

Q19 — Answer: (B) 41.8°
sin C = 1/μ = 1/1.5 = 0.667, giving C ≈ 41.8°. A common trap is inverting incorrectly to sin C = μ = 1.5, which is physically impossible since sin C cannot exceed 1.

Q20 — Answer: (C) Light travels from denser to rarer medium and i > C
TIR requires propagation from denser to rarer medium AND i > C. Option D fails because at i = C the refracted ray merely grazes the interface; complete reflection begins only for i > C.

Q21 — Answer: (C) 90 cm behind the surface
$n_2/v - n_1/u = (n_2-n_1)/R$: 1.5/v + 1/30 = 0.5/10 = 1/20 → 1.5/v = 1/20 − 1/30 = 1/60 → v = +90 cm. Positive v confirms real image on transmission side. Trap: using R = −10 (wrong sign for C on transmission side) gives a negative v, implying virtual image.

Q22 — Answer: (A) v = u, meaning the image coincides with the object
When $n_1 = n_2$, the RHS = 0. The equation becomes n/v = n/u, giving v = u: the image coincides with the object. Physically, no refractive-index change means no bending occurs and the ray continues undeviated.

Q23 — Answer: (A) √6/2
By Snell's law: n = sin 60° / sin 45° = (√3/2)/(1/√2) = √6/2 ≈ 1.22. Option B (√3) arises from using sin 45° = 1/2 instead of 1/√2 — the most common trigonometric substitution error in this calculation.

Q24 — Answer: (B) 30°
sin r = sin 45°/√2 = (1/√2)/√2 = 1/2, so r = 30°. Option C (45°) is the trap — students assume no bending occurs. Option A (60°) results from inverting the refractive index ratio.

Practise all 601 questions on Ray Optics and Optical Instruments
RankUp app — 45,000+ NEET questions, 30,000+ flashcards, mock tests. Built by Dr. Deepak Sahu, MBBS Gold Medalist.
Download free on Google Play · Practise online

Questions based on NCERT. RankUp is not affiliated with NTA.