Class 12 Physics - Ray Optics and Optical Instruments

JEE track | Short Notes + 5 CBSE-based questions + 5 JEE Main PYQ-based questions with solutions

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Format: Quick revision + solved practice	Chapter scope: Class 12 Physics

1. Quick Short Notes

- Reflection follows two laws: angle of incidence = angle of reflection, and the incident ray, reflected ray and normal lie in one plane.
- Mirror formula: $1/f = 1/v + 1/u$ for spherical mirrors with Cartesian sign convention.
- Lens formula: $1/f = 1/v - 1/u$ for thin lenses. Power $P = 1/f$ (in metre).
- Refractive index $n = c/v$. Snell's law: $n_1 \sin i = n_2 \sin r$.
- For total internal reflection, light must travel from denser to rarer medium and angle of incidence must exceed critical angle.
- Critical angle relation for denser to rarer medium: $\sin i_c = n_{rarer} / n_{denser}$.
- Magnification for mirrors: $m = -v/u$. For lenses: $m = v/u$.
- Combination of thin lenses in contact: $P = P_1 + P_2 + \ldots$
- Apparent depth = real depth / refractive index for near-normal viewing.
- Board tip: sign convention and diagram are the highest-scoring parts of ray optics answers.

2. CBSE-based Board Practice

Q1. A convex lens of focal length 20 cm forms an image of an object placed 30 cm from it. Find the image position and magnification.

Solution: Using sign convention, u = -30 cm, f = +20 cm. $1/f = 1/v - 1/u$ gives 1/20 = 1/v + 1/30. So 1/v = 1/60 and v = +60 cm. Magnification m = v/u = 60/(-30) = -2.

Q2. Define critical angle. Calculate the critical angle for light going from glass (n = 1.5) to air.

Solution: Critical angle is the angle of incidence in denser medium for which angle of refraction is 90 degrees. sin ic = 1/1.5 = 2/3, so ic approx 41.8 degrees.

Q3. An object is placed at 30 cm in front of a concave mirror of focal length 15 cm. Find the position and nature of image.

Solution: For concave mirror, u = -30 cm and f = -15 cm. $1/f = 1/v + 1/u$ gives -1/15 = 1/v - 1/30. So 1/v = -1/30 and v = -30 cm. Image is real, inverted and same size.

Q4. Two thin lenses of powers +2 D and -0.5 D are placed in contact. Find the equivalent power and focal length.

Solution: Peq = 2 + (-0.5) = 1.5 D. So f = 1/1.5 m = 0.667 m approx 66.7 cm.

Q5. Write two applications of total internal reflection.

Solution: Uses: optical fibre communication and right-angle prisms in periscopes/binoculars.

3. JEE Main PYQ-based Practice

Q1. A medium has refractive index 1.732 with respect to air. Find its critical angle.

Solution: $\sin i_c = 1/1.732$ approx 0.577. Therefore i_c approx 35.3 degrees.

Q2. Where is the image formed when an object is placed at 2F of a convex lens?

Solution: For an object at 2F, image is formed at 2F on the other side. It is real, inverted and of same size.

Q3. An object is placed 10 cm in front of a convex lens of focal length 25 cm. Find image position.

Solution: $u = -10$ cm, $f = +25$ cm. $1/25 = 1/v + 1/10$. So $1/v = -3/50$ and $v = -16.7$ cm. Negative v means image is virtual and erect on the same side as object.

Q4. Two converging lenses of powers +10 D and +15 D are in contact. Find the focal length of the combination.

Solution: Total power = 25 D. Hence focal length $f = 1/25$ m = 0.04 m = 4 cm.

Q5. An object lies 10 cm below the surface of water of refractive index 4/3. Find its apparent depth when viewed from air.

Solution: Apparent depth = real depth / n = 10 / (4/3) = 7.5 cm.

Practice tip: First revise the short notes, then attempt CBSE board questions in written format, and finally solve the exam-specific section in timed mode.