MODULE 2: OPTICS

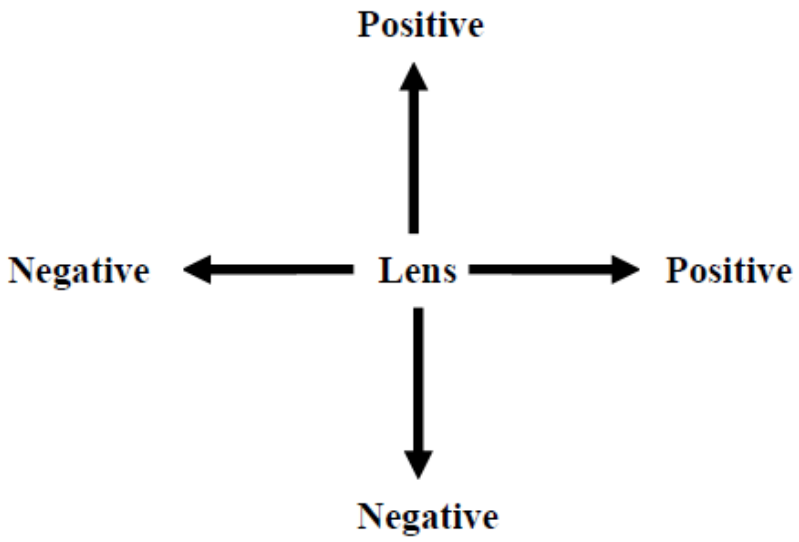
Important Questions

Part A: One word or sentence questions (1 mark)

1. The phenomenon due to which a ray of light, travelling from one optical medium to another, optical medium, bounces off from its surface with a change of angle, is called reflection of light.
2. Mirrors work on the principle of reflection of light. Spherical mirrors are of two types – concave mirror and convex mirror.
3. **Normal:** The perpendicular drawn at the point of incidence to the reflecting surface.
4. **Angle of incidence (**i): The angle between the incident ray and normal.
5. **Angle of reflection (r):** The angle between the reflected ray and normal.
6. **Pole (P):** Geometrical center of the mirror.
7. **Mirror equation:** $\boldsymbol{\frac{1}{u} + \frac{1}{v} = \frac{1}{f}}$
8. The phenomenon of bending of light when it travels from one medium to another is known as refraction.
9. **Angle of refraction (r):** The angle between the refracted ray and normal.
10. Refractive index of a medium is defined as the ratio of the speed of the light in vacuum (c) to the speed of the light in the medium (v). $n = \frac{c}{v}$
11. Refractive index of air or vacuum is taken as 1.
12. The refractive index of a medium is defined as the ratio of the sine of the angle of incidence to the sine of the angle of refraction when light travels from air to the medium.

    $Refractive\ index\ of\ medium\ 2\ with\ respect\ to\ medium\ 1\ is\ given\ by\ n_{21} = \frac{\sin i}{\sin r}$
13. Spherical Lenses work on the principle of refraction of light. Spherical lenses are of two types –convex lens and concave lens.
14. **Optic center**: The geometric center of the lens is called the optic center.
15. **Principal axis:** There are two centers of curvatures for a lens. The principal axis of a lens is the line joining the centers of curvature.
16. The distance between the object and the optic center of the lens is called object distance (u).

17. The distance between the image formed and the optic center of the lens is called <u>image distance (*v*)</u>
18. **Lens equation:** $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$
19. **Learn sign convention-** All distances are measured from the optic centre of the lens.



From the sign convention, it is clear that

a) The focal length of a convex lens is positive and that of a concave lens is negative

b) The object distance is always negative since the object is in front of the lens

c) If a real image is formed by a lens (always on the right side of the lens), the image distance is positive.

d) If a virtual image is formed by a lens (always on the left side of the lens), the image distance is negative

20. The ability of a lens to bend the light falling on it is called the <u>power of a lens.</u>
21. The power of a lens is defined as the reciprocal of the focal length of the lens. $P = \frac{1}{f}$
22. The SI unit of power of a lens is m^{-1} or
23. The power of a convex lens is positive and that of a concave lens is negative.
24. Magnification (m) of a lens is defined as the ratio of the height of the image to the height of the object. $m = \frac{h_o}{h_i}$

25. Magnification can also be defined as the ratio of image distance to object distance. $m = \frac{v}{u}$
26. Magnification is negative for real images and positive for virtual images.
27. **Combination of lenses**

$$\text{Effective focal length: } \frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2} + \frac{1}{f_3} + ----$$

$$\text{Effective power : } P = P_1 + P_2 + P_3 + ----$$

$$\text{Net magnification: } m = m_1 \times m_2 \times m_3 \times ----$$

28. A simple microscope or magnifier is an optical instrument to see the magnified image of an object.
29. An astronomical telescope is an optical instrument used to see a magnified image of distant objects
30. The ability of an instrument to show two very closed objects as separate is called its resolving power.
31. The angle of incidence in the denser medium for which the angle of refraction is 90^0 in the air is known as the critical angle of the denser medium
32. Total internal reflection is defined as the complete reflection of light back into a medium when light travels from a denser medium to a rarer medium and the angle of incidence in the denser medium is greater than the critical angle.
33. Relation between critical angle (C) and refractive index of the medium (n): $n = \frac{1}{\sin C}$
34. Brilliance of diamond is due to total internal reflection
35. Mirage is due to total internal reflection of light by the atmospheric layers
36. Optical fiber is a device which works on the principle of total internal reflection and transmits light signals from one place to another without much loss of energy.

Part B: Short Answer type questions (3 mark)

1. What is meant by reflection of light? State the laws of reflection.
2. Write mirror equation. What are the uses of spherical mirrors?
3. What is meant by refraction of light? State the laws of refraction.
4. Explain the term refractive index of a medium.

5. Explain the term principal focus in the case of both convex lens and concave lens.
6. List out the differences between real image and virtual image.
7. Simple problems related to the combination of lens.
8. Explain the terms total internal reflection and critical angle.
9. State the conditions for total internal reflection.
10. Explain the brilliance of diamond.
11. Mention three uses of total reflection prisms.

Part C: Essay type questions (7 marks)

1. Explain the term refraction of light. Discuss a few practical examples of refraction. (Twinkling of stars, real depth and apparent depth, Apparent shift in the position of the sun at sunrise and sunset).
2. Sketch the ray diagrams for the image formed by a convex lens when the object is placed at different locations. Discuss the position, size and nature of the image. (Ray diagrams for any two positions of the object can be asked).
3. Problems using **Lens equation:** $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$, equation for power of the lens and magnification. Learn sign convention also to properly solve the problems.
4. Discuss the common defects of spherical lenses (Spherical aberration and chromatic aberration).
5. Discuss the working of a simple microscope with a suitable ray diagram. Derive the equation for magnification of a simple microscope.
6. Explain total internal reflection with a ray diagram.
7. Discuss the applications of total internal reflections (Brilliance of diamond, Mirage, Total reflection prism).
8. Explain the working of optical fibers. List out the applications of optical fibers.