

2. RAY OPTICS & OPTICAL INSTRUMENTS



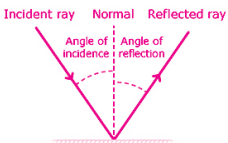
IMP DEFINITIONS & FORMULAS



- Ray optics** is the study of light in terms of Reflection & Refraction of light moving in straight lines.
- Reflection** is the 'bouncing back' of light ray when it falls on a surface.
- Law of reflection:** $\angle i = \angle r$
Angle of incidence = Angle of reflection
- Refractive index** of a medium denotes
 - the measure of bending of light ray.
 - how fast light travels through a medium
- Snell's law of refraction:**
The ratio of sine of angle of incidence ($\sin i$) in the denser medium to the sine of refraction ($\sin r$) in the rarer medium is a constant called refractive index (n_{21}) of the medium.
Refractive index $n_{21} = \frac{\sin i}{\sin r} = \text{constant}$
(or) $\frac{n_2}{n_1} = \frac{\sin i}{\sin r}$ (or) $n_1 \sin i = n_2 \sin r$
- Refractive index** is the ratio of speed of the light in a rarer medium to the speed of the light in the denser medium.
Refractive index : $n_{21} = \frac{v_2}{v_1} = \frac{c_1}{c_2} = \frac{\lambda_1}{\lambda_2}$
- Refraction** is the 'bending of light ray' when it passes from one medium to another medium.
- Critical angle:** When a light ray is passing from denser medium to rarer medium, the angle of incidence for which the angle of refraction is 90° is called **critical angle** i_c .
- Total Internal Reflection (TIR):** In the case of light ray passing from denser medium to rarer medium, if $i > i_c$, **total internal reflection** takes place.
 - Mirages are formed due to TIR.
- Dispersion:** Splitting of composite light into its constituent colours is called **dispersion**.
 - Dispersion of white light gives VIBGYOR.
- Red is least deviated. So red is least scattered. So red signals go larger distances. Hence red is used as danger signal.

BULLET MASTER'S

PHYSI BEATS!



2) RAY OPTICS [1 VSAQ+ 1 SAQ]

RRR Ray Optics \Rightarrow Reflection & Refraction

Light అనేది ray (కిరణం) లక్షణాలతో Propagate అవుతుందని తెలిపేది **Ray Optics**.

Light అనేది wave (తరంగం) లక్షణాలతో Propagate అవుతుందని తెలిపేది **Wave Optics**.

Imp. Applications: Mirrors, Lenses, Prisms, Microscopes

☞ దూరంగా క్లార్స్ రూమ్ లో జోర్డ్ పై అక్షరాలు Clear గా కనిపించని వారికి **Myopia** (-ve Power) ఉన్నట్లు.

Myopia ని సరిచేయడానికి వాడే గ్లాస్ లెస్ **Concave lens**. [TIP: a &a]

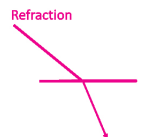
☞ దగ్గరగా చదివే పుస్తకాలలో అక్షరాలు కనిపించని వారికి **Hypermetropia** (+ve Power) ఉన్నట్లు.

Hypermetropia ని సరిచేయడానికి వాడే గ్లాస్ లెస్ **Convex lens**. [TIP: e&e]

IPE View :

☞ **IMP VSAQ:** Power of lens, Dispersion, Myopia, Hypermetropia

IMP SAQ: Critical angle & TIR, formation of Mirage, image in simple microscope.



MIRRORS

12. A concave mirror converges light rays.

A convex mirror diverges light rays.

13. **Mirror formula:** $\frac{1}{v} + \frac{1}{u} = \frac{1}{f} = \frac{2}{R}$

14. **Magnification for mirror:** $m = \frac{h'}{h} = -\frac{v}{u}$

15. **Refraction at a spherical surface:**

$$\frac{n_2}{v} - \frac{n_1}{u} = \frac{n_2 - n_1}{R}$$

LENSES

16. A convex lens converges light rays.

A concave lens diverges light rays.

17. **Power (P) of a convex lens:** $P = \frac{1}{f}$
Its SI unit is dioptre (D).

18. **Lens maker's formula:** $\frac{1}{f} = (n_{21} - 1) \left[\frac{1}{R_1} - \frac{1}{R_2} \right]$

19. **Thin lens formula:** $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$

20. **Magnification for lens:** $m = \frac{h'}{h} = \frac{v}{u}$

21. Combined focal length (f) of thin lenses in contact: $\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}$

22. Combined power (P) of lenses in contact
 $P = P_1 + P_2$

23. **Sign convention:** Distances measured in the direction of the incident ray are positive and the distances measured in the direction opposite to that of the incident ray are negative. Upward heights are positive and downward heights are negative.

24. As per sign convention,
for concave mirror $f = -f$
for convex mirror $f = +f$

25. As per sign convention,
for convex lens $f = +f$
for concave lens $f = -f$

HUMAN EYE

26. Human eye has a convex lens to converge light rays on to its retina.

The defect of forming the image by the eye lens in front of the retina is called **myopia**. It can be corrected by using a **concave lens**.

The defect of forming the image by the eye lens behind the retina is called **hypermetropia**. It can be corrected by using a **convex lens**.

PRISMS

27. **Refraction through a prism :**

$$r_1 + r_2 = A, \quad \delta = i + e - A$$

When $\delta = D_m$, $i = e$, $r_1 = r_2$ the refracted ray in the prism will be parallel to base of the prism.

- Refractive index of material of the prism

$$n_{21} = \frac{\sin\left(\frac{A + D_m}{2}\right)}{\sin\left(\frac{A}{2}\right)}$$

- For a thin prism, $D_m = (n_{21} - 1) A$

OPTICAL INSTRUMENTS

28. Simple microscope – Magnification :

$$m = 1 + \frac{D}{f} \text{ (near point), } m = \frac{D}{f} \text{ (infinity)}$$

29. **Compound microscope:**

Magnification $m = m_o m_e$

$$m = \left(\frac{v_o}{u_o}\right) \left(1 + \frac{D}{f_e}\right) \text{ or } m = \frac{LD}{f_o f_e}$$

30. **Telescope:** Magnification $m = \frac{f_o}{f_e}$

Length of telescope $L = f_o + f_e$