📘 LIGHT – Complete Notes

🔷 DEFINITIONS

1. **Light** – Light is a form of energy that enables us to see objects. It travels in straight lines in a homogeneous medium.
2. **Ray of Light** – The path along which light energy travels in a given direction.
3. **Beam of Light** – A collection of rays of light traveling together.
    - **Parallel beam** – rays parallel
    - **Convergent beam** – rays meet at a point
    - **Divergent beam** – rays spread out
4. **Reflection of Light** – The phenomenon of bouncing back of light rays into the same medium after striking a smooth surface.
5. **Refraction of Light** – The bending of light when it passes from one transparent medium to another due to change in speed.
6. **Dispersion of Light** – Splitting of white light into its constituent colours (VIBGYOR) when passed through a prism.
7. **Spectrum** – The band of seven colours obtained after dispersion.
8. **Total Internal Reflection (TIR)** – The complete reflection of light back into the same medium when angle of incidence exceeds the critical angle.
9. **Critical Angle** – The minimum angle of incidence in denser medium at which light ray is refracted along the boundary.
10. **Real Image** – Formed when light rays actually meet; can be obtained on a screen.
11. **Virtual Image** – Formed when light rays appear to meet; cannot be obtained on a screen.
12. **Lens** – A transparent medium bounded by at least one curved surface.

- **Convex lens** – thicker at center, converging lens.
- **Concave lens** – thinner at center, diverging lens.

13. **Mirror** – A polished surface which reflects light.

- **Plane mirror** – flat surface.

- **Concave mirror** – reflecting surface curved inward.
- **Convex mirror** – reflecting surface curved outward.

14. **Focal Length (f)** – Distance between the pole and the focus of a mirror or lens.
15. **Power of Lens (P)** – Ability of a lens to converge or diverge light. $P = \frac{100}{f(\text{cm})}$ or $P = \frac{1}{f(\text{m})}$. Unit = Dioptre (D).
16. **Optical Center** – A point in a lens where a light ray passes undeviated.
17. **Principal Axis** – The straight line passing through the pole and center of curvature of mirror/lens.
18. **Magnification (M)** – Ratio of image size to object size.
19. **Persistence of Vision** – The impression of an image left on the retina for about 1/16th of a second even after the object is removed.
20. **Prism** – A transparent refracting body bounded by plane surfaces used to disperse light.
21. **Eye Lens** – Transparent, flexible, convex lens present in human eye.
22. **Retina** – Light sensitive screen in human eye where image is formed.
23. **Blind Spot** – Point on retina where optic nerve leaves the eye; no vision possible.
24. **Power of Accommodation** – Ability of the eye lens to adjust its focal length to view nearby and distant objects clearly.
25. **Myopia (Short-sightedness)** – Eye defect in which a person can see nearby objects clearly but not far objects; corrected by concave lens.
26. **Hypermetropia (Long-sightedness)** – Eye defect in which a person can see distant objects clearly but not nearby objects; corrected by convex lens.
27. **Astigmatism** – Blurred vision due to irregular curvature of cornea; corrected by cylindrical lenses.
28. **Cataract** – Cloudy eye lens leading to blurred vision; corrected by surgery.
29. **Scattering of Light** – Spreading of light in different directions by small particles. (Explains sky's colour, reddening of Sun at sunrise/sunset).

🔷 THEORIES OF LIGHT

1. **Rectilinear Propagation of Light** – Light travels in a straight line in a homogeneous medium.
2. **Corpuscular Theory (Newton)** – Light consists of tiny particles called corpuscles.
3. **Wave Theory (Huygens)** – Light travels as a wave.
4. **Electromagnetic Theory (Maxwell)** – Light is an electromagnetic wave.
5. **Quantum Theory (Planck & Einstein)** – Light consists of packets of energy called photons (dual nature – wave + particle).

🔷 LAWS OF LIGHT

1. Laws of Reflection

- The incident ray, reflected ray, and normal at the point of incidence lie in the same plane.
- Angle of incidence = Angle of reflection.

2. Laws of Refraction (Snell's Law)

$$\frac{\sin i}{\sin r} = \text{constant} = \mu$$

where i= angle of incidence, r= angle of refraction, μ= refractive index.

3. Law of Rectilinear Propagation

Light travels in a straight line in a homogeneous medium.

4. Laws of Lenses and Mirrors

Mirror and Lens formula follow same relation:

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

where,

- f= focal length
- u= object distance
- v= image distance

(Sign convention applies – New Cartesian Sign Convention).

🔷 IMPORTANT FORMULAS

1. **Mirror Formula / Lens Formula**

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

2. **Magnification**

- For mirrors:

$$M = \frac{h_i}{h_o} = -\frac{v}{u}$$

- For lenses:

$$M = \frac{h_i}{h_o} = \frac{v}{u}$$

3. **Power of Lens**

$$P = \frac{100}{f(\text{cm})} = \frac{1}{f(\text{m})}$$

4. **Refractive Index**

$$\mu = \frac{\sin i}{\sin r} = \frac{c}{v}$$

where c= speed of light in vacuum, v= speed in medium.

5. **Lateral Shift in a Glass Slab**

$$d = \frac{t\sin(i-r)}{\cos r}$$

where t= thickness of slab.

6. **Critical Angle Relation**

$$\sin C = \frac{1}{\mu}$$

7. **Lens Maker's Formula**

$$\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

Perfect 👍 Let's **expand the notes** by adding the **image properties for concave & convex mirrors/lenses** and also the **major eye disorders** in a neat systematic way.

📘 LIGHT – Expanded Notes (Up to Class 10 NCERT)

🔷 IMAGE FORMATION BY MIRRORS

1. Concave Mirror

Position of Object	Position of Image	Nature of Image
At infinity	At focus (F)	Real, inverted, highly diminished
Beyond C (center of curvature)	Between C and F	Real, inverted, diminished
At C	At C	Real, inverted, same size
Between C and F	Beyond C	Real, inverted, magnified
At F	At infinity	Real, inverted, highly magnified
Between F and P (pole)	Behind the mirror	Virtual, erect, magnified

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2. Convex Mirror

Position of Object	Position of Image	Nature of Image
At infinity	At focus (behind mirror)	Virtual, erect, highly diminished
Anywhere in front	Between P and F (behind mirror)	Virtual, erect, diminished

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🔷 IMAGE FORMATION BY LENSES

1. Convex Lens (Converging Lens)

Position of Object	Position of Image	Nature of Image
At infinity	At focus (F2)	Real, inverted, highly diminished
Beyond 2F1	Between F2 and 2F2	Real, inverted, diminished
At 2F1	At 2F2	Real, inverted, same size

Position of Object	Position of Image	Nature of Image
Between F1 and 2F1	Beyond 2F2	Real, inverted, magnified
At F1	At infinity	Real, inverted, highly magnified
Between F1 and O	On same side of lens	Virtual, erect, magnified

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2. Concave Lens (Diverging Lens)

Position of Object	Position of Image	Nature of Image
At infinity	At focus (F1, same side)	Virtual, erect, highly diminished
Anywhere in front	Between F1 and O (same side)	Virtual, erect, diminished

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🔷 **PROPERTIES OF IMAGES**

Concave Mirror

- Can form **real & inverted** images (except when object is between F and P → virtual, erect).
- Can be **magnified or diminished** depending on object's position.
- Used in **reflectors, shaving mirrors, torches**.

Convex Mirror

- Always forms **virtual, erect, diminished** image.
- Wider field of view.
- Used in **rear-view mirrors of vehicles**.

Convex Lens

- Can form both **real & virtual images**.
- Used in **magnifying glasses, microscopes, projectors, spectacles**.

Concave Lens

- Always forms **virtual, erect, diminished** images.
- Used in **spectacles for myopia**.

🔷 MAJOR EYE DEFECTS (DISORDERS)

1. **Myopia (Near-sightedness)**
    - Person can see **near objects clearly but not distant objects**.
    - Cause: Elongated eyeball or eye lens has more curvature (shorter focal length).
    - Image forms **in front of retina**.
    - Correction: **Concave lens** (diverging lens).
2. **Hypermetropia (Far-sightedness)**
    - Person can see **distant objects clearly but not near objects**.
    - Cause: Eyeball is shorter or lens has less curvature (longer focal length).
    - Image forms **behind retina**.
    - Correction: **Convex lens** (converging lens).
3. **Astigmatism**
    - Uneven curvature of cornea/lens.
    - Causes **blurred or distorted vision** in certain directions.
    - Correction: **Cylindrical lens**.
4. **Presbyopia (Old-age sight)**
    - Due to loss of elasticity of eye lens with age.
    - Person **cannot see nearby objects clearly**.
    - Correction: **Convex lens spectacles**.
5. **Cataract**
    - Clouding of the eye lens due to protein deposition.
    - Causes **blurred vision, glare, difficulty in night vision**.
    - Correction: **Surgery (lens replacement with artificial lens)**.
