Class 10 Physics Study Notes

Comprehensive Chapter-wise Concepts, Laws, and Formulas

Based on the Latest Syllabus and Exam Pattern

1 Light: Reflection and Refraction

Light is a form of energy that enables us to see. It travels in straight lines (rectilinear propagation of light) and exhibits both wave and particle nature.

1.1 Reflection of Light

The bouncing back of light rays into the same medium when they strike a smooth surface is called reflection.

- **Laws of Reflection:**
  1. The angle of incidence is equal to the angle of reflection ($\angle i = \angle r$).
  2. The incident ray, the normal to the mirror at the point of incidence, and the reflected ray, all lie in the same plane.

1.2 Spherical Mirrors

Mirrors whose reflecting surfaces are spherical are called spherical mirrors.

- **Concave Mirror:** Reflecting surface is curved inwards. Converges light rays. Used in torches, search-lights, vehicle headlights, and by dentists.
- **Convex Mirror:** Reflecting surface is curved outwards. Diverges light rays. Used as rear-view mirrors in vehicles because they give an erect, diminished image and have a wider field of view.

Mirror Formula and Magnification: The relationship between object distance (u), image distance (v), and focal length (f) is given by:

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

Magnification (m) is the ratio of the height of the image (h') to the height of the object (h):

$$m = \frac{h'}{h} = -\frac{v}{u}$$

1.3 Refraction of Light

The bending of light when it passes from one transparent medium to another is called refraction. It happens due to the change in the speed of light in different media.

- **Laws of Refraction (Snell's Law):** The ratio of sine of angle of incidence to the sine of angle of refraction is constant for a given pair of media.

$$\frac{\sin i}{\sin r} = \text{constant} = n_{21}$$

  where n_{21} is the refractive index of the second medium with respect to the first.

- **Absolute Refractive Index (n):** $n = \frac{c}{v}$, where c is the speed of light in vacuum (3×10^8 m/s) and v is the speed of light in the medium.

1.4 Spherical Lenses

- **Convex Lens:** Thicker at the middle, thinner at edges. Converging lens.
- **Concave Lens:** Thinner at the middle, thicker at edges. Diverging lens.

Lens Formula and Power:

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

Magnification (m) for lenses:

$$m = \frac{h'}{h} = \frac{v}{u}$$

The **Power of a Lens** (P) is the reciprocal of its focal length (in meters). Its SI unit is Dioptre (D).

$$P = \frac{1}{f(\text{in meters})}$$

2 The Human Eye and the Colourful World

2.1 The Human Eye

The human eye works on the refraction of light through a natural convex lens.

- **Power of Accommodation:** The ability of the eye lens to adjust its focal length to see both near and distant objects clearly. The near point of a normal eye is 25 cm, and the far point is infinity.

2.2 Defects of Vision and Their Correction

- **Myopia (Near-sightedness):** A person can see nearby objects clearly but cannot see distant objects distinctly. Image forms in front of the retina. *Correction:* Concave lens of suitable power.
- **Hypermetropia (Far-sightedness):** A person can see distant objects clearly but cannot see nearby objects distinctly. Image forms behind the retina. *Correction:* Convex lens of suitable power.

- **Presbyopia:** The power of accommodation decreases with ageing. Corrected using bifocal lenses.

2.3 Refraction through a Prism and Dispersion

- **Dispersion:** The splitting of white light into its component seven colours (VIBGYOR) upon passing through a glass prism.
- **Atmospheric Refraction:** Causes phenomena like the twinkling of stars and advance sunrise/delayed sunset.
- **Scattering of Light:** Causes the blue colour of the sky and the reddening of the sun at sunrise and sunset (Tyndall Effect).

3 Electricity

3.1 Electric Current and Potential Difference

- **Electric Current (I):** The rate of flow of electric charges. SI unit is Ampere (A).

$$I = \frac{Q}{t}$$

- **Potential Difference (V):** Work done to move a unit charge from one point to another. SI unit is Volt (V).

$$V = \frac{W}{Q}$$

3.2 Ohm's Law and Resistance

Ohm's Law: At a constant temperature, the current flowing through a conductor is directly proportional to the potential difference across its ends.

$$V = IR$$

where R is the Resistance. SI unit is Ohm (Ω).

Factors on which Resistance depends: Resistance is directly proportional to length (l) and inversely proportional to the area of cross-section (A).

$$R = \rho \frac{l}{A}$$

where ρ (rho) is the electrical resistivity of the material.

3.3 Combination of Resistors

- **In Series:** Current remains same, potential difference divides.

$$R_s = R_1 + R_2 + R_3 + \dots$$

- **In Parallel:** Potential difference remains same, current divides.

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \dots$$

3.4 Heating Effect of Electric Current

Joule's Law of Heating: The heat (H) produced in a resistor is directly proportional to the square of current, resistance, and time.

$$H = I^2 R t$$

Electric Power (P): The rate at which electrical energy is consumed.

$$P = VI = I^2 R = \frac{V^2}{R}$$

Commercial unit of energy is Kilowatt-hour (kWh). 1 kWh = 3.6×10^6 Joules.

4 Magnetic Effects of Electric Current

4.1 Magnetic Field and Field Lines

A magnetic field is the region around a magnet where its force can be detected.

- Magnetic field lines emerge from the North pole and merge at the South pole outside the magnet.
- Inside the magnet, the direction is from South to North.
- They never intersect each other.

4.2 Magnetic Field due to a Current-Carrying Conductor

- **Right-Hand Thumb Rule:** If you hold a current-carrying straight wire in your right hand such that the thumb points towards the direction of current, your wrapped fingers show the direction of magnetic field lines.
- **Solenoid:** A coil of many circular turns of insulated copper wire wrapped closely in the shape of a cylinder. The magnetic field inside a long straight solenoid is uniform and resembles that of a bar magnet.

4.3 Force on a Current-Carrying Conductor

A current-carrying conductor placed in a magnetic field experiences a force. The direction of the force is given by **Fleming's Left-Hand Rule**:

> Stretch the thumb, forefinger, and middle finger of your left hand such that they are mutually perpendicular. If the forefinger points in the direction of the magnetic field and the middle finger in the direction of current, then the thumb will point in the direction of motion or the force acting on the conductor.

4.4 Domestic Electric Circuits

- **Live Wire (Positive):** Usually has red insulation.
- **Neutral Wire (Negative):** Usually has black insulation. Potential difference between Live and Neutral is 220V in India.
- **Earth Wire:** Usually has green insulation. Used as a safety measure to prevent severe electric shocks.
- **Electric Fuse:** A safety device based on the heating effect of electric current. It breaks the circuit if a current larger than the specified value flows.

5 Quick Formula Sheet

Concept / Topic	Formula	SI Unit
Mirror Formula	$\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$	–
Lens Formula	$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$	–
Magnification (Mirror)	$m = -\frac{v}{u} = \frac{h'}{h}$	–
Magnification (Lens)	$m = \frac{v}{u} = \frac{h'}{h}$	–
Power of Lens	$P = \frac{1}{f \text{ (in m)}}$	Dioptre (D)
Refractive Index	$n = \frac{c}{v}$	–
Electric Current	$I = \frac{Q}{t}$	Ampere (A)
Potential Difference	$V = \frac{W}{Q}$	Volt (V)
Ohm's Law	$V = IR$	–
Resistivity	$\rho = \frac{R \cdot A}{l}$	Ohm-meter ($\Omega \cdot$ m)
Resistors in Series	$R_s = R_1 + R_2 + \dots$	Ohm (Ω)
Resistors in Parallel	$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \dots$	Ohm (Ω)
Joule's Law of Heating	$H = I^2Rt$	Joule (J)
Electric Power	$P = VI = I^2R = \frac{V^2}{R}$	Watt (W)

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