Class 11 Physics (NCERT)

SYLLABUS

1. Units and Measurements
2. Motion in a Straight Line
3. Motion in a Plane
4. Laws of Motion
5. Work, Energy and Power
6. System of Particles and Rotational Motion
7. Gravitation
8. Mechanical Properties of Solids
9. Mechanical Properties of Fluids
10. Thermal Properties of Matter
11. Thermodynamics
12. Kinetic Theory
13. Oscillations
14. Waves

Units and Measurement

1. **Physical Quantities**
   - A quantity that can be measured and expressed in terms of numerical value and unit.
   - Two types:
     - **Fundamental Quantities**: Cannot be derived from other quantities (e.g., length, mass, time).
     - **Derived Quantities**: Obtained by combining fundamental quantities (e.g., speed, force, energy).

Units and Measurement

2. System of Units
    - **CGS System**: Centimeter (cm), Gram (g), Second (s)
    - **FPS System**: Foot (ft), Pound (lb), Second (s)
    - **MKS System**: Meter (m), Kilogram (kg), Second (s)
    - **SI System (International System of Units)**: Standard system with 7 base units.

Units and Measurement

3. **SI Base Units**

- Length → **meter (m)**
- Mass → **kilogram (kg)**
- Time → **second (s)**
- Electric Current → **ampere (A)**
- Temperature → **kelvin (K)**
- Amount of substance → **mole (mol)**
- Luminous intensity → **candela (cd)**

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Units and Measurement

Errors in Measurement

- **Systematic Errors**: Due to fault in the measuring instrument or method.
- **Random Errors**: Arise due to unpredictable fluctuations.
- **Absolute Error**: $\Delta X = |X_{\text{measured}} - X_{\text{true}}|$
- **Relative Error**: $\frac{\Delta X}{X_{\text{true}}}$
- **Percentage Error**: $\frac{\Delta X}{X_{\text{true}}} \times 100\%$

Units and Measurement

Dimensional Analysis

- **Dimensional Formula**: Expressing a physical quantity in terms of base quantities.
  - Example: Force $F = MLT^{-2}$
- **Dimensional Equations**: Equating a quantity to its dimensional formula.
- **Applications**:
  - Checking correctness of an equation.
  - Deriving formulas.
  - Converting units.

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Motion in a Straight Line

1. Kinematic Equations (For Uniformly Accelerated Motion)

$$v = v_0 + at$$

$$x = v_0 t + \frac{1}{2} a t^2$$

$$v^2 = v_0^2 + 2ax$$

$$x = \frac{(v + v_0)}{2} t$$

Where:

- v_0 = Initial velocity
- v = Final velocity
- a = Acceleration
- x = Displacement
- t = Time

Motion in a Straight Line

2. Motion under Gravity (Free Fall)

- Acceleration due to gravity: $g = 9.8\, m/s^2$ (downward)
- Equations remain the same, but a is replaced by $-g$ (negative because gravity acts downward).
- Time of flight (up & down):

$$t = \frac{2v_0}{g}$$

- Maximum height reached:

$$h_{\max} = \frac{v_0^2}{2g}$$

- Velocity while falling:

$$v = \sqrt{2gh}$$

Motion in a Straight Line

3. Relative Velocity

$$v_{\mathrm{AB}} = v_A - v_B$$

Where:

- v_{AB} = Velocity of A relative to B
- v_A, v_B = Velocities of A and B

If A and B move in the **same direction**, subtract velocities.

If they move in **opposite directions**, add velocities.

Motion in a Straight Line

4. Stopping Distance (When Brakes are Applied)

$$d_s = \frac{v_0^2}{2a}$$

Where:

- d_s = Stopping distance
- v_0 = Initial velocity
- a = Deceleration (negative acceleration)

Motion in a Straight Line

1. **Uniform motion**: Velocity remains constant (zero acceleration).
2. **Non-uniform motion**: Velocity changes over time (acceleration present).
3. **For an object thrown upward**:
    - Velocity becomes **zero** at the highest point.
    - Acceleration remains g **downward** throughout the motion.
4. **Free fall**:
    - Object moves under gravity alone.
    - Acceleration = $g = 9.8\, m/s^2$.
5. **Area under velocity-time graph** gives **displacement**.

Motion In A Plane

Addition of Vectors

- **Triangle Law**: If two vectors are represented as two sides of a triangle, their sum is the third side.
- **Parallelogram Law**: If two vectors form adjacent sides of a parallelogram, their sum is the diagonal.

Resultant of Two Vectors (A and B)

$$R = \sqrt{A^2 + B^2 + 2AB\cos\theta}$$

Where:

- A, B = Magnitudes of vectors
- θ = Angle between them

Direction of Resultant Vector

$$\tan\theta = \frac{B\sin\theta}{A + B\cos\theta}$$

Motion In A Plane

Resolution of Vectors

Any vector can be resolved into two perpendicular components:

- **Horizontal Component**: $A_x = A\cos\theta$
- **Vertical Component**: $A_y = A\sin\theta$

Motion In A Plane

Motion in a Plane (Projectile Motion)

- Motion in two dimensions under gravity.
- **Path of projectile**: Parabola.

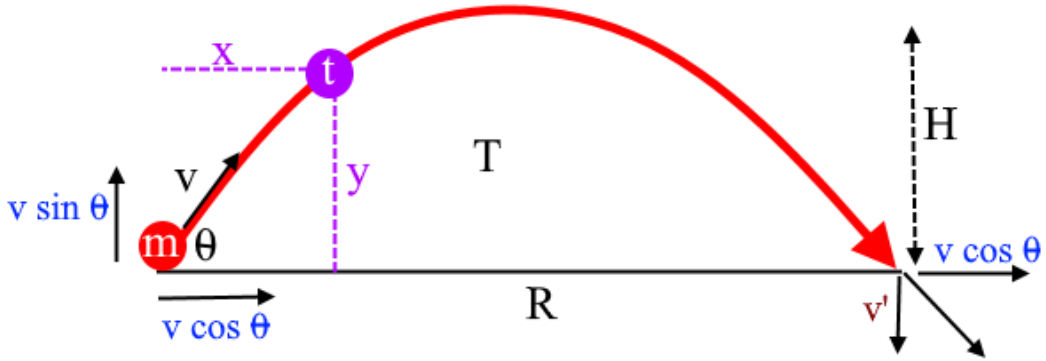
Equations of Motion in Two Dimensions

- **Horizontal Motion (Uniform Motion)**

$$x = v_0 \cos\theta \cdot t$$

- **Vertical Motion (Under Gravity)**

$$y = v_0 \sin\theta \cdot t - \frac{1}{2} g t^2$$



Motion In A Plane

Motion in a Plane (Projectile Motion)

Time of Flight

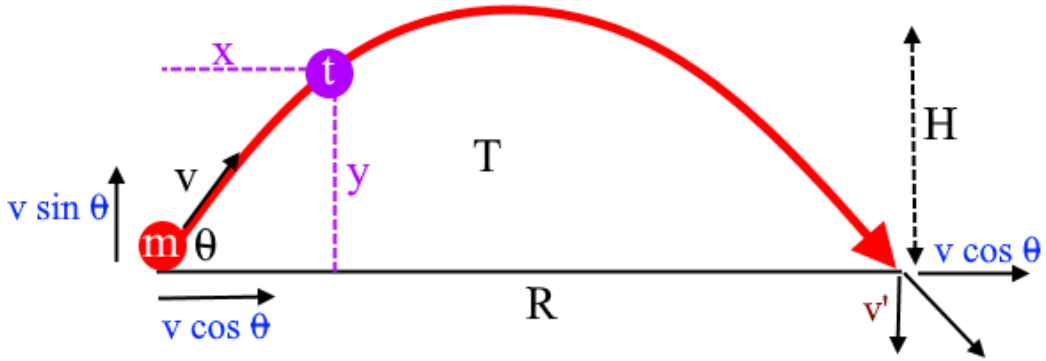
$$T = \frac{2v_0 \sin\theta}{g}$$

Maximum Height

$$H = \frac{v_0^2 \sin^2\theta}{2g}$$

Horizontal Range

$$R = \frac{v_0^2 \sin 2\theta}{g}$$



- Maximum range when $\theta = 45^\circ$.