1. Basic Kinematics Formula

Displacement (Δx):

$$\Delta x = x_{final} - x_{initial}$$

Average Velocity (V_{avg}):

$$V_{avg} = \frac{Total\ Displacement}{Total\ Time}$$

Average Speed:

$$Avg.\ Speed = \frac{Total\ Distance}{Total\ Time}$$

Instantaneous Velocity (v):

$$v = \frac{dx}{dt}$$

Instantaneous Acceleration (a):

$$a = \frac{dv}{dt} = \frac{d^2x}{dt^2}$$

2. Equations of Motion (Constant Acceleration ONLY)

First Equation:

$$v = u + at$$

Second Equation:

$$s = ut + \frac{1}{2}at^2$$

Third Equation:

$$v^2 = U^2 + 2as$$

Fourth Equation (Displacement in n^{th} second):

$$S_n = u + \frac{a}{2}(2n - 1)$$

3. Motion Under Gravity (Free Fall)

Time to reach Max Height:

$$t = \frac{u}{g}$$

Maximum Height Reached (H):

$$H = \frac{u^2}{2g}$$

Total Time of Flight (Up and Down):

$$T = \frac{2u}{g}$$

Velocity on hitting the ground:

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

4. Important Shortcuts & Special Cases

If a car applies the brakes,

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

Galileo's Law of Odd Numbers: For an object starting from rest, the distances covered in equal time intervals follow the ratio **1 : 3 : 5**……

Relative Velocity: The velocity of object A with respect to object B is:

$$V_{AB} = V_A - V_B$$

5. Calculus Methods (Variable Acceleration)

Find v from a:

$$v = \int a dt$$

Find s from v:

$$s = \int v dt$$

Acceleration as a function of x:

$$a = v\frac{dv}{dx}$$

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