KINEMATICS

Quantities & Definitions

1) **Scalar quantities** are physical quantities that have *magnitude* only.
2) **Vector quantities** are physical quantities that have both *magnitude* and *direction.*
3) Vector quantities can be negative. Negative means it is in the opposite direction.

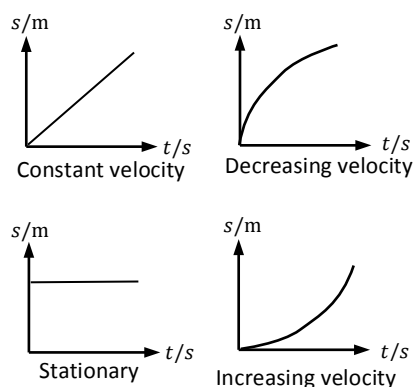|	Physical quantity	Definition	Unit
1	Distance, d (scalar)	is the total length covered by moving object regardless of direction of motion.	m
2	Displacement, s (vector)	is the distance measured in a straight line in a specified direction.	m
3	Speed, s (scalar)	is the rate of change of distance travelled with respect to time.	m/s or ms^{-1}
4	Velocity, v (vector)	is the rate of change of displacement with respect to time.	m/s or ms^{-1}
5	Acceleration, a (vector)	is the rate of change of velocity with respect to time.	m/s^2 or ms^{-2}

Equations of Motion

1) $a = \frac{v-u}{t}$ or $v = u + at$

2) $s = \frac{1}{2}(u + v)t$

3) $v^2 = u^2 + 2as$ (Optional)

4) $s = ut + \frac{1}{2}at^2$ (Optional)

- only applies to uniformly accelerated motion.
- air resistance is negligible.
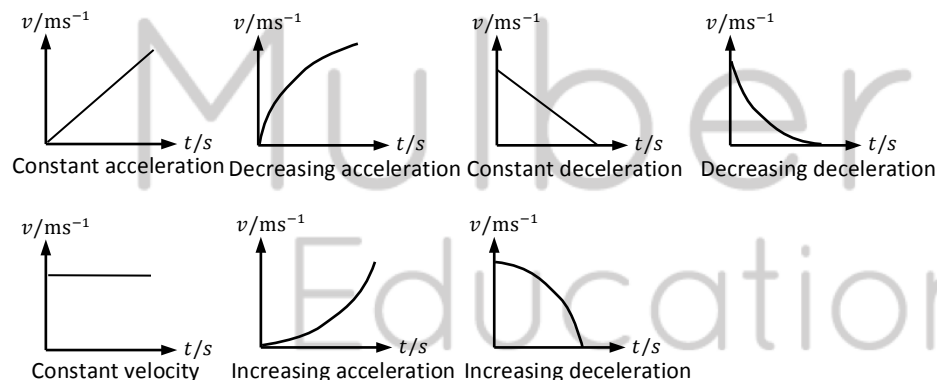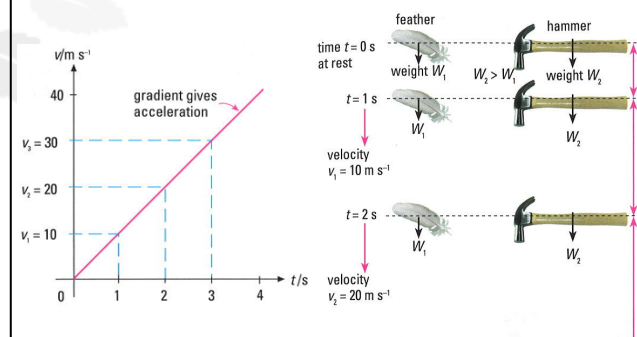- assign a direction of positive sign and be consistent throughout the application.

Free Fall Motion

Free Fall Motion (without air resistance)

An object is free falling if it is falling under its own weight only.
The acceleration is constant at 10 m/s^2 on Earth and is independent of mass.

$$a = g = 10\ m/s^2$$

Free Fall Motion (with air resistance)
Air resistance is a resistive force (opposes motion).
It increases with:

1) velocity
2) surface area (or size) of objects
3) density of fluid

Terminal velocity of a free falling object is achieved when the **air resistance is equal to its weight**. The object has zero aceleration.

Graph Types & Descriptions

Graphs	Gradient represent	Area under graph represents
Displacement-time	Velocity	-
Velocity-time	Acceleration	Displacement
Acceleration-time	-	Velocity

- A straight line graph indicates constant gradient.
- Downward sloping line indicates negative gradient.
- If area enclosed is always between the line and time axis.
- Area below time axis is negative, indicates negative quantity.

Displacement-time graphs

Constant velocity   Decreasing velocity

Stationary   Increasing velocity

Velocity-time

Constant acceleration   Decreasing acceleration   Constant deceleration   Decreasing deceleration

Constant velocity   Increasing acceleration   Increasing deceleration