WEEK 1: LINEAR MOTION

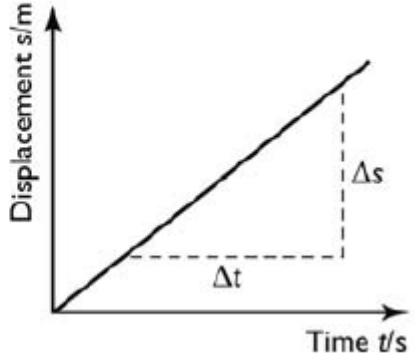
- **Objectives:**
- To explain the concepts of linear motion.
- To examine graphs of motion
- To derive Equations of motion and calculations about motion

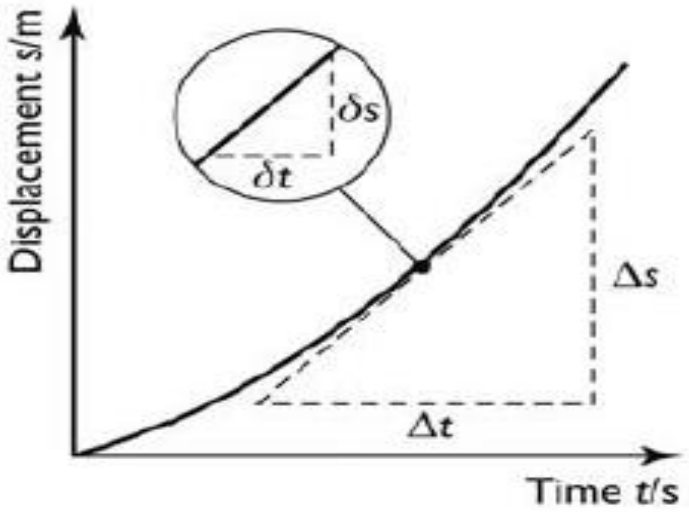
Concepts of Linear Motion

- **Displacement** is the distance an object is from a fixed reference point in a specified direction.
- Displacement is a vector quantity. It has both magnitude and direction.
- **Speed** is the distance travelled per unit time.
- Speed is a scalar quantity. It refers to the total distance travelled.
- **Velocity** is the change in displacement per unit time.
- Velocity is a vector quantity, being derived from displacement — not the total distance travelled.
- **Acceleration** is the rate of change of velocity.
- Acceleration is a vector quantity.
- An acceleration in the direction in which a body is travelling will increase its velocity.
- An acceleration in the opposite direction to which a body is travelling will decrease its velocity.

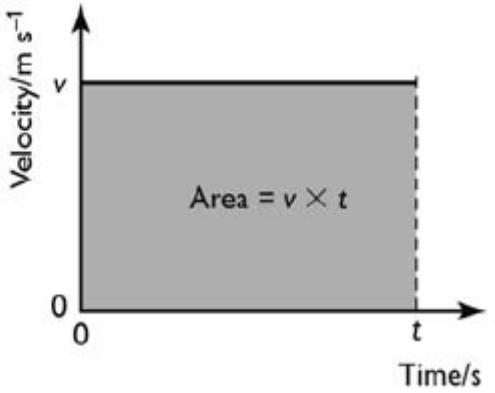
Graphs of Motion

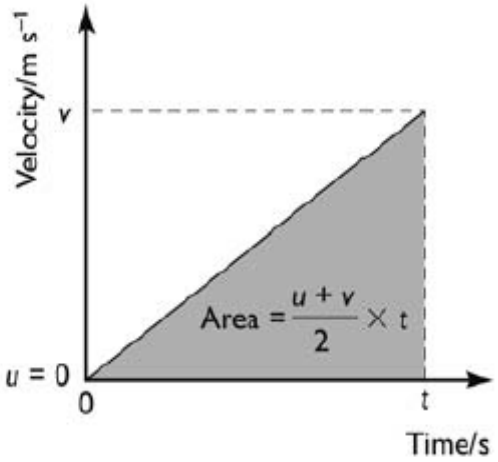
Displacement–time graphs





Velocity–time graphs

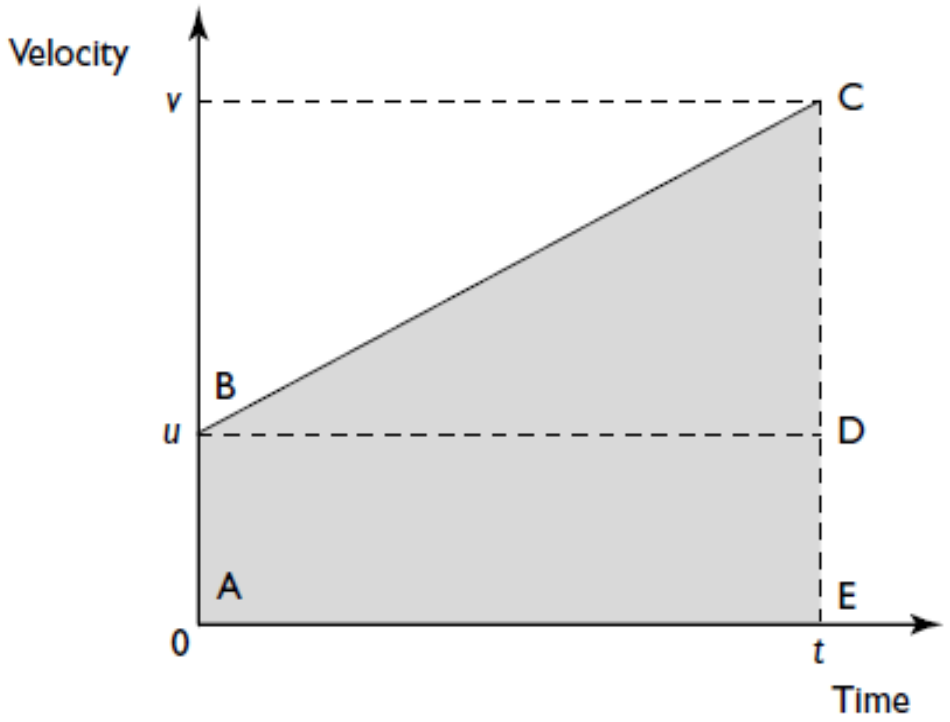




v = gradient = $\frac{\Delta s}{\Delta t}$

a = gradient = $\frac{v - u}{t_2 - t_1} = \frac{\Delta v}{\Delta t}$

Equations of Motion and Calculations



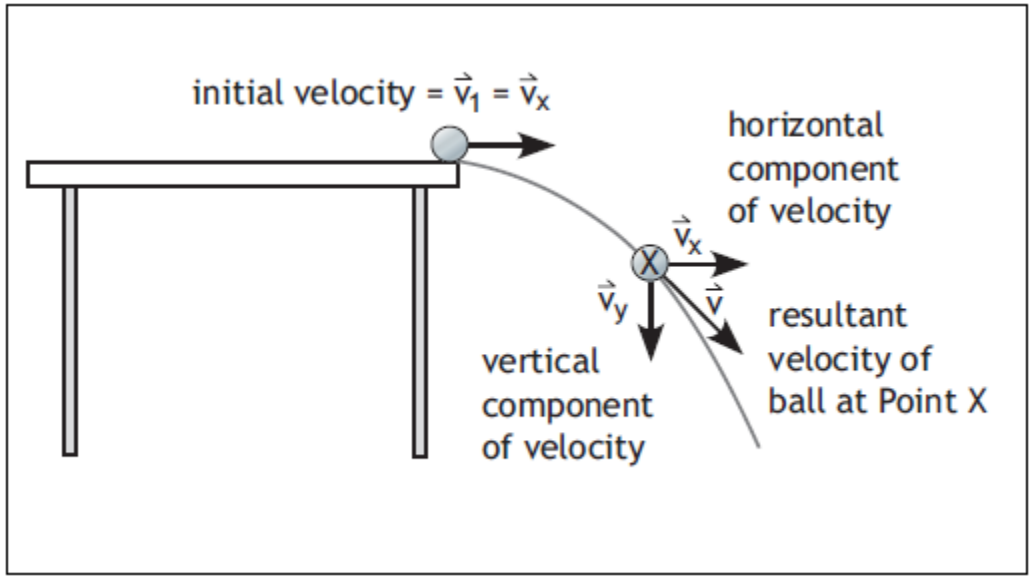
- The equations of uniformly accelerated motion are:

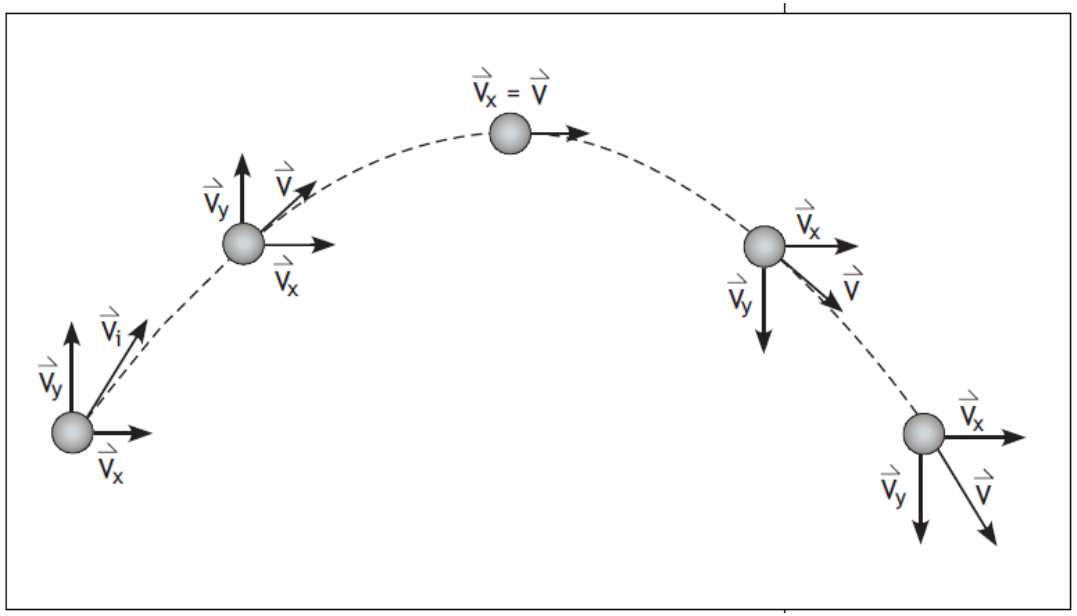
1. $v = u + at$
2. $s = \frac{v + u}{2} t$
3. $s = ut + \frac{1}{2} at^2$
4. $v^2 = u^2 + 2as$

WEEK 2 PROJECTILES

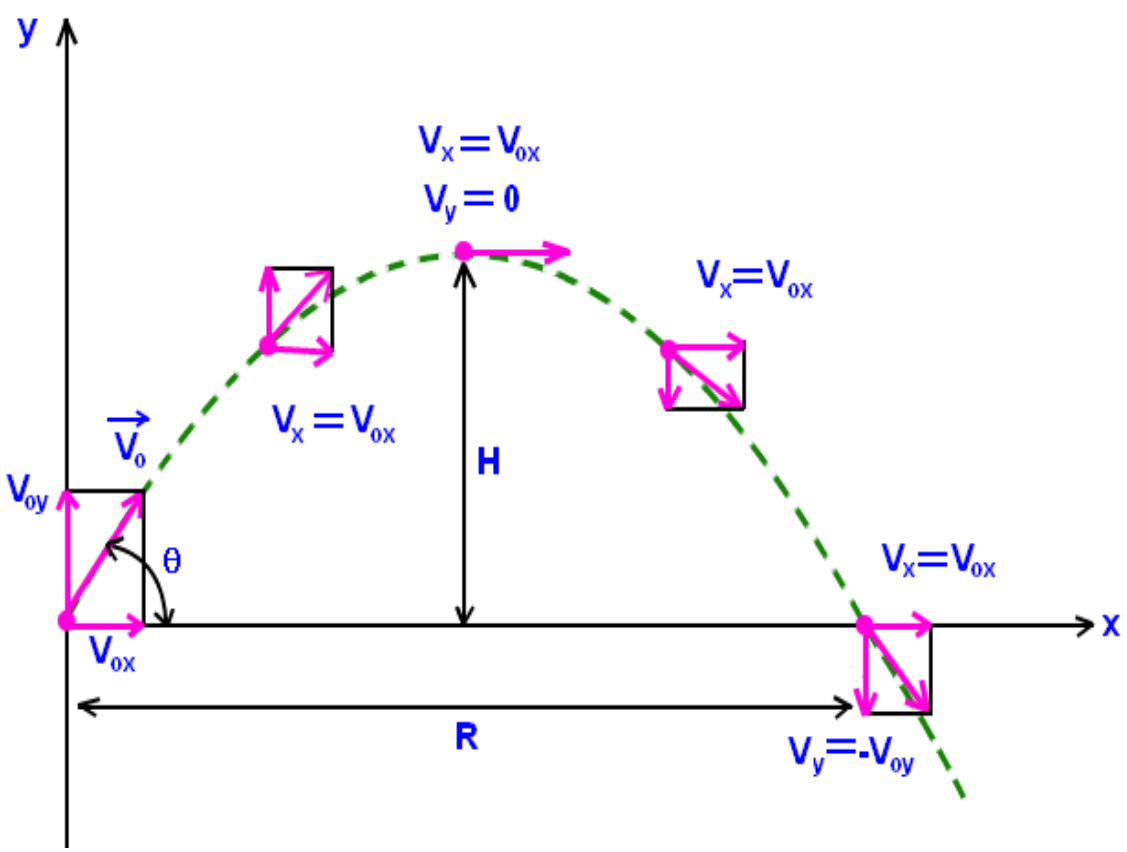
- **Objectives**
- To explain the Concepts of projectile motion
- To state Equations of trajectory
- To determine Time of flight
- To find Maximum height, Range, Direction of motion of projectile and motion of a projectile from a cliff.

Concepts of Projectile Motion





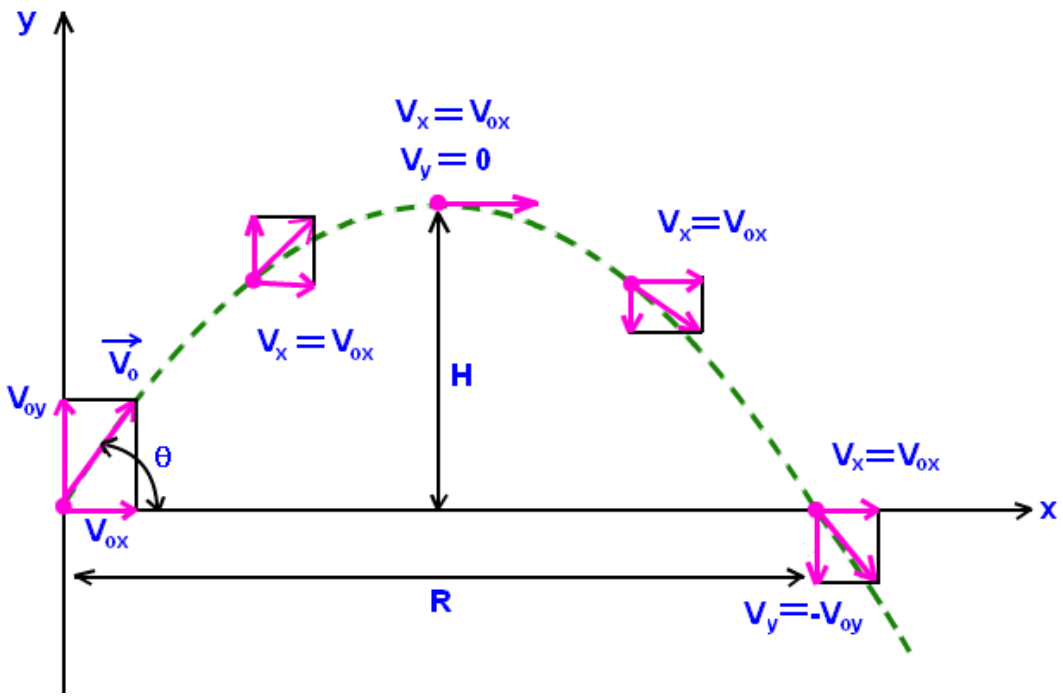
Equations of Trajectory



- **Trajectory formula** is given by
- $y = x \tan\theta - \frac{g x^2}{2 v^2 \cos^2 \theta}$

Where,
y is the horizontal component,
x is the vertical component,
g is gravity value,
v is initial velocity, and θ is angle of inclination of the initial velocity from horizontal axis

Time of Flight, Maximum Height and Range



- Trajectory related equations are:
- Time of Flight: $t = \frac{2\, v_0 \sin\theta}{g}$
- Max Height reached: $H = \frac{v_0^2\, sin^2\theta}{2g}$
- Horizontal Range: $R = \frac{v_0^2\, sin^2\theta}{g}$

Direction of Motion of Projectile and Motion of a Projectile from a Cliff

- Marshall throws a ball at an angle of 60^0. If it moves at the rate of 6m/s and Steve catches it after 4s. Calculate the vertical distance covered by it.
- The horizontal distance is given by: $x = v_0\, t = 6m/s \times 4s = 24\, m$

$$y = x \tan\theta - \frac{g x^2}{2\, v^2 \ \ cos^2\, \theta}$$

$$y = 24 \tan 60 - \frac{9.8 \times 24^2}{2 \times 6^2 \ \ cos^2\, 60}$$

$$y = -272.032 \text{ m}$$