LINEAR MOTION - Form 3 Physics Notes

Introduction

- The study of motion is divided into two areas namely kinematics and dynamics.
- Kinematics deals with the motion aspect only while dynamics deals with the motion and the forces associated with it.
- There are three common types of motion:
    - Linear or translational motion.
    - Circular or rotational motion.
    - Oscillatory or vibrational motion.
- In this topic, we concentrate on linear motion.
- Note that all motion is relative i.e the state of a body; at rest or in motion, is ONLY true with respect to the observer's position.

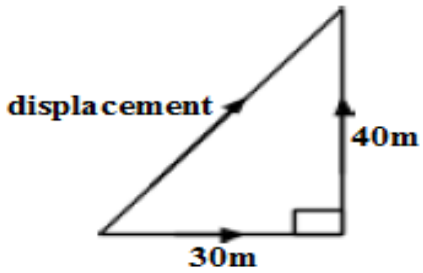
Terms Associated with Linear Motion

- **Distance**
    - is the length of the path covered by a body.
    - It only gives the magnitude but no direction i.e it is a scalar quantity.
- **Displacement**
    - is the distance through which a body travels in a specified direction. It is a vector quantity. Both distance and displacement are measured in *metres*.
- **Speed**
    - is the distance covered per unit time.
    - Speed = $^{\text{distance}}/_{\text{time}}$.
- **Velocity**
    - is the rate of change of displacement.
    - Velocity = $^{\text{displacement}}/_{\text{time}}$.
    - It is a vector quantity.
    - When the rate of change of displacement is non-uniform, we talk about average velocity;
    - Average velocity= $^{\text{total displacement}}/_{\text{total time}}$.
      Both speed and velocity are expressed in *metre per second (m/s)*.
- **Acceleration**
    - is the rate of change of velocity.
    - Thus, Acceleration= $^{\text{change in velocity}}/_{\text{time interval}} = ^{\text{(final velocity v - initial veolicity u)}}/_{\text{time}}$.
    - Acceleration is measured in metre per square second (m/s^2).
    - If the velocity of a body decreases with time, its acceleration becomes negative.

- A negative acceleration is referred to as *deceleration* or retardation.

Example 1.1

1. A body covers a distance of 2m in 4seconds, rests for 2seconds and finally covers a distance of 90m in 6seconds. Calculate its average speed.
   Solution:
   Average speed = $^{\text{total distance}}/_{\text{total time}} = {}^{(2m+90m)}/_{(4s+2s+6s)}$
   $= {}^{92m}/_{12s} = 7^{2}/_{3}$ m/s.
2. A body moves 30m due east in 2seconds, then 40m due north in 4seconds. Determine its:
   a. Average speed.
   Solution:



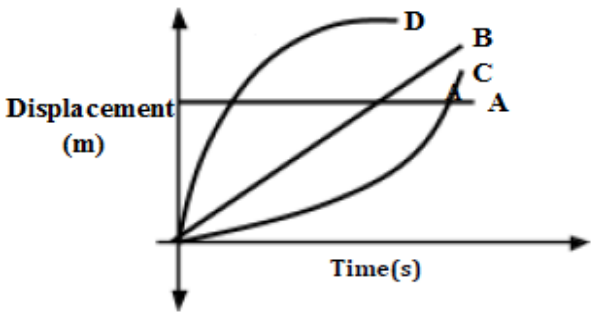
   Average speed= $^{\text{total distance}}/_{\text{time}} = {}^{(30m+40m)}/_{(2s+4s)}$
   $= {}^{70m}/_{6s} = 11.67$ m/s.
   b. Average velocity.
   Solution:
   Average velocity= $^{\text{total displacement}}/_{\text{time}} = {}^{50m}/_{6s}$
   =8.33m/s.
3. A body is made to change its velocity from 20m/s to 36 m/s in 0.1s. What is the acceleration produced?
   $a = {}^{(v-u)}/_{t} = {}^{(36m/s - 20m/s)}/_{0.1s}$
   $=160$ m/s^2.
4. A particle moving with a velocity of 200m/s is brought to rest in 0.02s. What is the acceleration of the particle?
   $a = {}^{(v-u)}/_{t} = {}^{(0m/s - 200m/s)}/_{0.02}$
   $= {}^{-200}/_{0.02} = -10{,}000$m/s^2.

Motion Graphs.

- There are two categories; displacement-time graphs and velocity time graphs.

Displacement-time Graphs

- The slope of a displacement-time graph gives the velocity of the body.
- The various displacement-time graphs are as illustrated below:



- **Graph A**: the body is at rest i.e there is no change in displacement as time changes. The slope of