Force, Motion and Energy

Motion and Rest

- – Motion is the change in the position of object with respect to its surroundings.
- – An object which do not change their position is said to be at rest.
- – Motion is a relative phenomenon

An object appearing to be in motion to one person can appear to be at rest as viewed by another person.

Example: Trees on road side

- Force is a push or pull.

Newton's law of motion:

This law states that energy body continues to be us its state of rest or the state of uniform motion along a straight line unless it is acted upon by some external force.

It gives the definition of force and inertia

Inertia

The inherent property of a body to resist any change in its state of rest or state of Uniform motion unless it is influenced upon by an external unbalanced force is known as inertia.

2nd law of motion:

The force acting on a body is directly proportional to the rate of change of linear momentum of the body and change in momentum tooks place in the direction of force

Force = Mass × acceleration

Linear Momentum:

The impact of force is more of the velocity and mass of the body is more to quantity the impact of a force a physical quantity linear momentum is defined.

P = Mass × Velocity
P = M × V
Unit is Kg m/s

Impulse:

A large force acting for a very short interval of time is called impulsive force.

$$J = F \times t$$

3rd law of motion:

For every action there is as equal and opposite reaction. They always act on two different bodies.

$$F_B = -F_A$$

Principle of Linear Momentum

There is no change in the linear momentum of a system of bodies as long as not net external force acts on them.

Rocket Propulsion:

- Newton's third law of motion
- Principle of linear momentum

While in motion, the mass of the rocket gradually decreases until the fuel is completely burnt out. Since, there is no net external force acting on it, the linear momentum of the system is conserved. The mass of the rocket decreases with the attitude which increases velocity of the rocket and at one stage it just escapes from the gravitational pull of the earth. This velocity is called escape velocity.

$$V_e = \sqrt{\frac{2GM}{r}}$$

1. Which of the following law undergoes rocket propulsion?
   a. Newton 1st law of motion   b. Newton 2nd law of motion
   c. Newton 3rd law of motion   d. None of these

<div align="right">(Group 2, 2013)</div>

2. Inertia of a body depends upon
   a. weight of the object   b. Acceleration due to gravity of planet
   c. mass of the object   d. Both a & b

3. Newton's III law is applicable
   a. for a body is at rest   b. for a body is motion
   c. Both a & b   d. only for bodies with equal masses

Distance and Displacement

The actual length of the path travelled by a moving body irrespective of the direction is called distance travelled by the body.

S.I Unit is meter

Displacement is defined as the change in position of a moving body in a particular direction. It is a vector quantity.

S.I Unit is meter

Speed, Velocity and Acceleration:

i) Speed $= \dfrac{\text{Distance}}{\text{Time}}$

SI Unit is ms^{-1}

ii) Velocity is the rate of change of displacement.

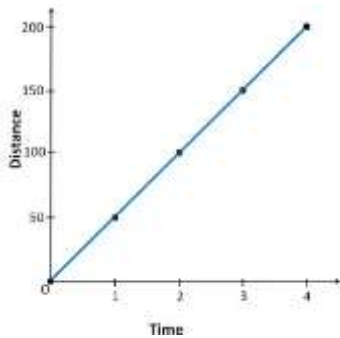$$\text{Velocity} = \dfrac{\text{Displacement}}{\text{Time Taken}}$$

iii) Acceleration is the rate of change of velocity.

$$\text{Acceleration} = \text{Change in velocity}$$

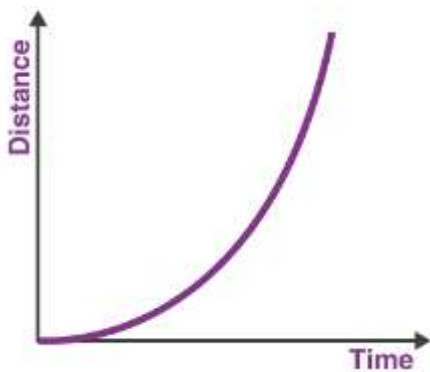$$a = \dfrac{\text{final velocity - initial velocity}}{\text{Time Taken}}$$

SI Unit – ms^{-2}

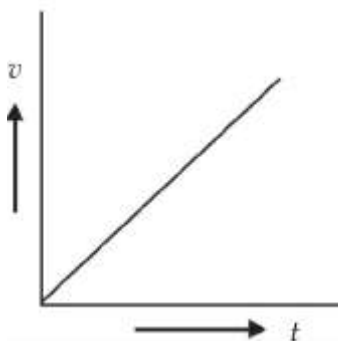## Distance – Time graph for uniform motion

equal distance in equal intervals at time, it is a straight line.
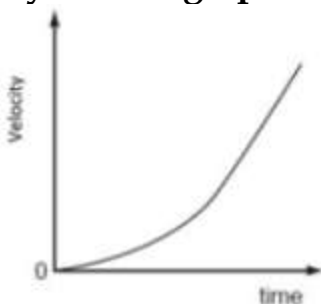
Distance – Time graph for non- uniform motion

Non-linear variation

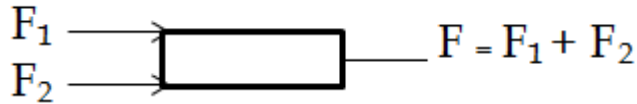## Velocity – Time graph for Uniform acceleration

(i) It is a straight line

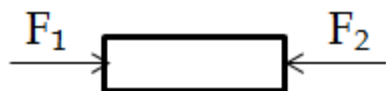## Velocity – Time graph for Non-Uniform acceleration

- There is no shape. It can have any shape.

Types of Forces:

(i) Parallel Force

$$F = F_1 + F_2$$

(ii) Unlike Parallel Force

$F = F_1 - F_2 \ (F_1 > F_2)$
$F = F_2 - F_1 \ (F_2 > F_1)$
$F = 0 \ (F_1 = F_2)$

(iii) Rotational effect of force.
(iv) Torque: The turning (or) rotating effect of a force about a fixed point (or) Fixed axis is called Torque.

$$\boxed{l = F \times d}$$ It is a vector quantity

(v) Couple: two equal and unlike parallel forces applied simultaneously at two distinct points constitute a couple.

$$\boxed{M = F \times s}$$ $Nm \rightarrow$ Unit

Factors affecting Force

- Value
- Area of contact

Thrust

It is a force acting perpendicular to an object.

Pressure

The Force per unit area acting on an object concerned is called pressure.

$$\text{Pressure} = \frac{\text{Force}}{\text{Area}}$$

S.I Unit Pressure is Pascal.
1 Pascal = 1 Nm^{-2}

Pressure exerted by a force depends on the magnitude of the force and the area of content.

Atmosphere Pressure:

The amount of force or weight of the atmosphere air that acts downwards on unit surface area of the earth is known as Atmospheric Pressure.

It is measured by using barometer device. It is invented by 'Torvicelli'. S.I Unit Nm^{-2} (or) Pascal

1 atomic Pressure = 1.01×10^{-5} Nm^{-2}

Factors affecting pressure exerted by liquids:
(i) Depth (h)
(ii) Density
(iii) It will exerts in all direction