Chapter 8 Force and laws of motion

Force

It is the force that enables us to do any work. To do anything, either we pull or push the object. Therefore, pull or push is called force.

For example, to open a door, either we push or pull it. A drawer is pulled to open and pushed to close.

Effect of Force

(i) Force can move a stationary body.
(ii) Force can stop a moving body.
(iii) Force can change the direction of a moving object.
(iv) Force can change the speed of a moving body.
(v) Force can change the shape and size of an object.

Forces are mainly of two types

1. Balanced forces
2. Unbalanced forces

Balanced Forces

If the resultant of applied forces is equal to zero, it is called balanced forces.

For example, in the tug of war, if both the team applies a similar magnitude of forces in opposite directions, the rope does not move on either side.

Unbalanced Forces

If the resultant of applied forces is greater than zero, the forces are called unbalanced forces.

Inertia

The natural tendency of objects to resist a change in their state of rest or of uniform motion is called inertia.

Mass

The mass of an object is a measure of its inertia. Its SI unit is kilogram (kg).

The inertia of an object is measured by its mass. Inertia is directly proportional to the mass. This means inertia increases with an increase in mass and decreases with a decrease in mass.

Momentum

- Momentum is the power of motion of an object.

- The product of velocity and mass is called momentum. Momentum is denoted by 'p'.

Therefore, $Momentum\ of\ the\ object\ =\ Mass\ \times\ Velocity$

Or, $$\boxed{p\ =\ m\ \times\ v}$$

$$Where, p\ =\ momentum,\ m\ =\ mass\ of\ the\ object\ and\ v\ =\ velocity\ of\ the\ object.$$

$$Therefore, SI\ unit\ of\ momentum =\ kg\ m/s$$

Laws of Motion

Newton's First Law of Motion (Law of Inertia)

Any object remains in the state of rest or uniform motion along a straight line until it is required to change the state by applying an external force.

Statement of Second Law

The rate of change of momentum of an object is proportional to the applied unbalanced force in the direction of the force.

$$\boxed{F = ma}$$

Mathematical expression

$$Suppose,\quad Mass\ of\ an\ object\ =\ m$$
$$Initial\ velocity\ of\ an\ object\ =\ u$$
$$Final\ velocity\ of\ an\ object\ =\ v$$
$$So, Initial\ momentum, p_1 =\ mu$$
$$Final\ momentum,\ p_2 =\ mv$$

$$\therefore Change\ in\ momentum =\ Final\ momentum - Initial\ momentum$$
$$=\ mv - mu$$
$$=\ m(v - u)$$

$$\therefore\ Rate\ of\ change\ of\ momentum = \frac{Change\ in\ momentum}{Time\ taken}$$

$$= \frac{m\ (v\ -\ u\ )}{t}$$

According to second law, this rate of change of momentum is directly proportional to force.