

9th Standard Science

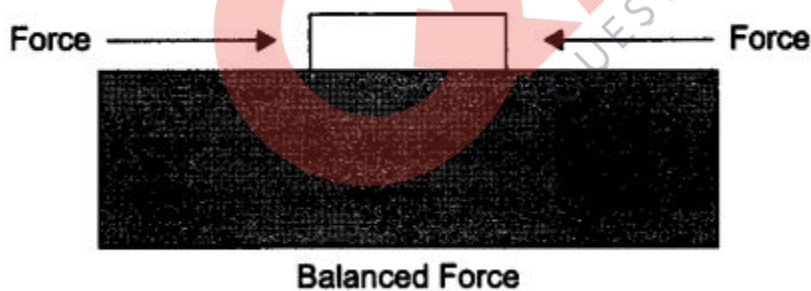
Force and Laws of Motion

Force: It is a push or pulls on an object that produces an acceleration in the body on which it acts. S.I. unit of force is Newton.

A force can do three things on a body.

- It can change the speed of the body.
- It can change the direction of motion of a body.
- It can change the shape of a body.

Balanced forces: Forces are said to be balanced forces if they nullify one another and their resultant force is zero.



Frictional force: The force that always opposes the motion of objects is called a force of friction.

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

Mathematically,

$$F \propto \frac{p_2 - p_1}{t} \text{ or } \frac{m(v - u)}{t} \text{ or } ma$$

$$F = k ma \text{ (where } k \text{ is a proportionality constant)}$$

$$F = ma \quad (\because k = 1)$$

Momentum: The momentum of an object is the product of its mass and velocity and has the same direction as that of the velocity. Its S.I. unit is kg m/s.

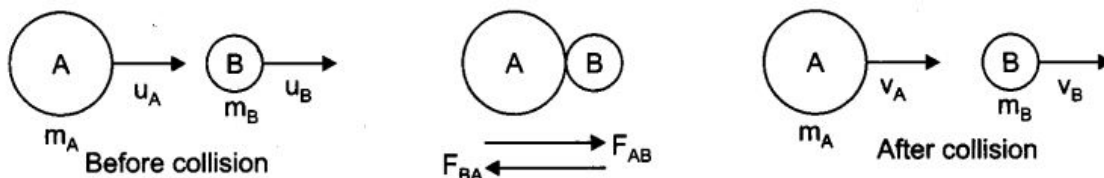
$$(p = mv)$$

1 Newton: A force of one Newton produces an acceleration of 1 m/s^2 on an object of mass 1 kg.

$$\text{IN.} = 1 \text{ kg m/s}^2 \text{ (} F = ma \text{)}$$

Third law of motion: To every action, there is an equal and opposite reaction and they act on two different bodies.

Conservation of momentum: If the external force on a system is zero, the momentum of the system remains constant i.e., in an isolated system, the total momentum remains conserved.



Suppose A and B are two balls, they have mass m_A and m_B and initial velocities u_A and u_B as shown in above figure before collision. The two bodies collide and force is exerted by each body. There is change in their velocities due to collision.

Unbalanced forces: When two opposite forces acting on a body, move a body in the direction of the greater force or forces which brings motion in a body are called as unbalanced forces.

First law of motion: An object remains in a state of rest or of uniform motion in a straight line unless acted upon by an external unbalanced force.

Inertia: The natural tendency of an object to resist a change in their state of rest or of uniform motion is called inertia.

The mass of an object is a measure of its inertia.

Its S.I. unit is kg.

A body with greater mass has greater inertia.

$(m_A u_A + m_B u_B)$ is the total momentum of the two balls A and B before collision and $(m_A v_A + m_B v_B)$ is their total momentum after the collision.

The sum of momenta of the two objects before collision is equal to the sum of momentum after the collision, provided there is no external unbalanced force acting on them.

This is known as the law of conservation of momentum.