

# Force and Law of Motion

## 1. Force

It is a push or pull on an object that produces an acceleration in the body on which it acts.  
S.I. unit- Newton.

### 1.1 Balanced force

When balanced forces are applied to an object, there will be no net effective force acting on the object. Balanced forces do not cause a change in motion.

### 1.2 Unbalanced force

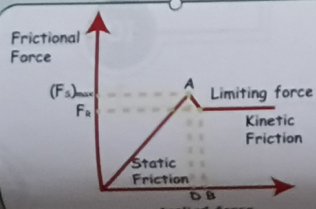
Unbalanced forces acting on an object change its speed and/or direction of motion. It moves in the direction of the force with the highest magnitude.

### 1.3 Frictional force

The force that opposes relative motion is called friction. It arises between the surfaces in contact.

#### 1.3.1 Types of friction

- **Static friction:** Static friction is defined as the frictional force that acts between the surfaces when they are at rest with respect to each other.
- **Sliding friction:** Sliding friction is defined as the resistance that is created between any two objects when they are sliding against each other.
- **Rolling friction:** Rolling friction is defined as the force which resists the motion of a ball or wheel and is the weakest type of friction.
- **Fluid friction:** Fluid friction is defined as the friction that exists between the layers of the fluid when they are moving relative to each other.



### 1.4 Impulse

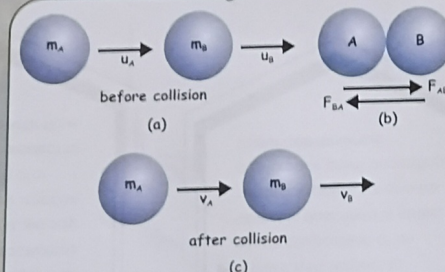
Impulse of a force is defined as the measurement of effect of force.  
•  $I = F \times t$   
• SI unit- Newton second  
• Vector quantity

### 1.5 Momentum

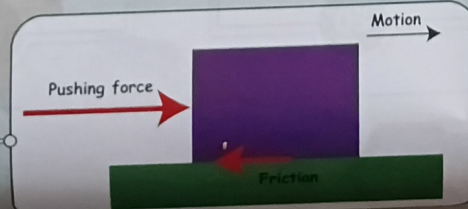
The momentum of an object is the product of its mass and velocity and has the same direction as that of the velocity. S.I. unit-  $\text{kgm/s}$ .

### 1.6 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.



$$m_A u_A + m_B u_B = m_A v_A + m_B v_B$$



## 2.1 Inertia of rest

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

## 2. Inertia

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

## 2.2 Inertia of Motion

An object will continue to be in motion until a force acts on it.

## 2.3 Inertia of Direction

The tendency of a body to oppose any change in its direction of motion is known as inertia of direction.

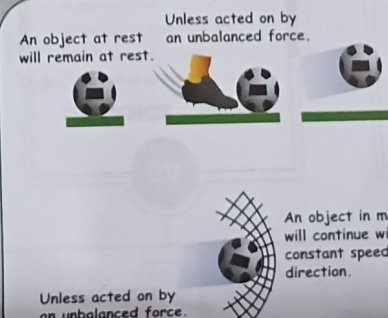
## 3. Newton's law of motion

Newton's laws of motion are three basic laws of classical mechanics that describe the relationship between the motion of an object and the forces acting on it.

### 3.1 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.

- If  $F_{\text{net}} = 0$ , then  $a = 0$ .



### 3.2 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.

$$F = ma$$

### 3.3 Third law of motion

To every action, there is an equal and opposite reaction and they act on two different bodies.

- Action and reaction forces act simultaneously on different object but are equal and opposite.

