



Class 9<sup>th</sup>

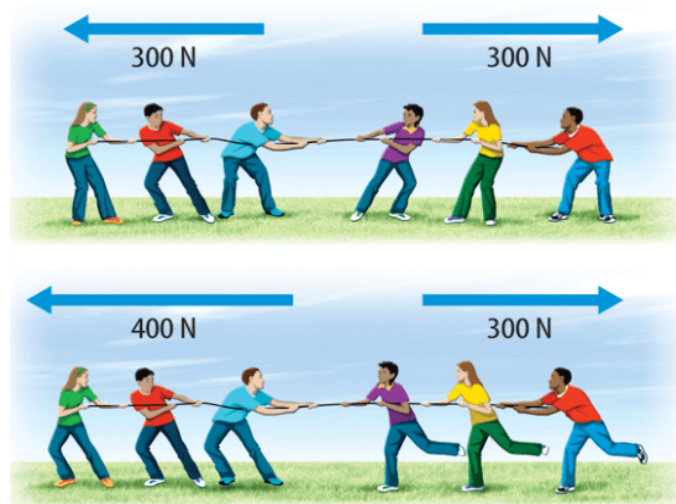
## PHYSICS

### FORCE AND LAWS OF MOTION

#### Force:

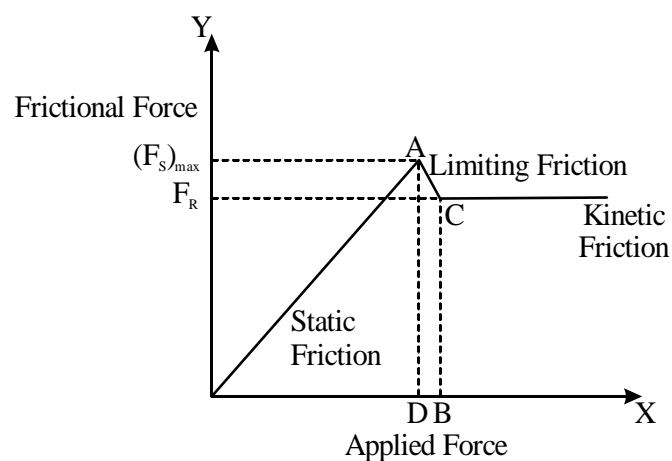
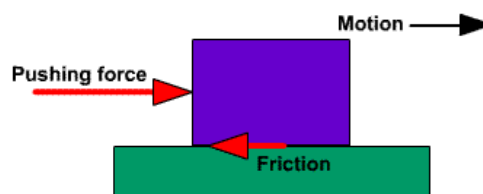
It is a push or pull on an object that produces an acceleration in the body on which it acts. S.I. unit- Newton.

- **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.
- **Unbalanced force** - Unbalanced forces acting on an object change its speed and/or direction of motion. The net effective force is not zero in this case.



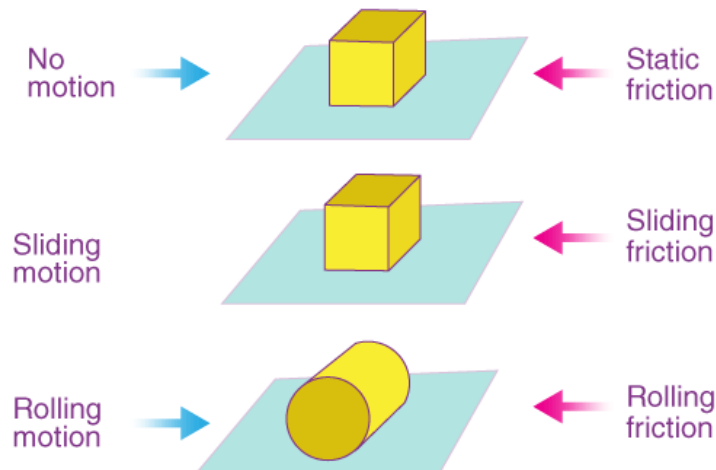
#### Frictional Force:

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





### **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.

### **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.
- A body with greater mass has greater inertia.

### **Types of inertia**

#### **1. Inertia of rest:**

An object stays at rest, and it remains at rest until an external force affects it.

Example: the tendency of moving back when the stationary bus starts to move is due to the inertia of rest.

#### **2. Inertia of motion:**

An object will continue to be in motion until a force acts on it. Example: the passengers fall forward when a moving bus stops suddenly due to inertia of motion.



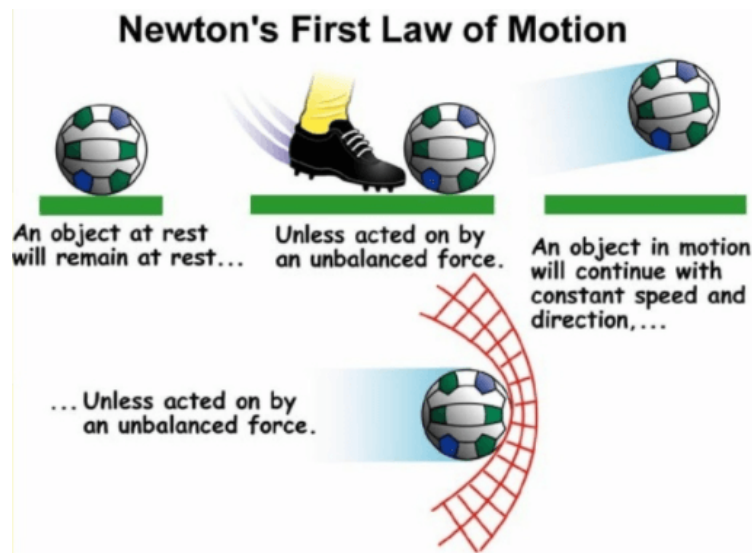
### 3. Inertia of direction:

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

Example: when a car takes a sharp turn, the driver tends to get thrown to the other side due to inertia of direction.

#### 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.



#### **Momentum :**

The momentum of an object is defined as the product of its mass and velocity.  $p = mv$ . It is a vector quantity. S.I unit of momentum is  $\text{kg ms}^{-2}$

#### 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.

- $F = m \times a$

**Unit of force (Newton)** - Force is said to be 1N if 1kg force is applied on an object and it accelerates by  $1\text{ms}^{-2}$ .

#### Applications of Second Law of Motion

- When we catch a ball, the momentum of the ball is transferred from ball to hand. If we keep our hand stationary, the force with which momentum is transferred might hurt our hand. But as soon as we pull our hands back, net momentum is decreased, thus reducing the force with which the ball makes an impact with our hands.





- A karate player makes use of the second law of motion to perform the task of breaking a slab of bricks. Since, according to law, the force is proportional to the acceleration, the player tends to move his/her hands over the slab of bricks swiftly. This helps him/her to gain acceleration and produce a proportionate amount of force. The force is sufficient enough to break the bricks.

### Impulse:

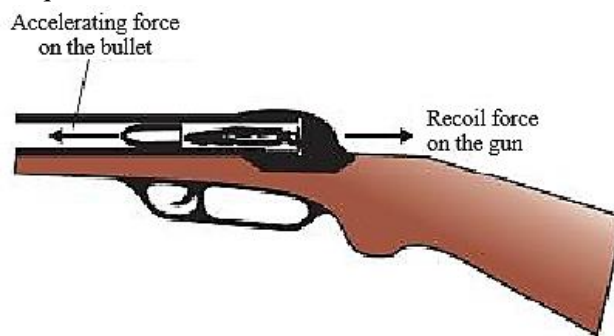
Impulse is the change of momentum of an object when the object is acted upon by a force for an interval of time.

- $I = F \cdot t$
- S.I unit- Newton second
- Vector quantity

### Third law of motion:

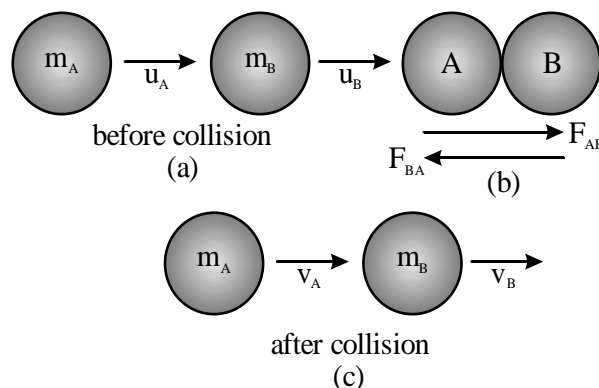
To every action, there is an equal and opposite reaction and they act on two different bodies.

Example: When a bullet is shot from a gun, the gun puts a force on the bullet that propels it forward. In the backward direction, the bullet exerts an equal force on the rifle.



### Law of Conservation of momentum:

For two or more bodies in an isolated system acting upon each other, their total momentum remains constant unless an external force is applied. Therefore, momentum can neither be created nor destroyed.



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

### Recoiled Velocity of Gun:

Recoil velocity is the backward velocity encountered when a shooter fires a bullet. The shooter experiences a backward jerk because of the recoil velocity.