8th – Physics Force

Force: A pull or push over an object because of its interaction with other object is called force. Example: to open a drawer, one has to pull it; and to close the drawer one has to push it. Thus, in both the conditions a person applies force by pull or push.

To kick a ball, one has to push it, i.e. a force is applied. To ride a bicycle one has to push the pedal. In this condition, force is applied while pushing the pedal.

State of rest: An object is called in the state of rest when it is not moving. This means a stationary object is called in the state of rest. For example – a building, an electric pole, a ball kept over the ground and not moving, etc.

State of motion: A moving object is called in the state of motion. For example – a moving car, a moving ball, etc. A force can speed up a moving object. Force can decrease the speed of a moving object. Force can stop a moving object. Force can change the direction of a moving object. Force can move a stationary object.

Effects of Force: A force cannot be seen. It can be judged by the following effects:

1. Force can make an object move from its position of rest: for example, pushing any person will make he/she fall down, to pluck an apple from the tree we pull the apple towards us.
2. Force can stop or slow down the moving objects: applying brakes on a moving car will slow down its speed or the car can be stopped. A ball is topped by a player by applying force in opposite direction.
3. Force can make a moving object move faster: applying force won the paddles of a moving bicycle, will move the cycle faster.
4. Force can bring change in direction of moving objects: in football matches, a player applies force in the football to change its direction. A force can change the direction of a moving car. In the game of carom, when we take a rebound (spring back) then the direction of striker changes. This is because the edge of the carom board exerts a force on the striker.
5. Force can change the shape and size of objects: force applied by the women changes the shape of the dough (kneaded flour) into round chapattis. When we squeeze toothpaste tube to take out toothpaste, its shape changes. When you apply force on an inflated balloon; using your hand from both sides, the force of pressure changes the shape of balloon. A blacksmith changes the shape of an iron rod by applying force using a hammer. When a rubber band is stretched in opposite directions, its shape is changed

Forces are due an interaction: To apply a force over an object interaction between object and source of force is necessary. Example: To open a drawer one has to pull by holding it, drawer will not open otherwise. To kick a ball one has to touch it, otherwise force will not be applied over the ball.

Direction and Magnitude of Force: The measure of amount or strength of force is called the magnitude of force. Thus, strength or amount of force is expressed in terms of magnitude.

Condition when more than two forces are applied over an object:

1. Forces applied in same direction: When more than one force is applied in the same direction, the total force is the magnitude of both the forces.

Example – It is difficult to push a car by single person, but two or more persons can collectively push the same car easily. This is because when more than one person tries to push the car, magnitudes of forces applied by each of the person are summed up and applied over than car, and car is pushed easily because of greater magnitude of force. That means if three units of force are applied over an object by each of the two persons,

The total unit of force = sum of both forces = 3 unit + 3 unit = 6 unit

2. Forces applied in opposite direction: When two forces are applied over an object from opposite directions, the total effective force is the difference of two forces. Example:

(a) When two persons are pushing a box in opposite directions and the magnitude of both the forces is equal, then box will not move, because the difference of two forces will be equal to zero. Let a person applying 4 unit of force in one direction and other person is also applying 4 unit of force in opposite direction on the same wooden box. Therefore, the magnitude of total force = 4 unit – 4 unit = 0

(b) If one person is applying a force of 4 unit in one direction and another person is applying a force of 6 unit in opposite direction, Then total magnitude of force = 6 unit – 4 unit = 2 unit. Thus, force will act in the direction of larger magnitude of force.

Balanced and Unbalanced Forces

When more than one force acts on the object then the effect of these forces is due to the net force acting on it. When the two forces acting on an object are different, the object undergoes a change in its state of rest or motion. Such forces are called **unbalanced forces.**

- Unbalanced forces acting in the same direction combine by addition i.e. $F = F_1 + F_2$.
- Unbalanced forces acting in the opposite direction combine by subtraction i.e. $F = F_1 - F_2$.
- If the forces equal and opposite the net force acting on the object is Zero. Such pair of forces is called **Balanced Forces**

Law of Inertia: An object continues to be in motion with the same speed and in same direction unless acted upon by an unbalanced force. An object resists change in their state of rest of motion. This is known as **Law of Inertia**.

Force is defined as the product of mass of the object and acceleration produced in the object. $F = m \cdot a$

Where F is Force applied, 'm is mass of object and a is acceleration produced' in the object. The force is said to be 1N if it produces an acceleration of 1 m/s^2 in a body of mass 1 kg.

Types of Force

1. Contact Force: Force that comes into action after the interaction between objects is called contact force. Contact force acts on the point of contact. For contact force; interaction between objects is necessary. Example: pushing a car, opening a drawer, kicking a ball, etc. In these examples, interaction between objects is necessary. Muscular force, force of friction, etc. are types of contact force. Other examples include cycling, kicking a ball.

Muscular Force or Biological Force: Force caused by the action of muscles is called muscular force. In other words, force resulting because of action of muscle is called muscular force. Muscular force is applied only after interaction with the object. Hence it is a type of contact force. Example: While kicking a ball, the player applies force over the ball using his leg muscles. While opening a drawer, you pull the drawer holding it by hand. In this action, muscles of your hand apply the force. While pulling a cart, the horse or the ox applies the force of its muscles.

Frictional Force: Force acting between the surfaces of two objects is called the force of friction. Force of friction always acts in the opposite direction of the movement of object. Force of friction is acting over all the moving objects. Example: A moving football stops after going to a certain distance. This happens because of force of friction between the surface of ground and the surface of football. A moving boat stops after some distance because of friction between the surface of water and the surface of boat. Since force of friction comes into action only after interaction between two objects, thus, it is a type of contact force.

- Friction also causes heat. When surfaces are rubbed together, heat is produced. Due to friction the surface of objects weared away. The bottom of your shoes, type of the vehicle becomes smooth due to wearing. Friction helps us in walking.

When we walk, there is friction between our foot (sole of our shoe) and the ground. This prevents us from slipping.

- Friction helps us to write. There is friction between the pen and paper on which we are writing.
- Friction can be increased by making the surface rough. It can be decreased by making the surface smooth or by oiling the surface.

Elastic Force: When we stretch, twist or bend certain objects like a spring, rubber band or sponge their shape and size changes. The force which acts is called elastic force.

2. Non – contact Force: Force that comes into action without interaction between two objects is called non-contact force. For example; a magnet can pull an iron nail from a distance. Magnetic force, Electrostatic force and Gravitational force are examples of non-contact force.

Magnetic Force: Force exerted by a magnet on another magnet or on magnetic substances is called magnetic force. A magnet can exert force even without coming in contact, thus it is a non-contact force. Magnet was discovered some 5000 years ago in Magnesia. Magnet cause a force in the area around them. The area of force around a magnet is called 'magnetic field.' Earth also has a magnetic field. It is surrounded by magnetic lines of forces. We can also use magnetic compass to see the magnetic fields of Earth.

Example – A magnet attracts the opposite pole of another magnet and repels the similar pole of another magnet.

Electrostatic Force: Force exerted by a charged body is called electrostatic force. A charged body attracts an uncharged body. A positively charged body attracts a negatively charged body and repels a positively charged body without coming in contact, thus it is a non-contact force.

Gravitational Force: Force exerted by earth, moon, sun and other planets is called gravitational force or force of gravity. Earth attracts all objects towards it. Similarly, all other planets along with moon attract all objects towards them. Since, earth attracts all objects even without coming in contact, thus gravitational force is a non-contact force. The force of gravity depends on the mass of object and their distance from each other. The bigger and heavier the body is, the greater is its force of gravity. Example: When anything is released from a height, it falls over the ground because of gravitational pull of earth.

Gravitational force was first discovered by Isaac Newton when he saw an apple falling from a tree. Mass of a body is measured in 'kilograms' whereas weight is measured in 'Newtons.'

Spring Balance is a simple device that can be used for measuring the weight of a body.

The object to be weighed is attached to the hook of spring balance which is held vertically either from a hook or with a hand. The spring gets stretched due to gravitational pull and hence, the pointer slides downward on the engraved scale.

Exercise 1

1. Define Force and write its SI unit.
2. Give one example of elastic force.
3. Write differences between friction and gravity
4. What happens when a rubber band is stretched?