

Chapter 2: Force and Motion

Introduction: Human beings perform various daily activities such as walking, running, ploughing, writing, reading, and playing. Every activity requires energy and the application of force. For instance, when we push, pull, lift, or throw something, we are using force. Machines and animals such as horses, mules, or donkeys also exert force to perform tasks such as carrying loads or pulling carts.

A **force** is an external agent that can change the state of rest or motion of an object. In simple terms, a force can either **push** or **pull** an object. The S.I. unit of force is the **newton (N)**. One newton is defined as the force required to accelerate a 1 kg mass by 1 m/s². ($1\text{ N} = 1\text{ kg}\cdot\text{m/s}^2$).

Effects of Force: A force can have different effects on an object depending on its direction and magnitude. The main effects of force are as follows:

(a) Force can bring motion to a body at rest: When an object is at rest, it can be made to move by applying force. For example, pushing a stationary cart makes it move. Similarly, a football moves when a player kicks it. The application of force changes the object's position, producing motion.

(b) Force can bring a moving object to rest: A moving object can be slowed down or stopped by applying force in the opposite direction. For example, when we apply brakes to a moving bicycle, frictional force acts on the wheels, bringing it to rest.

(c) Force can produce acceleration: A force can change the speed or direction of a moving object. The rate of change of velocity is called **acceleration**. When a force acts in the direction of motion, it causes **positive acceleration**. When the force acts opposite to the direction of motion, it causes **negative acceleration** (deceleration).

(d) Force can change the shape or size of an object: When force is applied, an object's shape or size can change. For example, pressing a rubber ball changes its shape, and stretching a rubber band increases its length.

Unit of Force: The S.I. unit of force is **newton (N)**. Different activities require different magnitudes of force. For instance, pedaling a bicycle needs a small force, while pushing a car requires a much larger force.

Motion of an Object: Motion means the change in position of an object with time relative to its surroundings. Depending on whether a body changes its position or not, it may be in one of two states:

(1) Rest: If an object does not change its position relative to its surroundings, it is said to be at rest. Examples include a tree, a house, or a parked car.

(2) Motion: If an object changes its position with time relative to its surroundings, it is said to be in motion. Examples include a flying bird, a moving bicycle, or flowing water.

Types of Motion: There are several types of motion observed in daily life. These include translatory, circular, oscillatory, and random motion.

A. Translatory Motion: Every point of a body moves in the same direction and covers equal distance in the same time. Example: A car moving straight on a road. Activity: Drop a wooden block vertically; all parts move in the same direction — showing translatory motion.

B. Circular Motion: When an object moves around a fixed point in a circular path, it is called circular motion. Example: The rotation of a fan blade or the motion of a stone tied to a string when whirled in a circle.

C. Oscillatory Motion: In oscillatory motion, a body moves back and forth about a fixed position. Example: The swinging of a pendulum or the vibration of a tuning fork.

D. Random Motion: When an object moves in an irregular and unpredictable manner, it is called random motion. Example: The movement of dust particles in air or the motion of insects flying around.

Summary:

- Force is a push or pull that changes the state of motion of an object.
- The effects of force include starting or stopping motion, changing speed or direction, and deforming shape.
- Motion is the change in position of a body relative to its surroundings.
- Motion can be translatory, circular, oscillatory, or random.
- The S.I. unit of force is **newton (N)**.

Important Questions and Answers:

1. What is force?

Force is a push or pull that can change the state of rest or motion of a body.

2. What is the S.I. unit of force?

The S.I. unit of force is **newton (N)**.

3. State the effects of force.

Force can: (a) move a stationary body, (b) stop a moving body, (c) change speed or direction, (d) change shape or size of a body.

4. Define motion and rest.

If a body changes its position with time, it is in motion. If it does not, it is at rest.

5. What is acceleration?

Acceleration is the rate of change of velocity of a moving object caused by force.

6. Write the different types of motion with examples.

- (a) Translatory – a moving car.
- (b) Circular – rotation of fan blades.
- (c) Oscillatory – pendulum motion.
- (d) Random – flying of insects.

7. What happens when brakes are applied to a bicycle?

Braking exerts force opposite to motion, causing the bicycle to slow down or stop.

8. Give two examples where force changes the shape of an object.

Pressing a rubber ball and stretching a rubber band.

9. Differentiate between positive and negative acceleration.

Positive acceleration increases speed; negative acceleration (deceleration) decreases it.

10. Why is force called an external agent?

Because it acts on a body from outside to cause motion or deformation.