

# NCERT Physics Questions

## Chapter 8: Forces and Laws of Motion

### Solutions

#### Theory questions

##### Short theory questions

1. State the first law of motion.

*Ans: An object remains in a state of rest or of uniform motion in a straight line unless compelled to change that state by an applied force.*

2. Define inertia.

*Ans: The tendency of undisturbed objects to stay at rest or to keep moving with the same velocity is called inertia.*

3. What is the relation between inertia and mass.

*Ans:*

- *The mass of an object is a measure of its inertia.*
- *Inertia is a qualitative property, mass is the quantitative measure of inertia.*

4. Define 2nd law of motion.

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

*Its numerical formula is*

$$F \propto \frac{p_2 - p_1}{t}$$

$$F \propto \frac{m(v - u)}{t}$$

where an object of mass,  $m$  is moving along a straight line with an initial velocity,  $u$ . It is uniformly accelerated to velocity,  $v$  in time,  $t$  by the application of a constant force,  $F$  throughout the time,  $t$ . The initial and final momentum of the object will be,  $p_1 = mu$  and  $p_2 = mv$  respectively.

5. Define the SI unit of force.

*Ans: One unit of force is  $\text{kg m s}^{-2}$  or newton  $N$ . It is defined as the amount that produces an acceleration of  $1 \text{ m s}^{-2}$  in an object of  $1 \text{ kg}$  mass.*

6. Define Newton's 3rd law of motion.

- – The third law of motion states that when one object exerts a force on another object, the second object instantaneously exerts a force back on the first.  
Alternatively,
- To every action there is an equal and opposite reaction
- The action and reaction always act on two different objects, simultaneously.

## Long theory questions

1. Derive equation of force from Newton's 2nd law of motion.

*Ans: Consider an object of mass,  $m$  is moving along a straight line with an initial velocity,  $u$ . It is uniformly accelerated to velocity,  $v$  in time,  $t$  by the application of a constant force,  $F$  throughout the time,  $t$ . The initial and final momentum of the object will be,  $p_1 = mu$  and  $p_2 = mv$  respectively.*

*The change in momentum:*

$$\propto p_2 - p_1$$

$$\propto mv - mu$$

$$\propto m \times (v - u)$$

*The rate of change of momentum:*

$$\propto \frac{m \times (v - u)}{t}$$

*Using Newton's 2nd law,*

$$F \propto \frac{m(v - u)}{t}$$

$$F = \frac{km(v - u)}{t}$$

*Using  $a = \frac{v-u}{t}$ ,*

$$F = kma$$

*Units of  $F$  are chosen such that  $k = 1$ . Therefore,*

$$F = ma$$