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, p1 = mu and p2 = mv respectively.

5. Define the SI unit of force.
   Ans: One unit of force is kg m s^{-2} or newton N. It is defined as the amount that produces an acceleration of 1 m s-2 in an object of 1 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, p1 = mu and p2 = 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,*

$$F = ma$$