

**SUBJECT:- PHYSICS**

**CLASS:- IXTH**

**DATE:- 10/06/XXI**

**SUBJECT TEACHER:- MR. NEEL NIRANJAN**

**CHAPTER 2. ( FORCE AND LAWS OF MOTION)(BASED ON NCERT PATTERN)**

**Second Law of motion:-**

- Newton's second law of motion gives the relationship between the force and acceleration.
- 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
- The rate of change of momentum of an object is proportional to the applied force. So, Newton's second law of motion can be expressed as

$$\text{Force} \propto \frac{\text{change in momentum}}{\text{Time taken}}$$

- Suppose 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,  $F$ .
- The initial and final momentum of the object will be,  $p_1 = mu$  and  $p_2 = mv$  respectively.
- Now change in momentum would be

$$\text{The change in momentum} = p_2 - p_1 = m \times (v - u)$$

$$\text{rate of change of momentum} = \frac{m \times (v - u)}{t}$$

- Now force applied is proportional to rate of change of momentum. So,

$$\text{Force} \propto \frac{\text{change in momentum}}{\text{Time taken}}$$

or,

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

or,

$$\text{Force } F = \frac{km \times (v - u)}{t} = kma \quad (2)$$

where,  $\mathbf{a} = (\mathbf{v} - \mathbf{u})/t$  is the acceleration which is the rate of change of velocity. The quantity,  $\mathbf{k}$  is a constant of proportionality

- The unit of force is chosen in such a way that the value of the constant,  $\mathbf{k}$  becomes one.
- For this, one unit of force is defined as the amount that produces an acceleration of  $1 \text{ ms}^{-2}$  in an object of  $1 \text{ kg}$  mass.
- That is, **1 unit of force =  $\mathbf{k} \times (1 \text{ kg}) \times (1 \text{ m s}^{-2})$** . Thus, the value of  $\mathbf{k}$  becomes 1.
- From Eq. 2  
 **$F = ma$**
- The unit of force is  $\text{kgms}^{-2}$  or Newton, which has the symbol **N**.
- The second law of motion gives us a method to measure the force acting on an object as a product of its mass and acceleration.