STEPPING STONE SCHOOL (HIGH)

CLASS – IX

PHYSICS

WORKSHEET- 12

Date – 19/06/2020, (Day- 12)

Chapter- LAWS OF MOTION (Pt. III)

Topic- Linear momentum and Newton's Second Law of Motion

Time limit: 30 minutes.

Please read the notes carefully and on the basis of it copy down the questions and solve them on a sheet of paper date wise. Keep the worksheet ready in a file to be submitted on the opening day.

Linear momemtum:

It is the product of mass and velocity. It is denoted by 'p' for a body of mass 'm' moving with velocity 'v' linear momentum

$p = mv$

It is a vector quantity.

S.I unit of momentum is kg ms^{-1} and C.G.S unit is g cms^{-1}

Change in momentum:

Change in momentum $\Delta p = \Delta (mv)$

Where Δ symbol before a quantity denotes a small change in that quantity.

The change in product mv can be either due to change in mss m or due to change in velocity v or due to change m both the mass m and velocity v.

So, $\Delta p = \Delta (mv) = m\Delta v$

<u>Newton's Second law of motion:</u>

Statement : The rate of change in momentum of body is directly proportional to the force applied on it.

Direction:

Initial momentum of the body = mu

Final momentum of the body = mv

Change in momentum = mv – mu

Rate of change in momentum = $\frac{mv - mu}{t}$

from the equation, v = u + at

or $a = \frac{v - u}{t}$

Accordingly

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

or $F \propto ma$

or F= k.ma

If F= 1, m = 1, a= 1

Then k = 1

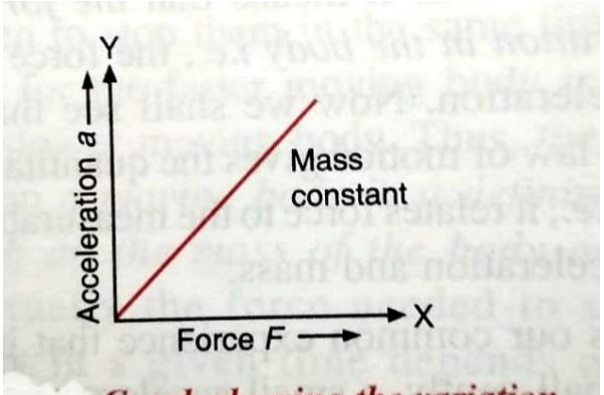
Therefore, F = ma

i.e. Force = mass × acceleration

Conclusion:

(i) The acceleration produced in a body of given mass is directly proportional to the force applied on it.

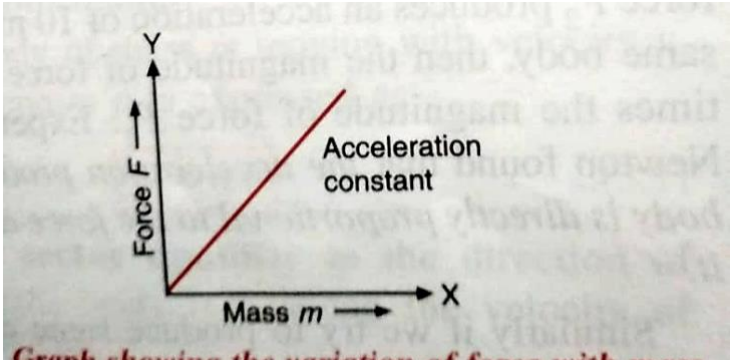
i.e. $a \propto F$



Graph showing the variation of acceleration with force

(ii) The force needed to produce a given acceleration in a body is directly proportional to the mass of the body.

i.e. $F \propto m$



Graph showing the variation of force with mass

<u>CGS and SI unit of force:</u>

CGS unit → dyne

One dyne is the force which when acts on a body of mass

1g produces an acceleration of $1cms^{-2}$

i.e. 1 dyne = $1g \times 1cms^{-2}$

SI unit → newton

One newton is the force which when acts on a body of mass

1kg produces an acceleration of 1 ms^{-2}

Relationship between newton and dyne:

1 newton = 1 kg ×1ms^{-2}

= 1000 g × 100 cm s^{-2}

= 10^{-5} dyne

Obtaining newton's first law of motion from second law of motion

From Newton's second law, F= ma

If F= 0, then a = 0

This means that if no force is applied on the body, its acceleration will be zero.

If the body is at rest, it will remain at rest and if it is moving, it will remain moving in the same direction with the same speed. This is Newton's first law of motion.

Exercise:

Answer the following questions:

1. Define linear momentum and state its S.I unit.

2. Two balls A and B if masses m and 2 m are in motion with velocities 2v and v respectively .Compare: (i) their inertia

(ii) the momentum (iii) force required to stop

3. Write mathematical form of Newton's second law of motion. State condition if any

4. Name the S.I unit of force and define it.

5. Why does a glass vessel break when it falls on a carpet?

6. A body of mass 5kg is moving with velocity $2ms^{-1}$. Calculate its linear momentum

7. A force of 15 N acts on a body of mass 2kg, calculate the acceleration produced.

Please tap on the hyperlink below to watch the video content of the topic Linear momentum and Newton's second law of motion

https://www.youtube.com/watch?v=RKERiyi2mlk

https://www.youtube.com/watch?v=8YhYqN9BwB4