Dates→ 26.08.24

TENDER HEART HIGH SCHOOL, 33-B, CHD.

CLASS- VIII, Subject: PHYSICS

CH-3 (LAWS OF MOTION)

3(c):- Linear Momentum and Newton's Second law of motion

Q1:- Define linear momentum. Is it a vector or a scalar quantity? State S.I unit of linear momentum?

Ans Linear momentum is a motion contained in a body. Mathematically, it is given by product of mass and velocity i.e

$$p = \text{mass} \times \text{velocity}$$

$$\boxed{p = mv}$$

p - Linear momentum of the body

v - velocity with which the body is moving

m - mass of body

Q2:→ How rate of change of momentum = mass x acceleration. prove it. Also state when this relation holds?

Ans:→

Applied Force(F) changes the velocity of body whose mass is m from u to v.

here u - initial velocity

v - final velocity

Due to change of velocity (∵ of force applied) momentum will change.

So, Initial momentum = mu

final momentum = mv

Change in momentum = mv - mu

Change in momentum = m(v-u)

Thus Rate of change of momentum = $\frac{m(v-u)}{t}$ —(1)

we know that $\frac{v-u}{t}$ = a (acceleration)

= Rate of change of velocity

∴ Thus from Equation (1)

∴ Rate of change of momentum = m × a

⟹ Rate of change of momentum = mass × acceleration

This relation holds only when mass of body remains constant.

Q3 :→ State Newton's second Law of motion: What information do you get from it?

Ans:→ According to Newton's second law of motion, the rate of change of momentum of a body is directly proportional to the force applied on it and change in momentum takes place in the direction of force applied.

Actually, Newton's second law of motion provides that force is related to the measurable quantities such as mass and acceleration because mathematically Newton's second law of motion is $\boxed{F=ma}$

Q4:→ Write mathematical form of Newton's second law of motion. State condition if any.

Ans:→

The mathematical form of Newton's second law of motion is $\boxed{F=ma}$

F – force, m = mass, a = acceleration

Conditions for the relation to hold true :→

(i) velocity must be smaller than the velocity of light

(ii) Mass of the body should remain constant.

Q5:→ State two factors on which force needed to stop a moving body in a given time depends.

Ans:→ (1) Mass of the body

(2) Velocity of the body

Q6 :→ Why does a glass vessel break when it falls on a hard floor, but it does not break when it falls on a carpet?

Ans :→ When a glass vessel falls on hard floor, it comes to rest in a short time so, floor exerts a large force on it and it breaks. [because $F = \frac{\text{change in momentum}}{\text{Time}}$; so force is inversely proportional to duration of time]
When glass vessel falls on a carpet, it does not come to rest immediately because of time duration increases. Therefore carpet exerts a less force on vessel and it does not break.

Q7 :→ A cricketer pulls his hands back while a catching a fast moving cricket ball. Explain why?

Ans A :→ cricketer pulls back his hand while catching a cricket ball by doing so he takes a long time to stop the ball. So, the force exerted by the ball on his hands will be less because accordeing to newton's second law of motion,

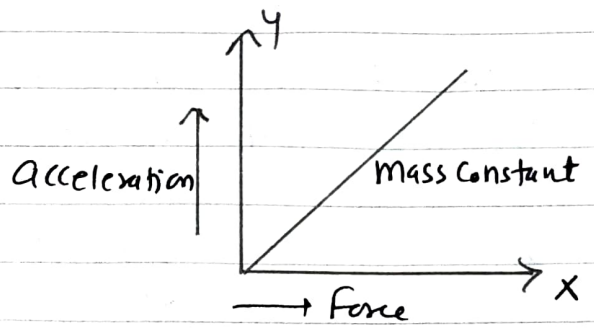
$$F = \frac{\text{Change in momentum}}{\text{Time}}$$

Force will be less when time duration is long.

Q8 :→ Write S.I and C.G.S units of force. Write Relation between S.I and C.G.S units of force.

Ans :→ The S.I unit of force is newton.
The C.G.S unit of force is Dyne.
Also $\boxed{1 \text{ newton} = 10^5 \text{ dyne}}$

Q9 :→ What conclusion is given by the Newton's second law of motion interms of graphical form for force, mass and acceleration? when mass of body is taken as Constant.



The acceleration produced in a body of constant mass, is directly proportional to force applied.

Q10:→ Define one newton force.

Ans:→ One newton force is the force when acts on a body of mass 1Kg, produces an acceleration of $1m/s^2$.

i.e $1 newton = 1Kg \times 1m/s^2$

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* Learn this

In S.I system;

$F = ma$

$1 Newton = 1Kg \times 1m/s^2$

In C.G.S System;

$F = ma$

$1 dyne = 1g \times 1cm/s^2$

⇒ $F = ma$ (Newton's Second Law)

⇒ F = rate Change of momentum

* Applied force changes the velocity of body so, acceleration comes
* Applied force also changes the momentum of the body

Numerical :→ (1) Find the force that applied on a body of mass 5Kg, produces an acceleration of $10m/s^2$.

Ans $F = ma$; $F = ?$, $m = 5Kg$, $a = 10m/s^2$

So $F = ma$

$= 5Kg \times 10m/s^2 = 50 Kgm/s^2 = 50 N$ (N = newton)

($\because 1Kgm/s^2 = 1N$)