Force and Laws of Motion

✓ push & pull, pressing, lifting, stretching are effects

→ Force is an external agent or cause capable of changing the state of rest or motion of a particular body once applied on it

Eg - lifting a weight; stretching a Rubber band; Pressing a button

Force is a vector qty

Types of forces

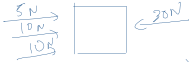
Resultant/net force :- Summation of all the forces being applied on the body.

Balanced forces :- If the resultant of all the forces acting on a body is zero, the forces are called balanced force.

Unbalanced forces :- If the resultant forces acting on the body is not zero, the forces are called unbalanced force.

Q. Type of force resultant acts direction

Rf : 30+20 -40
= 50-40 = 10N



Rf : (5+10+10 - 30) = -5N

2) Find the value of x in the balanced force system.

3) Find the value of x if system is an unbalanced force system, with resultant force equal to 23 units towards left

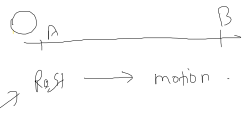
$10 + 2x - 46 = -23$

$2x - 36 = -23$

$2x = 13$

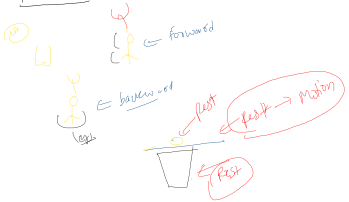
$x = 6.5$

Newton's 1st law of motion



→ A body at rest will remain at rest and a body in motion will continue in motion in a straight line with a uniform speed, unless it is compelled by an external unbalanced forces to change its state of rest or of uniform motion.

Inertia



The tendency of a body due to which it resists a change in its state of rest or of uniform motion.

→ Why it is recommended to wear Seat belt in the car ? & if you wear & if you don't what will be the consequences ?

6.20

✓ Greater the inertia of a body, greater will be the force required to bring a change in its state of rest or of motion.

✓ Heavier the body, the more will be its inertia.

Momentum

Force required to move big rock >>> wooden block.

$F \propto m$

$m\uparrow$ $F\uparrow$

Tennis ball → throwing of ball through hand → $V\uparrow$ (mass of the ball remain same)

tennis Racket hit the ball → $V\uparrow\uparrow$

$F \propto V$

$$F \propto mV$$

✓ $F \propto P$ (momentum)

Momentum : Momentum is defined of a body as the product of its mass & velocity.

✓ It is a vector quantity.

✓ SI unit = $Kg\,ms^{-1}$

Q) What is the P of a man of m 75000 gm when he walks with a uniform velocity of 18 Km/hr.

Velocity = ms^{-1}
Momentum = $Kg\,ms^{-1}$

(5:35)

$m = 75000\,gm$

$m = 75\,Kg$

$V = 18\,Km\,h^{-1} = \frac{18 \times 5}{18} = 5\,ms^{-1}$

ms^{-1} : $\frac{18\,Km}{1\,hr} = \frac{18 \times 1000\,m}{60\,min \times 60\,sec}$

$P = 75 \times 5 = 375\,Kg\,ms^{-1}$

Q An object's momentum is 80 $Kg\,ms^{-1}$ & its mass is 16000 g, Find the velocity of object.

$Kg\,ms^{-1} \rightarrow P = mV$

$80 = \frac{16000}{1000}\,Kg \times V$

$\frac{80}{16} = V$

$5\,ms^{-1}$

Q Calculate momentum (1 m)

i) A truck of mass 2000 kg moving at $5\,ms^{-1}$

ii) A bullet of mass 0.02 kg " at $400\,ms^{-1}$.

$m \times V$

$\frac{400 \times 2}{100}$

$= 8\,m$

Q What is the change in momentum of a car weighing 1500 kg when its speed increases from 36 Km/hr to 72 Km/hr uniformly.

$\Delta V = V_F - V_i$

$\frac{72 \times 5}{18} = 20$

$\Delta P = mV_F - mV_i$
$= m(V_F - V_i)$
$= 1500(20 - 10) = 15000\,Kg\,ms^{-1}$

Newton's Second law of Motion

Case-I: 2 Kg, $U = 0$ → $V = 5\,m/s$

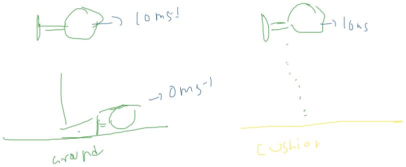
→ $\Delta P = P_F - P_i$
$= mv - mu$
$= m(v - u)$
$= 2(5 - 0)$
$= 10\,Kg\,ms^{-1}$

Case-II: 2 Kg, $U = 0$ → $V = 10\,m/s$

More force applied → $20\,Kg\,ms^{-1}$

$F \propto$ change in momentum

More the force more will be change in momentum.



✓ Change in momentum $\propto$ Force

✓ $F \propto \frac{1}{T}$