Home Assignment :-

Momentum, Force as rate of change of momentum, The connection between Newton's first law and second law.

~~1. A motor car of mass 1200kg is moving along a straight line wi~~

1. Given

Mass of the motor car, $m = 1200\,kg$

Intial velocity of the motor car, $u = 90\,km/h$
$= 25\,m/s$.

Final velocity of the motor car, $v = 18\,km/h$
$= 5\,m/s$

Time $= 4\,m/s$

Soln = $\Delta P = mv - mu$

$\Delta P = 1200 \times 5 - 1200 \times 25 = -24000\,kg\,m/s$

$v = u + at$

$5 = 25 + a \times 4$

$\Rightarrow a = -5\ m/s^2$

(-ve shows retardation)

$|F| = m|a| = 1200 \times 5 = 6000\ N.$

2 - Mass, m = 100 kg

Time interval. $\Delta t = 10s$

(i) Distance traveled in next 5 seconds

$d = 100m.$

Thus velocity accquired by body ; $v = \frac{d}{t} = \frac{100}{5} = 20 m/s$

(ii) Accl^n produced by the force,

$a = \frac{v}{\Delta t} = \frac{20}{10} = 2 m/s^2$

(iii) magnitude of force

$F = ma$

$100kg \times 2 m/s^2 = 200 N$

3 - m - mass of object, u = initial velocity

v = final ~~ve~~ velocity, t = time interval

F = Constant force

$P_1 = mu$ = initial momentum ~~force~~ of obj.

$P_2 = mv$ = final momentum of obj.

Date
Page

$\Delta P = P_2 - P_1 = mv - mu = m(v-u)$

The rate of change of $P = \frac{m(v-u)}{t}$

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

$F = \frac{Km(v-u)}{t}$

$F = Kma$

The unit of force is chosen so that the value of becomes 1 so, $F = ma$

(4) Newton's 1st law of motion states that obj. can in rest will remain in rest until & unless a force acts upon it while, the 2nd law of motion states that the accln. (a) of a body is dependant on mass (m) & the force (F) acting upon that body so we can say that the force is the product of mass & accln.. Ac to 2nd law ∴ $F = ma$,

Ac to the 1st law

$F = 0$, if mass is const.

$F \propto a$

$a = 0$, so here we can say that when force is equals to 0 accln. is also 0 or when the obj. is at rest or in motion it will remain in rest & motion respectively until & unless a force acts upon it.

5 (a) Firing of bullet, Recoil
(b) Action - hammering a nail, Reaⁿ - the nail exerts equal force on hamer.
(c) Books exerts force on the table (gravity) the table exerts equal force on the **book**
d - The fuel burns & releases large amt. of force in opposite direction of ~~momentum~~ movement of rocket, the burnt fuel exerts equal pressure on the rocket & rocket moves in upward direction.
e - Action - the person exerts force on the floor.
Reaction - the floor exerts equal force on the legs of person due to which he move forward.
f - Action - the train collides to stationary train by applying large amt. of Force due to its large P.

6 (a) - A hose which is ejecting large amts of water at a high velocity, then a reaction force is applied to us in the backward direction. This is because of Newton's 3rd law of motion.

6(b) Action & Reaction don't cancel each other or $F_{net} \neq 0$ because the action & reaction are applied 2 different bodies instead of 1

$\therefore F_{net} \neq 0$

7(a) According to Newtons 3rd law, to every action, there is an equal & opposite reaction. When we jump on the shore from boat we are appling force on the boat in the opposite direction in order to move forward and hence the boat moves in the opposite direction.

(b) As the air released moves in downward direction, ~~the equal opposite force on the the balloon~~. the equal-opposite reaction of downward going air pushes the balloon upwards and vice versa.

8(a) According to Newton's 3rd law of motion, the gas expelled applies a opposite force on the rocket's body & hence propelling it.

(b) Yes in the direction opposite to that of the gas expelled.

(c) Accelⁿ (a) is 2a —— (1)

$F = ma$

But $a = 2a$ from (1)

Hence $F = m \times 2a$

$a = \frac{F}{2m}$.

(d) - Mass is twiced (m) = 2m —— (1)

a remains same.

$F = ma$

But $m = 2m$ from - (1)

$F = \frac{2m \times a}{2m}$

(e) Mass (m) & accelⁿ (a) are doubled ⇒ $m = 2m$ & $a = 2a$

$F = ma$

$F = 2a \times 2m$

$a = \frac{F}{4m}$

For a exerted on rocket by gas

$F = ma$

$F = 2m \times 2a = 4ma$ —— (1)

Force in orginal situation = $F = ma$ —— (11)

From (1) & (11) force exerted (1) is 4 times more than in (11)