

H/W

1) An object of mass of  $1.5 \text{ kg}$  travelling in a straight line with a velocity of  $5 \text{ m/s}$  collides with a wooden block of mass  $5 \text{ kg}$  ~~is~~ ~~resting~~ ~~sitting~~ on the floor. This ~~an~~ object strikes with wooden block after collision & both move together in a straight line.

2) The total momentum after collision is:-

Ans:  $7.5 \text{ kg m/s}$  (3) (✓)

ii) The velocity of the combination of these objects after collision is:-

Ans:  $1.5 \text{ m/s}$  (3) (✓)

2) A  $20 \text{ kg}$  bullet can fire  $10$  bullets per second. Mass of each bullet is  $0.2 \text{ kg}$ . The muzzle speed of the bullet is  $150 \text{ m/s}$ . What is the recoil velocity of the gun? How much force is required to hold the gun?

Mass of the gun =  $M$

mass of the bullet =  $m$

Velocity of the ~~bullet~~ bullet =  $v$

Recoil velocity of the gun =  $V$

$$a) V = -mv/M$$

$$\Rightarrow V = \frac{-0.2 \times 150}{20}$$

$$b) V = \frac{-30}{20} = \frac{-3}{2} = -1.5 \text{ m/s} \quad (\text{Ans})$$

$\therefore$  The recoil velocity is  $-1.5 \text{ m/s}$ .  
{ Gun moves opp. side of the bullet }

The required force :-

[ Change in momentum per second due to bullets :-

Momentum of one bullet  $\Rightarrow p = mv$

$$= 0.2 \times 150$$

$$= 30 \text{ kg m/s}$$

$N =$  no. of bullet per sec  $= 10$ .

$\therefore \frac{dp}{dt} =$  change in momentum,

$$N(p-0) = 10(30) = 300 \text{ N} \quad (\text{Ans}) \quad \text{force required}$$

2) State & prove law of conservation of linear momentum.

(Ans)

Suppose A & B two objects of mass  $m_1$  &  $m_2$  are moving in the same dir<sup>n</sup> with velocity  $u_1$  &  $u_2$  respectively ( $u_1 > u_2$ ). Object A collides with object B & after time  $t$  both moves in the original dir<sup>n</sup> with velocity  $v_1$  &  $v_2$  respectively.

The change<sup>o</sup> in momentum of obj. A is  $m_1 v_1 - m_1 u_1$

The force on B by A is  $F_1 = \frac{\text{change in momentum}}{\text{time}}$

$$= F_1 = \frac{m_1 v_1 - m_1 u_1}{t}$$

①

the change in momentum of object B

$$\text{is } m_2 v_2 - m_2 u_2$$

$$\text{The force on A by B is } = F = \frac{m_2 v_2 - m_2 u_2}{t}$$

# By Newton's Third Law ②

$$F_1 = -F_2$$

$$\frac{m_1 v_1 - m_1 u_1}{t} = - \left( \frac{m_2 v_2 - m_2 u_2}{t} \right)$$

$$\Rightarrow m_1 v_1 - m_1 u_1 = m_2 v_2 - m_2 u_2$$

$$\Rightarrow m_1 u_1 + m_2 u_2 = m_1 v_1 + m_2 v_2$$

$\Rightarrow$  Initial momentum = Final momentum.

} Proved }

3) A bomb explodes into several parts.  
Why these parts fly off in different dir<sup>n</sup>s.

Ans) The conservation of momentum demands that final momentum should be zero. The several parts carry equal & opp. momentum to make total momentum zero. Thus these parts move in different dir<sup>n</sup>s.