Home Assignment

Q. An object of mass 1.5 kg travelling in a straight line with a velocity of 5m/s collides with a wooden block of mass 5 kg resting on the floor. This object sticks with wooden block after collision & both move together is a straight line.

i) The total momentum after collision is :-

Ans - 7.5 kg m/s

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

Ans - 1.15 m/s

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

Ans - Mass of the gun : M

Mass of the bullet = m

Velocity of the bullet = v

Recoil velocity of the gun = v

$\Rightarrow v = mv/m$

$\Rightarrow v = \frac{0.2 \times 150}{20}$

$\Rightarrow v = \frac{-30}{20} = \frac{-3}{2} = -1.5 \text{ m/s}$

∴ The recoil velocity is 1.5 m/s (gun moves opposite 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

$\therefore \frac{dv}{dt}$ = change in momentum

$(N(P-0) = 10(30) = 300 N$ force required

(3) 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^n with velocity u_1, u_2 respectively $(v_1 > v_2)$. Object A collides with object B & after time t both moves in the

original dist^n with velocity v_1 & v_2 respectively.
The change in momentum of obj : AB $m_1v_1 - m_1v_1$
The force on B by A is F_1 = change in momentum / time.

$$\therefore F_1 = \frac{m_1v_1 - m_1v_1}{t} \quad \text{——— (1)}$$

The change in momentum of object B is $m_2v_2 - m_2v_2$
The force on A by B is $F = \frac{m_2v_2 - m_2v_2}{t}$ ——— (2)

Newton's third law

$$F_1 = F_2$$

$$\frac{m_1v_1 - m_1v_1}{t} = -\left(\frac{m_2v_2 - m_2v_2}{t}\right)$$

$$\Rightarrow m_1v_1 - m_1v_1 = m_2v_2 - m_2u_2$$

$$\Rightarrow m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$$

$\Rightarrow$ Initial momentum = Final momentum

Proved

Q. A bomb explodes into several parts. why these parts fly off in different directions.

Ans - The conservation of momentum demands that final momentum should be zero. The several parts carry equal & opposite momentum to make total momentum zero. Thus these parts move in different dir^n.