Foundation +

WS-10 9th class

Thank

①

(1)

$m_{bullet} = 40\ gm = 40\times10^{-3}\ kg$: $M_{Riffle} = 16\ kg$

$V_{bullet} = 200\ m/s$ $\qquad V_{recoil} = ?$

According to law of conservation of linear momentum

$$V_{recoil} = -\frac{m_b u_b}{M_R}$$

-ve sign shown gun give kick in backward direction

$$\Rightarrow V_{recoil} = +\frac{\cancel{40}\times10^{-\cancel{3}}\times 2\cancel{00}}{16}$$

$$= \frac{8}{16} = 0.5\ m/s$$

(2)

$m_{bullet} = 100\ gm = 10^{-1}\ kg$: $u_{bullet} = 60\ m/s.$

$V_{recoil} = -2\ m/s$ $\qquad M_{gun} = ?$

According to law of conservation of linear momentum

$$V_{recoil} = -\frac{m_{bullet}\ u_{bullet}}{M_{gun}}$$

$$\Rightarrow \cancel{-}2 = \cancel{-}\frac{10^{-1}\times\cancel{60}^{30}}{M_{gun}} \Rightarrow M_{gun} = 30\times10^{-1} = 3\ kg$$

(3)

$m_A = 6\ kg$: $m_B = 4\ kg$

$u_A = 2\ m/s$ $\qquad u_B = -1.5\ m/s$ $\qquad$ After collision the two bodies get struck and move with same velocity

$$V_A = V_B = V_{com}$$

According to LCLM $\quad m_A u_A + m_B u_B = m_A V_A + m_B V_B$

3^{rd} continuation

$\Rightarrow \quad 6 \times 2 + 4(-1.5) = 6 V_{com} + 4 V_{com}$

$\Rightarrow \quad 12 - 6 = 10 V_{com} \Rightarrow 10 V_{com} = 6$

$\Rightarrow V_{com} = \frac{6}{10} = 0.6 m/s$

4

$m_1 = 6$ kg $\quad m_2 = ?$

u_1 = initial velocity $\quad u_2 = 0$

velocities of two bodies after collision $v_1 = v_2 = \frac{u_1}{3}$

∴ Acc to law of conservation of linear momentum

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

$\Rightarrow 6 \times u_1 + m_2 \times 0 = 6_1 \frac{u_1}{3} + m_2 \frac{u_1}{3}$

$\Rightarrow \quad 6\cancel{u_1} = \frac{\cancel{u_1}}{3}(6 + m_2) \quad \Rightarrow 6 = \frac{1}{3}(6 + m_2)$

$\Rightarrow 6 + m_2 = 18$

$\Rightarrow m_2 = 12$ kg.

5

$u_{shot} = 140$ m/s $\qquad m_{Block} = 13 m_{shot}$

$u_{Block} = 0.$ $\qquad$ After striking both shot and block

move with same velocity $v_{shot} = v_{Block} = v.$

Acc to law of conservation of linear momentum

$\Rightarrow m_s u_s + m_B u_B = m_s v_s + m_B v_B$

$\Rightarrow m_s \times 140 + m_B \times 0 = m_s v + 13 m_s v$

$\Rightarrow \quad \frac{\cancel{140}}{10} \cancel{m_s} = \cancel{14} \cancel{m_s} v$

$\Rightarrow v = \underline{10 \text{ m/s}}$

(6)

$m_1 = 2\,kg$; $m_2 = 4\,kg$

$u_1 = 6\,m/s$ $u_2 = 2\,m/s$

$v_1 = ?$ $v_2 = 4\,m/s$

According to Law of conservation of linear momentum

$$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$$

$$\Rightarrow 2\times6 + 4\times2 = 2v_1 + 4\times4$$

$$\Rightarrow 12 + 8 = 2v_1 + 16 \Rightarrow 2v_1 = 20-16$$

$$\Rightarrow 2v_1 = 4$$

$$\Rightarrow v_1 = 2\,m/s$$

(7)

$m_1 = 2\,kg$ $t = 2\,sec$ increase in speed $= 3$

$dv = 3\,m/s$

From $F = \frac{dp}{dt} = m\frac{dv}{dt}$

$$\Rightarrow F = 2\times\frac{3}{\cancel{2}} = 3\,N$$

(8)

$F = 15\,N$; $m = 20\,kg$; $t = 8\,sec$ $u = 0$ $v = ?$

From $F = ma$

$$\Rightarrow a = \frac{F}{m} = \frac{15}{20} = \frac{3}{4}$$

From $v = u + at \Rightarrow v = 0 + \frac{3}{\cancel{4}}\times\cancel{8}^{2}$

$$\Rightarrow v = 3\times2 = 6\,m/s$$

(9)

$m_b = 10\ gm = 10^{-2}\ kg$; $u_b = 300\ m/s$

$M_{gun} = 6\ kg$

$v_{recoil} = ?$

According to law of conservation of linear momentum

$$v_{recoil} = -\frac{m_b u_b}{M_{gun}}$$

$$v_{recoil} = -\frac{10^{-2} \times 300}{6} = -0.5\ m/s$$

(10)

$m_b = 10\ gm = 10^{-2}\ kg$ $\quad u_b = 400\ m/s$

$m_{block} = 900\ gm$

$u_{block} = 0$

After collision both bullet and block move with same velocity

$v_{bullet} = v_{block} = v_{com}$.

According to law of conservation of linear momentum

$$m_{bullet} u_{bullet} + M_{block} u_{block} = M_{bullet} v_{bullet} + M_{block} v_{block}$$

$$\Rightarrow 10 \times 400 + 900 \times 0 = 10\, v_{com} + 900\, v_{com}$$

$$\Rightarrow 4000 = 910\, v_{com}$$

$$\Rightarrow v_{com} = \frac{4000}{910} = 4.4\ m/s$$

(16), (17) (21) & (22)

$m_1 = 1\ kg$; $m_2 = 3\ kg$

$u_1 = 9\ m/s$; $u_2 = 3\ m/s$

$v_1 = 2\ m/s$

Before collision $p = m_1 u_1 + m_2 u_2$

$= 1 \times 9 + 3 \times 3$

$= 9 + 9 = 18\ kg\ m/s$

According to law of conservation of linear momentum

$P_{Before} = m_1 v_1 + m_2 v_2$

$\Rightarrow 18 = 1 \times v_1 + 3 \times 2$

$\Rightarrow 18 = v_1 + 6 \Rightarrow v_1 = 18 - 6 = 12\ m/s$

(23), (24)

$m_1 = 4\ kg$; $m_2 = 8\ kg$; $u_1 = 4\ m/s$; $u_2 = 2\ m/s$

$v_2 = 8\ m/s$ $v_1 = ?$

According to LCLM

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

$\Rightarrow 4 \times 4 + 8 \times 2 = 4 \times v_1 + 8 \times 8$

$\Rightarrow 16 + 16 = 4v_1 + 64$

$\Rightarrow 32 = 4v_1 + 64$

$\Rightarrow 4v_1 = 32 - 64$

$\Rightarrow 4v_1 = -32$

$\Rightarrow v_1 = -8\ m/s$

If $u_1 = u_2 = v_{com}$

$$P_{Before} = P_{After}$$

$$\Rightarrow m_1 u_1 + m_2 u_2 = m_1 v_{com} + m_2 v_{com}$$

$$\Rightarrow 32 = 4 v_{com} + 8 v_{com}$$

$$\Rightarrow 32 = 12 v_{com}$$

$$v_{com} = \frac{32}{12} = \frac{8}{3} = 2.66 \, m/s$$

M, V.

Thank   WS - ~~10~~ 17   4th Newton's law (III rd

(11)

Given $F = 100\,N$; $m = 2\,kg$; $t = 10\,s$.

From Newton's IInd law $F = \frac{dp}{dt}$

$\Rightarrow dp = F \times dt$

$= 100 \times 10$

$= 1000\,Ns$

(12)

Given
$m_1 = 3\,kg \rightarrow a_1 = 0.5\,m/s^2$
$m_2 = 1.5\,kg \rightarrow a_2 = ?$

From Newton's 2nd law $F = ma$ Given $F =$ same

$\therefore m_1 a_1 = m_2 a_2$

$\Rightarrow a_2 = \frac{m_1 a_1}{m_2} = \frac{3}{1.5} \times 0.5 = 1\,m/s^2$

(13)

Given $m_1 = 2\,kg \rightarrow a_1 = 1\,m/s$
$m_2 = 2\,kg$ After gluing the total mass $= m_1 + m_2$
$= 4\,kg$

and acceleration of combined mass is a.

Given $F =$ same $\therefore ma =$ constant

$\Rightarrow m_1 a_1 = (m_1 + m_2) a$

$\Rightarrow 2 \times 1 = 4 \times a$

$\Rightarrow a = \frac{2}{4} = 0.5\,m/s^2$

(14)

Given $m = 2\,kg$; $t = 2\,sec$; $dv = 3\,m/s$

From Newton's 2nd law $F = \frac{dp}{dt}$

$$\Rightarrow F = m\frac{dv}{dt}$$

$$= 2 \times \frac{3}{2}$$

$$= 3\,N.$$

(15)

Given $F = 15\,N$; $m = 20\,kg$; $t = 8\,sec$

From Newton's 2nd law $F = ma$

$$= m\frac{dv}{t}$$

$$\Rightarrow \cancel{15}^{\,3} = \cancel{20}^{\,4} \times \frac{dv}{\cancel{8}\;2}$$

$$\Rightarrow 3 = \frac{dv}{2} \Rightarrow dv = 6\,m/s$$

L Task

LTask
SAQ's

(1)

$M = 300\,gm$ $\quad m_1 = 200\,gm$ $\quad v_1 = 12\,(-\hat{i})\,m/s$

$u = 0$ $\quad m_2 = 100\,gm$ $\quad v_2 = ?$

According to law of conservation of linear momentum

$$Mu = m_1 v_1 + m_2 v_2$$

$$\Rightarrow 300 \times 0 = 200\,[12\,(-\hat{i})] + 100\,v_2$$

$$\Rightarrow 0 = 2400\,(-\hat{i}) + 100\,v_2$$

$$\Rightarrow 100\,v_2 = +2400\,\hat{i} \Rightarrow v_2 = 24\,\hat{i}$$ towards North

(2)

$m_s = 2\,kg$ $\quad M_c = 198\,kg$; $u_s = 50\,m/s$

According to LCLM $\quad v_{recoil} = -\dfrac{m_s u_s}{M_c}$

$$= -\frac{2 \times 50}{198}$$

$$= -\frac{100}{198} \simeq -0.5\,m/s$$

(3) (4)

M , V

$m_1 = m$ $m_2 = M - m$

$u_1 = 0$ $V_2 = ?$

Acc to LCLM

$$M_1 u_1 + m_2 u_2 = M_1 V_1 + m_2 V_2$$

$$\Rightarrow MV = m \times 0 + (M-m) V_2$$

$$\Rightarrow MV = (M-m) V_2$$

$$\Rightarrow V_2 = \frac{MV}{M-m}.$$

(4)

$M_{t_1} = 1200$ kg , $M_{t_2} = 1600$ kg

$u_1 = 7$ m/s , $u_2 = 0$

After collision both are moving with same velocity

$V_1 = V_2 = V_{com}$.

Acc to law of conservation of linear momentum

$$m_{t_1} u_1 + m_{t_2} u_2 = M_{t_1} V_1 + m_{t_2} V_2$$

$$\Rightarrow 1200 \times 7 + 1600 \times 0 = 1200 V_{com} + 1600 V_{com}$$

$$\Rightarrow \overset{3}{\cancel{1200}} \times 7 = \overset{4}{\cancel{2800}} V_{com} \Rightarrow V_{com} = 3 \text{ m/s}$$

(9)

$a = 1$ m/s^2 , $m = 500$ gm $= 5 \times 10^{-1}$ kg.

From $F = ma = 5 \times 10^{-1} \times 1$

$= 0.5N$

(5)

$m_1 = 10000 kg$; $u_1 = 1 m/s$

$m_2 = 2m_1$ $u_2 = -0.2 m/s$ After collision the tr

trucks are coupled so their velocity after collision is same

$$V_1 = V_2 = V$$

Acc to law of conservation of linear momentum

$$m_1u_1 + m_2u_2 = m_1V_1 + m_2V_2$$

$$\Rightarrow m_1 \times 1 + 2m_1 \times (-0.2) = m_1V + 2m_1V$$

$$\Rightarrow m_1 - 0.4m_1 = 3m_1V$$

$$\Rightarrow 0.6\cancel{m_1} = 3\cancel{m_1}V \Rightarrow V = \frac{0.6}{3} = 0.2 m/s$$

(6)

$M = 238$ $u = 0$

After α-particle ($_2He^4$) was emitted mass of Remaining nucleus $m_1 = 234$; $m_2 = m_\alpha = 4$

$V_\alpha = V$.

According to law of conservation of linear momentum

$$Mu = m_1V_1 + m_2V_2$$

$$\Rightarrow 238 \times 0 = 234V_1 + 4V$$

$$\Rightarrow 234V_1 = -4V$$

$$\Rightarrow V_1 = -\frac{4V}{234}$$

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7

$M_{man} = 50\ kg$

$m_{stone} = 0.1\ kg$

$V_{man} = ?$

$V_{stone} = 10\ m/s$

According to law of conservation of linear momentum

$$V_{man} = -\frac{m_{stone} \times V_{stone}}{M_{man}}$$

$$\Rightarrow V_{man} = -\frac{0.1 \times 10}{50} = -\frac{1}{50} = -0.02\ m/s$$

'−ve' sign shows both ~~stone~~ man ~~and~~ moves back in opposite direction to motion of stone

8

$M = 40\ kg$; $u = 80\ m/s$

$m_1 = 32\ kg$; $m_2 = 8\ kg$

$v_1 = ?$ $\quad v_2 = 0$

Acc to LCLM $\quad MU = m_1 V_1 + m_2 V_2$

$$\Rightarrow 40 \times 80 = 32 \times V_1 + 8 \times 0$$

$$\Rightarrow 3200 = 32\, V_1$$

$$\Rightarrow V_1 = 100\ m/s$$

10

$a = 5\ cm/s^2$; $m = 20\ gm$

$$F = ma = 20 \times 5 = \cancel{25\ dynes}$$

$$= 100\ dynes$$

$$= 100 \times 10^{-5}\ N$$

$$= 10^{-3}\ N$$

(11)

Given $m = 2\,kg$; $s = 1\,m$; $v = 3\,m/sec.$

From $v^2 - u^2 = 2as$

$\Rightarrow 3^2 - 0^2 = 2a \times 1$

$\Rightarrow 9 = 2a$

$\Rightarrow a = \frac{9}{2}$

From $F = ma$

$= 2 \times \frac{9}{2}$

$= 9\,N.$

(12)

(12)

Given $M_{air} = 8\ gm = 8\times10^{-3}\ kg$

$v_{air} = 7\ cm/sec.$ $t = 5.6\ sec.$

$\therefore$ Average force acting on balloon is $F = \frac{dp}{dt}$

$\Rightarrow F = m\frac{dv}{dt} = \frac{8\times7}{5.6}$

$\Rightarrow F = \frac{56}{5.6} = 10$ dynes $= 10\times10^{-5}\ N = 10^{-4}\ N$

(13)

Given $m = 0.03\ kg = 3\times10^{-2}\ kg$

$\frac{n}{t} = 200$; $v = 30\ m/s$

average force $= F = \frac{dp}{dt}$ = For 'n' bullets

$F = n\frac{dp}{dt} = n\,m\frac{dv}{dt}$

$= 200\times3\times10^{-2}\times30$

$= 180\ N.$

(14)

$m = 40\ gm$; $v = 1200\ m/s$ $\frac{n}{t} = ?$

$= 40\times10^{-3}\ kg$ $F = 144\ N.$

From Newton's 2^{nd} law $F = \frac{dp}{dt}$ For 'n' bullets

$F = n\frac{dp}{dt} = n\,m\frac{dv}{dt}$

$\Rightarrow 144 = \frac{n}{t}\times40\times10^{-3}\times1200$

$\Rightarrow \frac{n}{t} = 3$

Scanned with OKEN Scanner

(15)

Given $v = 5 \, m/s$

$$\frac{dm}{dt} = 5 \, kg/sec.$$

From $F = \frac{dp}{dt} = v \frac{dm}{dt}$

$$= 5 \times 5$$

$$= 25 \, N.$$

(17) (8)

Given $\frac{m_1}{m_2} = \frac{2}{3}$

when shell is exploded into 2 pieces. Acc to law of conservation of linear momentum the two pieces have equal and opposite momenta's

$$P_1 = -P_2$$

$$\Rightarrow m_1 V_1 = -m_2 V_2$$

$$\Rightarrow \frac{V_1}{V_2} = -\frac{m_2}{m_1} = \frac{3}{2}$$

$\frac{P_1}{P_2} = \frac{1}{1}$ ∴ lighter body have greater velocity

because mass $\propto \frac{1}{\text{Velocity}}$ [P = constant]

(23)

$m_{bullet} = 50\ gm$ $\quad u_{bullet} = 30\ m/s$
$= 50 \times 10^{-3}\ kg$
$M_{gun} = ?$ $\quad V_{recoil} = -1\ m/s$

According to Law of conservation of linear momentum

$$V_{recoil} = -\frac{m_{bullet} \times V_{bullet}}{M_{gun}}$$

$$\Rightarrow \cancel{-}1 = \cancel{-}\frac{50 \times 10^{-3} \times 30}{M_{gun}}$$

$$\Rightarrow M_{gun} = 1500 \times 10^{-3}$$

$$= 1.5\ kg$$

(24) (6)

$M_G = 10\ kg$ $m_b = 10\ gm = 10^{-2}\ kg$

$V_{recoil} = ?$ $u_b = 400\ m/s$ $n = 4$

Acc to LCLM

$$V_{recoil} = -\frac{n m_b u_b}{M_G}$$

$$\Rightarrow V_{recoil} = -\frac{4 \times 10^{-2} \times 400}{10}$$

$$= -0.4\ m/s \times 4$$

$$= -1.6\ m/s.$$

(25), (26)

$m_1 = 6\ kg;\ m_2 = 8\ kg$ $V_2 = 8\ m/s$

$u_1 = 4\ m/s;\ u_2 = 2\ m/s$ $V_1 = ?$

According to law of conservation of linear momentum

$$m_1 u_1 + m_2 u_2 = m_1 V_1 + m_2 V_2$$

$$\Rightarrow 6 \times 4 + 8 \times 2 = 6 \times V_1 + 8 \times 8$$

$$\Rightarrow 24 + 16 = 6V_1 + 64$$

$$\Rightarrow 40 = 6V_1 + 64 \Rightarrow 6V_1 = -24 \Rightarrow V_1 = -4\ m/s$$

momentum After collision $= m_1 V_1 + m_2 V_2$

$$= 6 \times (-4) + 8 \times 8$$

$$= -24 + 64$$

$$= 40\ NS$$