WS-15 - Energy   9th foundation +

Thank   ①

① Given

$m = 5\ kg$; $h = 30\ m$

Given all Energy is converted into heat

$heat = mgh = 5 \times 10 \times 30 = 1500\ J$

in $cal = \frac{1500}{4.2} \approx 357\ cal \approx 350\ cal$

② Given $m_1 = 1\ gm$; $m_2 = 4\ gm$.   K.E = same

$\therefore\ p^2 \propto m$ From $K.E = \frac{p^2}{2m} \Rightarrow p^2 = 2m\ K.E$

$\Rightarrow \frac{P_1}{P_2} = \sqrt{\frac{m_1}{m_2}} = \sqrt{\frac{1}{4}} = \frac{1}{2} \rightarrow C$

③

let $m_1 = 4\ kg$; $m_2 = 8\ kg$

$V_1 = ?$ $V_2 = 6\ m/s$

According to law of conservation of linear momentum

$m_1 V_1 = -m_2 V_2$

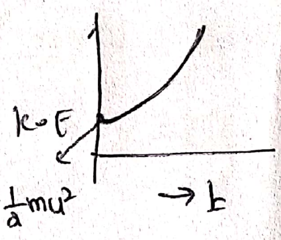
$\Rightarrow 4 \times V_1 = -8 \times 6 \Rightarrow V_1 = -12\ m/s$

K-E of $m_1 = \frac{1}{2} m_1 V_1^2 = \frac{1}{\cancel{2}} \times \cancel{4}^2 \times (-12)^2 = 2 \times 144 = 288\ J \rightarrow D$

④ when a body is given a horizontal velocity = u

$K.E_I = \frac{1}{2} m u^2$ From $V = u + gt$

After 't' sec $K.E_F = \frac{1}{2} m v^2 = \frac{1}{2} m (u + gt)^2$



$= \frac{1}{2} m (u^2 + g^2 t^2 + 2ugt)$

$= \frac{1}{2} m u^2 + \frac{1}{2} g^2 m t^2 + mugt$

(5)

Acc to W-E theorem $W =$ change in K.E

$W = \frac{1}{2} m v^2 \Rightarrow W \propto v^2 \rightarrow$ graph is Parabola

$\rightarrow D$

(6)

From $v^2 - u^2 = 2as$ here $S = x$ $a = -ve$

$\Rightarrow v^2 - u^2 = -2ax$

According to W-E theorem $W = \Delta K.E$

$\Rightarrow f\,x = \frac{1}{2} m (v^2 - u^2)$

$\rightarrow f(x) = \Delta K.E$

$\Delta K.E \propto \underline{x} \rightarrow A$

(7)

Given $m = 25\,gm = 25 \times 10^{-3}\,kg$; $u = 500\,m/s$

$v = 100\,m/s$

According to W-E theorem

$W = \frac{1}{2} m (v^2 - u^2)$

$\Rightarrow W = \frac{1}{2} \times 25 \times 10^{-3} [100^2 - 500^2]$

$\Rightarrow \frac{1}{\cancel{2}} \times 25 \times \cancel{10^{-3}} \times 60\cancel{0} \times (-\overset{2}{\cancel{4}}\cancel{00})$

$\Rightarrow 50 \times 60 = 3000\,J$

(8)

Given $l = 1m$.

At lowest point U_i, k_i are potential and kinetic energies

$U_i = 0$; $k_i = \frac{1}{2} m v^2$ where $v \rightarrow$ speed at lowest point

Total Energy at lowest point $T_i = U_i + k_i = 0 + \frac{1}{2} m v^2$

$T_i = \frac{1}{2} m v^2$

Scanned with OKEN Scanner

⑧

Given that 10% of the initial energy gets dissipated due to air resistance.

$$T_i = \frac{10}{100} T_F$$

$T_F \rightarrow$ Total Energy in horizontal position

$$T_F = U_F + K_F = mgh + 0 = mgh$$

$$\therefore T_f = \frac{10}{100} \times mgh$$

$$\Rightarrow \frac{1}{2} mv^2 = \frac{1}{10} mg \times h$$

$$\Rightarrow v^2 = \frac{1}{5} \times 9.8 \times 1 \qquad [h = l = 1m]$$

$$\Rightarrow v = \sqrt{\frac{9.8}{5}} = 1.4 \ m/s$$

⑨

Given $m = 5$ kg, $h = 20m$, $v = 10 m/s$

work done $= -mgh + \frac{1}{2} m v^2$

$$\Rightarrow -5 \times 10 \times 20 + \frac{1}{2} \times 5 \times 10^2$$

$$\Rightarrow -1000 + 250$$

$$\Rightarrow -750 J$$

(10)

let u be the velocity of Projection

At max height $v=0$ $\therefore$ $E = mgh$ which is P.E

As velocity doubled i.e. $2u$.

Total Energy $E' = mgh'$ because $h \propto u^2$

$E' = 4mgh$.

$\frac{h}{h'} = \left(\frac{u}{u'}\right)^2$

$\Rightarrow h' = 4h$

$E = U + K.E$

$K.E = E - U$

At a height $\frac{3h}{4}$ $U = \frac{3}{4}mgh$

$= E' - \frac{3}{4}mgh$

$\Rightarrow 4mgh - \frac{3}{4}mgh = \frac{13}{4}mgh = \frac{13}{4}E \rightarrow$

(12)

FBD for block

$F = T$

$W_{gravity} = -20 \times 2 = -40J$

$W_T = F \times d$

$= 40 \times 2 = 80J$

Acc W-E theorem

$W = \Delta K.E$

$\Rightarrow 40 = F \times d$

$\Rightarrow 40 = 20 \times d$

$\Rightarrow d = 2m$

A, B, D are correct

(14)

Given momentum $P = 10$ kg m/s ; $K.E = 50J$

$K.E = \frac{P^2}{2m}$

$\Rightarrow m = 1$ kg $\rightarrow$ D

$\Rightarrow 50 = \frac{10^2}{2m}$

$\Rightarrow 2m = \frac{100}{50}$

(15)

Since $k.E' = 2\,k.E$; $m' = 2m$

From $k.E = \dfrac{p^2}{2m}$

$\Rightarrow P = \sqrt{2m\,k.E}$ $\Rightarrow \dfrac{P'}{P} = \sqrt{\dfrac{m'\,k.E'}{m\,k.E}}$

$\Rightarrow \dfrac{P'}{P} = \sqrt{\dfrac{2\cancel{m} \times 2\,\cancel{k.E}}{\cancel{m}\,\cancel{k.E}}} = 2$ $\Rightarrow P' = 2P \Rightarrow$ doubled

(16)

K·E

(17)

Given $m = 150 \times 10^{-3}$ kg ; $u = 2\hat{i} + 6\hat{j}$ m/s

$|\vec{v}| = \sqrt{2^2 + 6^2} = \sqrt{40}$ m/s

$K.E = \frac{1}{2} m u^2$

$= \frac{1}{2} \times 15\cancel{0} \times 10^{-3} \times 4\cancel{0}$

$\Rightarrow 3\ J.$

(18)

$K.E_I = 50\,J$; $K.E_F = 25\,J$

$\therefore$ work done $= K.E_I - K.E_F$

$= 50 - 25 = 25\,J.$

L Task

Jee main level

(1)

work done = $Vq \Rightarrow Ve$ Given $V = 1$ volt

$\therefore w = 1 eV \rightarrow B$

(2)

let 'p' be the original momentum

New momentum $p' = p + \frac{50}{100} p = \frac{150}{100} p = \frac{3}{2} p$

$K.E = \frac{p^2}{2m} \Rightarrow K.E \propto p^2$

$\Rightarrow \frac{K.E}{K.E'} = \left(\frac{p}{p'}\right)^2 \Rightarrow \frac{K.E}{K.E'} = \left(\frac{p}{\frac{3}{2}p}\right)^2$

$\Rightarrow \frac{K.E}{K.E'} = \frac{4}{9} \Rightarrow K.E' = \frac{9}{4} K.E \Rightarrow 225\% \ K.E$

$= (100 + 125)\% \ K.E$

$\Rightarrow$ 125% increases $\rightarrow$ C

(3)

Given $K.E' = 4 \, K.E$

we know $K.E = \frac{p^2}{2m} \Rightarrow K.E \propto p^2$

$\Rightarrow \frac{K.E'}{K.E} = \left(\frac{p'}{p}\right)^2$

$\Rightarrow 4 \frac{\cancel{K.E}}{\cancel{K.E}} = \left(\frac{p'}{p}\right)^2$

$\Rightarrow \frac{p'}{p} = \sqrt{4} \Rightarrow 2$

$p' = 2p \rightarrow$ doubled (or) twice that of initial value. $\rightarrow$ A

(4) Given $K.E = 3P \rightarrow (1)$

~~Given~~ we know $K.E = \frac{1}{2}mv^2$; $P = mv$

From (1) $\frac{1}{2}\cancel{m}v^{\cancel{2}} = 3\cancel{m}\cancel{v}$

$\Rightarrow \frac{v}{2} = 3 \Rightarrow v = 6$ units $\rightarrow$ C

(5)

According to law of conservation of linear momentum

momentum of 3rd particle $P_3 = \sqrt{P_1^2 + P_2^2}$

Given $P_1 = P\hat{i}$; $P_2 = 2P\hat{j}$ $\quad P_3 = \sqrt{P^2 + (2P)^2} = \sqrt{5P^2} = \sqrt{5}P$

$K.E = \frac{P^2}{2m}$ $\quad K.E_3 = E_3 = \frac{P_3^2}{2m_3} = \frac{5P^2}{2\frac{m}{3}}$

$E_2 = K.E_2 \rightarrow K.E$ of 2nd part $= \frac{P_2^2}{2m_2} = \frac{4P^2}{2\frac{m}{3}}$

$\therefore \frac{E_2}{E_3} = \frac{\frac{4\cancel{P^2}}{\cancel{2m/3}}}{\frac{5\cancel{P^2}}{\cancel{2m/3}}} = \frac{4}{5}$ $\quad$ [Given $m_1 = m_2 = m_3 = \frac{m}{3}$]

(6)

After emitting α - particle

$m_A > m_B$ $\quad$ Since $K.E = \frac{1}{2}mv^2$

$K.E_A > K.E_B$

$\therefore \frac{K.E_A}{K.E_B} > 1$

Given $F_1 = 3\hat{i}+4\hat{j}$ N ; $F_2 = -3\hat{k}$ N ; $F_3 = 2\hat{i}$ N ; $F_4 = \hat{j}+4\hat{k}$ N

Net force $F = F_1+F_2+F_3+F_4$

$= 3\hat{i}+4\hat{j}-3\hat{k}+2\hat{i}+\hat{j}+4\hat{k}$

$\Rightarrow 5\hat{i}+5\hat{j}+\hat{k}$

displacement $= \vec{r}_2-\vec{r}_1 \Rightarrow (5\hat{i}+\hat{j}+2\hat{k})-(3\hat{i}+2\hat{j}-\hat{k})$ m

$\Rightarrow 2\hat{i}-\hat{j}+\hat{k}$

According to W-E theorem $W = \Delta K.E$

$\Rightarrow \Delta K.E \Rightarrow \vec{F}\cdot\vec{S}$

$\Delta K.E = (5\hat{i}+5\hat{j}+\hat{k})\cdot(2\hat{i}-\hat{j}+\hat{k})$

$\Rightarrow 5\times2 - 5\times1 + 1\times1$

$\Rightarrow 10-5+1 = 6$ J $\rightarrow$ C

(5)

Given $x = \frac{t^3}{3}$; velocity $v = \frac{dx}{dt} = \frac{3t^2}{3} = t^2$

acceleration $a = \frac{dv}{dt} = \frac{d}{dt}t^2 = 2t$

at $t = 2$ sec

$a = 2(2) = 4$ m/s^2

$x = \frac{2^3}{3} = \frac{8}{3}$ m

For small amt of work done $dw = F\,dx = ma\,dx$

$dw = 2\times 2t\; d\left(\frac{t^3}{3}\right)$

$= 4t\; t^2\,dt$

$\Rightarrow \int dw = \int 4t^3\,dt$

$W = 4\times\frac{t^4}{4} = t^4 = 16$ J $\rightarrow$ B

(9)

No. of bullets per min $= \frac{240}{60} = 4$ m/sec

$m = 10^{-2}$ kg

Power $= 7.2 \times 10^3$ W

$P = n \times \frac{w}{t}$

$\Rightarrow 7.2 \times 10^3 = 4 \times \frac{1}{2} m v^2$

$\Rightarrow 3.6 \times 10^3 = 10^{-2} \times v^2$

$v^2 = 36 \times 10^4$ $\Rightarrow v = 600$ m/s

(10)

work done $= F \times S$

$= ma \times \frac{1}{2} a t^2$

[From $S = ut + \frac{1}{2} a t^2$

$S = 0 \times t + \frac{1}{2} a t^2$

$S = \frac{1}{2} a t^2$

$W = \frac{1}{2} m a^2 t^2$

$= \frac{1}{2} m \frac{v^2}{t_1^2} t^2$

$a = \frac{v}{t_1}$

(14)

Given $m = 10$ kg; $v = 5$ m/s

momentum $= mv = 10 \times 5 = 50$ kg m/sec

(15)

K.E $= \frac{1}{2} m v^2$

[Given $m = 10$ kg; $v = 5$ m/s]

$= \frac{1}{2} \times 10 \times 5^2 = 125$ J

(16)

If $m' = \frac{m}{2}$; $v' = 2v$

$K.E' = \frac{1}{2} m' v'^2 = \frac{1}{2} \frac{m}{2} (2v)^2 = \frac{1}{2} m v^2 \times 2$

$\Delta K.E = K.E' - K.E = 2 \frac{1}{2} m v^2 - \frac{1}{2} m v^2 = \frac{1}{2} m v^2 = \frac{1}{2} \times 10 \times 5^2 = 125$ J

Given $m = 10$ kg ; $v = 5$ m/s

(17)

If $p' = \frac{150}{100} p = [p + \frac{50}{100} p]$

$= \frac{3}{4} p$

$k.E = \frac{p^2}{2m} \Rightarrow \frac{k.E'}{k.E} = \left[\frac{p'}{p}\right]^2$

$\Rightarrow \frac{k.E'}{k.E} = \left[\frac{3p}{4p}\right]^2 = \frac{9}{16}$

$k.E' = \frac{9}{16} \times 100\, k.E = 225\% = [100+125]\%\, k.E$

Increases by 125%

(18)

Given $m = 40\,kg$; $u = 8\,m/s$, $v = 9\,m/s$

work done = change in k.E

$= \frac{1}{2} m (v^2 - u^2)$

$= \frac{1}{2} \times 40\, [9^2 - 8^2]$

$= 20 \times 17 \times 1 = 340\,J$

(19)

Given $p' = 2p$ where $p \rightarrow$ original momentum

we know $k.E = \frac{p^2}{2m}$ $\Rightarrow \frac{k.E'}{k.E} = \left[\frac{2p}{p}\right]^2 = 4$

$\Rightarrow k.E \propto p^2$ $\Rightarrow k.E' = 4\, k.E$

$\Rightarrow \frac{k.E'}{k.E} = \left[\frac{p'}{p}\right]^2$

Kinetic Energy is increased by 4 times