WS-10 WS-10 9^{th} advanced ①

T Kayle Energy

①

Given $v = 2\ m/s$

Volume $= 1\ cc = 10^{-3}\ m^3$

density $= 1.2\ gm/cc$

$= 1.2 \times 10^{3}\ kg/m^3$

$\therefore m = d \times Vol$

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

$= \frac{1}{2} \times d \times Vol \times v^2$

$= \frac{1}{2} \times 1.2 \times 10^{3} \times 10^{-3} \times 2^2$

$= 0.6 \times 4 = 2.4\ J$

②

Given $K.E = K$

For mass $m_1 = m$

After removing $\frac{1}{4}$ th of mass

Remaining mass $m_2 = \frac{3}{4} m$

velocity $V_2 = 2V$.

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

$\Rightarrow K.E \propto m v^2$

$\Rightarrow \frac{K_2}{K_1} = \frac{m_2}{m_1} \left(\frac{V_2}{V_1}\right)^2$

$\Rightarrow \frac{K_2}{K} = \frac{3m}{4m} \left[\frac{2V}{V}\right]^2$

$\Rightarrow \frac{K_2}{K} = \frac{3}{4} \times 4$

$\Rightarrow K_2 = 3K.$

③

Given mass of bullet $m = 10\ gm$

Before coming to rest $\Rightarrow V = 0$

Distance travelled $s = x = 8 \times 10^{-2}\ m$

$F = -100\ N$ [Resistive force

Acc. to W-E theorem

$W = \Delta K.E$

$\Rightarrow F.S = \frac{1}{2} m (v^2 - u^2)$

$= -100 \times 8 \times 10^{-2} = \frac{1}{2} \times 10 \times 10^{-3} (0^2 - u^2)$

$\Rightarrow 1600 = \frac{1}{2} u^2$

$\Rightarrow u^2 = 1600$

$\Rightarrow u = 40\ m/s$

④

Given $m = 5\ kg$, $u = \frac{P}{m}$

$F = 5\ N$ $\quad u = \frac{20}{5} = 4\ m/s$

$t = 10\ sec$

After 10 sec

$\Rightarrow V = u + at$

$\Rightarrow V = 4 + \frac{F}{m} \times 10$

$= 4 + \frac{5}{5} \times 10 = 14\ m/s$

$\therefore \Delta K.E = \frac{1}{2} m (v^2 - u^2)$

$= \frac{1}{2} \times 5 (14^2 - 4^2)$

$= \frac{1}{2} \times 5 \times 28 \times 10$

$= 700\ J$

(5)

Given $l = 20\times10^{-2}$ m ; $m = 100$ gm $= 10^{-1}$ kg ; $\theta = 60°$

$$v = \sqrt{2gl(1-\cos\theta)} = \sqrt{2\times10\times10^{-1}(1-\cos60)}$$

$$v = \sqrt{4(1-\tfrac{1}{2})} = \sqrt{\tfrac{4}{2}} = \sqrt{2} = 1.414 \text{ m/s}$$

(6)

Height from which ball was released $H = 20$m

Rebouncing height $= 16$m.

$$\% \text{ loss of Energy} = \frac{h_2 - h_1}{h_1}\times100 = \frac{16-20}{20}\times100$$

$$= -4\times5 = -20\,\%$$

(7)

Here velocity of a car $= 72$ kmph $= 72\times\frac{5}{18} = 20$ m/s

$v = 0$ ∴ change in K.E $= \frac{1}{2}m(v^2-u^2)$

$$= \frac{1}{2}m(0-20)^2 = -200m$$

Here 25% of energy is wasted in overcoming friction so remaining 75% of Energy is utilised to raise the car to a height H.

Gain P.E $= 75\%$ K.E

$$mgh = \frac{3}{4}\times(200)$$

$$\Rightarrow 10\times h = \frac{3}{4}\times200$$

$$\Rightarrow h = 15\text{m}$$

(8)

Given $m = 2\ kg$; $h = 0.4\ m$; $k = 1960\ N/m$

As the body falls from certain height on to a string, it's P.E decreased and is converted into strain energy

$\therefore mgh = \frac{1}{2} k x^2$

$\Rightarrow 2 \times 9.8 \times 0.4 = \frac{1}{2} \times 1960 \times x^2$

$\Rightarrow 0.8 = 50 x^2 \Rightarrow x^2 = \frac{0.8}{50} = \frac{1}{100}$

$\Rightarrow x = \frac{1}{10} m = 10\ cm$

(9)

Lowest position $h_1 = 2m$

highest position $h_2 = 4.5m$

$v_L = \sqrt{2g(h_1 - h_2)} = \sqrt{2 \times g \times (2.5)}$

$= \sqrt{5 \times g} = \sqrt{5 \times 9.8} = 7\ m/s$

(10)

Given $m = 100\ gm = 10^{-1} kg$

$V = 50\ m/s$

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

$= \frac{1}{2} \times 10^{-1} \times (50)^2$

$= \frac{250}{2}$

$= 125\ J$

(16)

$m = 50 \times 10^{3}\ kg$

$S = 40\ m$

Final velocity

$V = \sqrt{2gh}$

$V = \sqrt{2 \times 10 \times 40}$

$= 20\sqrt{2}\ m/s$

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

$= \frac{1}{2} \times 50 \times 10^{-3} (20\sqrt{2})^2$

$= 20\ J$

(17)

$m = 2\ kg$; $x = \frac{t^3}{3}$

$a = \frac{d^2x}{dt^2} = \frac{d}{dt}\left[\frac{dx}{dt}\right] = \frac{d}{dt}\left(\frac{3t^2}{3}\right)$

$= \frac{d}{dt} t^2 = 2t^{2-1} = 2t$

At $t = 2$ sec

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

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

$W = F \cdot S$

$= ma\,S$

$= 2 \times 4 \times \frac{8}{3} = \frac{64}{3} J$

(18)

$m = 25\times10^{-3}$ kg

$u = 500$ m/s

$v = 100$ m/s

$W = \Delta K.E$

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

$\Rightarrow W = \frac{1}{2}\times25\times10^{-3}(100^2-500^2)$

$= \frac{1}{2}\times25\times10^{-3}\times10^4(1-25)$

$= -\frac{1}{2}\times25\times10\times(24)$

$= -3000$ J

LTask SAQ's

(1) $s = 100$ m, $t = 10$ s ; $m = 60$ kg.

$v = \frac{s}{t} = \frac{100}{10} = 10$ m/s

$\therefore K.E = \frac{1}{2}mv^2$

$= \frac{1}{2}\times60\times10^2$

$= 30\times100$

$= 3000$ J

(2) According to W-E theorem

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

$v = 15\times10^{-2}$ m/s ; $u = 65\times10^{-2}$ m/s

$m = 5$ kg

$W = \frac{1}{2}\times5[(15\times10^{-2})^2-(65\times10^{-2})^2]$

$= \frac{1}{2}\times5\times10^{-4}(15^2-65^2)$

$= \frac{1}{2}\times5\times10^{-4}\times80\times50 = 1$ J

$W = F.S$

$F = \frac{W}{S} = \frac{1}{(v-u)t}$

$F = \frac{1}{(65-15)\times10^{-2}\times0.2} = 10$ N

(3)

Velocity of projection $= \sqrt{2gh}$

$= \sqrt{2\times10\times20}$

As it reaches ground only 50% of energy utilised

$\Rightarrow \frac{1}{2}mgh = \frac{1}{2}\times mv^2$

$\Rightarrow 10\times20 = v^2$

$\Rightarrow v = \sqrt{200}$

$= 14.14$ m/s

(4)

4

Distance travelled by the car without Passengers $= 10m$

Here only car weight is there $= mg$

After Adding 25% of weight Now the weight in car $= 125\% \, mg = \frac{5}{4} mg$

we know $S \propto$ weight

$$\Rightarrow \frac{S_1}{S_2} = \frac{W_1}{W_2} \Rightarrow \frac{10}{S_2} = \frac{4}{5} \Rightarrow S_2 = 12.5\,m$$

5

let initial $k.E_{bullet} = k.E$

For covering a distance $S_1 = 2\,cm$ $\quad k.E_2 = 25\% \, k.E = \frac{1}{4} k.E$

with remaing $\frac{3}{4} k.E$ It can cover a distance S_2

$\therefore S \propto k.E$

$$\Rightarrow \frac{S_1}{S_2} = \frac{k_1 E}{k.E_2} \Rightarrow \frac{2}{S_2} = \frac{\frac{1}{4} k.E}{\frac{3}{4} k.E} = \frac{1}{3} \Rightarrow S_2 = 6\,cm$$

6

let x_1 be the initial compression $= 3cm$

$\therefore$ The potential energy stored $U_1 = U = \frac{1}{2} k x_1^2 = \frac{1}{2} k (3)^2 = \frac{9k}{2}$

when spring is compressed by further $3cm$ then new compression $= 6\,cm$

The P.E stored is $U_2 = \frac{1}{2} k x_2^2$

Increase in $P.E = U_2 - U_1 = \frac{1}{2} k (x_2^2 - x_1^2)$

$$= \frac{1}{2} k [6^2 - 3^2] = \frac{1}{2} k [36 - 9]$$

$$= 27 \frac{k}{2} = 3 \, \frac{9k}{2} = 3U$$

(7)

initial angle of projection $\theta_1 = 60^\circ$ $K.E_1 = k = \frac{1}{2}mu^2$

At highest point velocity is $= u\cos\theta = u_H$

$u_H = u\cos 60$

$= \frac{u}{2}$

$\therefore$ $K.E = \frac{1}{2}mu_H^2$

$= \frac{1}{2}m(\frac{u}{2})^2 = \frac{1}{2}mu^2 \times \frac{1}{4} = \frac{k}{4}$

(8)

Given $m = 2kg$; $h = 10m$

$\therefore$ P.E of a body $= mgh = 2\times10\times10 = 200J$

(9)

Given $P.E = 490J$; $m = 5kg$

we know that $P.E = mgh$

$\Rightarrow 490 = 5\times9.8\times h$

$\Rightarrow 490 = 49h \Rightarrow h = 10m$

(10)

we know that $F = -\frac{du}{dx}$ (slope of u-x graph]

As the slope is $-ve$, then the force $= +ve$

(14)

Given $v = 3\hat{i} + 4\hat{j} + 5\hat{k}$ m/s , $m = 1.5$ kg

$|v| = \sqrt{3^2+4^2+5^2} =$

$= \sqrt{50}$ m/s

$\therefore$ $K.E = \frac{1}{2}mv^2$

$= \frac{1}{2}\times1.5\times(\sqrt{50})^2$

$= \frac{1}{2}\times1.5\times50 = 37.5J$

(15)

(4)

Given height of building $h = 20m$

$m = 10\,kg$; $v = 10\,m/s$.

The K.E of each ball = P.E

$= mgh$

$= 10 \times 10 \times 20$

$= 2000\,J$

$= 2\,kJ$

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