

WS-10

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9th advanced

①

Thayle

Energy

①

Given $v = 2 \text{ m/s}$ Volume $= 1 \text{ cc} = 10^{-3} \text{ m}^3$ density $= 1.2 \text{ gm/cc}$
 $= 1.2 \times 10^3 \text{ kg/m}^3$

$$\therefore m = \frac{d}{\rho} \times \text{Vol}$$

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

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

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

$$= 0.6 \times 4 = 2.4 \text{ J}$$

②

Given $\text{K.E} = \text{K}$ For mass $m_1 = m$ After removing $\frac{1}{4}$ th of massRemaining mass $m_2 = \frac{3}{4} m$ velocity $v_2 = 2v$

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

$$\Rightarrow \text{K.E} \propto m v^2$$

$$\Rightarrow \frac{k_2}{k_1} = \frac{m_2}{m_1} \left(\frac{v_2}{v_1} \right)^2$$

$$\Rightarrow \frac{k_2}{k} = \frac{3m}{4} \left(\frac{2v}{v} \right)^2$$

$$\Rightarrow \frac{k_2}{k} = \frac{3}{4} \times 4$$

$$\Rightarrow k_2 = 3k$$

③

Given mass of bullet $m = 10 \text{ gm}$ Before coming to rest $\Rightarrow v = 0$ distance travelled $s = x = 8 \times 10^{-2} \text{ m}$ $F = -100 \text{ N}$ [Resistive force]

Acc. to W-E theorem

$$W = \Delta \text{K.E}$$

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

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

$$\Rightarrow 7800 = \frac{1}{2} u^2$$

$$\Rightarrow u^2 = 1600$$

$$\Rightarrow u = 40 \text{ m/s}$$

④

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

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

$$t = 10 \text{ s}$$

After 10 s

$$\Rightarrow v = u + at$$

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

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

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

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

$$= \frac{1}{2} \times 5 \times 20 \times 10$$

$$= 700 \text{ J}$$



5

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

$$v = \sqrt{2gl(1 - \cos\theta)} = \sqrt{2 \times 10 \times 10^{-1} (1 - \cos 60^\circ)}$$

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

6

Height from which ball was released $H = 20 \text{ m}$
Rebounding height $= 16 \text{ m}$

$$\% \text{ loss of Energy} = \frac{h_2 - h_1}{h_1} \times 100 = \frac{16 - 20}{20} \times 100$$

$$= -4 \times 5 = -20\%$$

7

Here velocity of a car $= 72 \text{ kmph} = 72 \times \frac{5}{18} = 20 \text{ m/s}$
 $v = 0$;

$$\text{change in k.E} = \frac{1}{2} m (v^2 - u^2)$$

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

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

$$\text{Gain P.E} = 75\% \text{ k.E}$$

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

$$110 \times h = \frac{3}{4} \times 200$$

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

Given $m = 2 \text{ kg}$, $h = 0.4 \text{ m}$, $k = 1960 \text{ N/m}$

As the body falls from certain height on to a spring, its P.E decreased and is converted into strain Energy

$$\begin{aligned} \therefore mgh &= \frac{1}{2} kx^2 \\ &= 2 \times 9.8 \times 0.4 = \frac{1}{2} \times 1960 \times x^2 \\ \therefore 0.4 &= 50x^2 \Rightarrow x^2 = \frac{0.4}{50} = \frac{1}{100} \\ \therefore x &= \frac{1}{10} \text{ m} = 10 \text{ cm} \end{aligned}$$

lowest position $h_1 = 2 \text{ m}$

highest position $h_2 = 4.5 \text{ m}$

$$\begin{aligned} v_c &= \sqrt{2g(h_1 - h_2)} = \sqrt{2 \times 9.8 \times (2.5)} \\ &= \sqrt{5 \times 9.8} = \sqrt{5 \times 9.8} = 7 \text{ m/s} \end{aligned}$$

Given $m = 100 \text{ g} = 0.1 \text{ kg}$

$v = 50 \text{ m/s}$

$$\begin{aligned} KE &= \frac{1}{2} mv^2 \\ &= \frac{1}{2} \times 0.1 \times (50)^2 \\ &= \frac{950}{2} \\ &= 125 \text{ J} \end{aligned}$$

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

$S = 40 \text{ m}$

Final velocity

$$v = \sqrt{2gh}$$

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

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

$$KE = \frac{1}{2} mv^2$$

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

$$= 20 \text{ J}$$

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

$$\begin{aligned} Q &= \frac{d^2x}{dt^2} = \frac{d}{dt} \left[\frac{dx}{dt} \right] = \frac{d}{dt} \left[\frac{3t^2}{3} \right] \\ &= \frac{d}{dt} t^2 = 2t = 2t \end{aligned}$$

At $t = 2 \text{ s}$

$$Q = 2(2) = 4 \text{ m/s}^2$$

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

$W = F \cdot s$

$= ma \cdot s$

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

(18)

$$m = 25 \times 10^{-3} \text{ kg}$$

$$u = 500 \text{ m/s}$$

$$v = 100 \text{ m/s}$$

$$W = \Delta K.E$$

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

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

$$= \frac{1}{2} \times 25 \times 10^{-3} \times 10^4 (1 - 25)$$

$$= -\frac{1}{2} \times 25 \times 10 \times (24)$$

$$= -3000 \text{ J}$$

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(19)

$$S = 100 \text{ m}, k = 10 \text{ s}; m = 60 \text{ kg} \quad (2)$$

$$v = \frac{S}{k} = \frac{100}{10} = 10 \text{ m/s}$$

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

$$= \frac{1}{2} \times 60 \times 10^2$$

$$= 30 \times 100$$

$$= 3000 \text{ J}$$

According to W-E theorem

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

$$v = 15 \times 10^2 \text{ m/s}; u = 65 \times 10^2 \text{ m/s}$$

$$m = 5 \text{ kg}$$

$$W = \frac{1}{2} \times 5 [(15 \times 10^2)^2 - (65 \times 10^2)^2]$$

$$= \frac{1}{2} \times 5 \times 10^4 (15^2 - 65^2)$$

$$= \frac{1}{2} \times 5 \times 10^4 \times 80 \times 50 = 1 \text{ J}$$

$$\dot{W} = F \cdot \dot{s}$$

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

$$F = \frac{1}{(65-15) \times 10^2 \times 0.2} = 10 \text{ N}$$

(20)

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

$$= \sqrt{2 \times 10 \times 20}$$

As it reaches ground only

50% of energy utilised

$$\therefore \frac{1}{2} mgh = \frac{1}{2} m v^2$$

$$\therefore 10 \times 20 = v^2$$

$$\therefore v = \sqrt{200}$$

$$= 14.14 \text{ m/s}$$

(21)



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
 $= 1.25mg = \frac{5}{4}mg$

we know $s \propto \text{weight}$

$$\Rightarrow \frac{s_1}{s_2} = \frac{w_1}{w_2} \Rightarrow \frac{10}{s_2} = \frac{4}{5} \Rightarrow s_2 = 12.5 \text{ m}$$

(5)

let initial $k \cdot E_{\text{bullet}} = k \cdot E$

For covering a distance $s_1 = 20 \text{ m}$ $k \cdot E_2 = 25\% k \cdot E$
 $= \frac{1}{4} k \cdot E$

with remaining $\frac{3}{4} k \cdot E$ it can cover a distance s_2

$\therefore s \propto k \cdot E$

$$\Rightarrow \frac{s_1}{s_2} = \frac{k \cdot E_1}{k \cdot E_2} \Rightarrow \frac{2}{s_2} = \frac{\frac{1}{4} k \cdot E}{\frac{3}{4} k \cdot E} = \frac{1}{3} \Rightarrow s_2 = 6 \text{ m}$$

(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 = 6cm

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 $\theta_i = 60^\circ$ $K.E_i = K = \frac{1}{2} m u^2$

At highest point velocity $u = u \cos \theta = u_H$
 $u_H = u \cos 60$
 $= \frac{u}{2}$

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

$$= \frac{1}{2} m \left(\frac{u}{2} \right)^2 = \frac{1}{2} m u^2 \times \frac{1}{4} = \frac{K}{4}$$

(8)

Given $m = 2 \text{ kg}$; $h = 10 \text{ m}$

$$\therefore P.E \text{ of a body} = mgh = 2 \times 10 \times 10 = 200 \text{ J}$$

(9)

Given $P.E = 490 \text{ J}$; $m = 5 \text{ kg}$

We know that $P.E = mgh$

$$\Rightarrow 490 = 5 \times 9.8 \times h$$

$$\Rightarrow 490 = 49 h \Rightarrow h = 10 \text{ m}$$

(10)

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

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

(11)

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

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

$$= \sqrt{50} \text{ m/s}$$

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

$$= \frac{1}{2} \times 1.5 \times (\sqrt{50})^2$$

$$= \frac{1}{2} \times 1.5 \times 50 = 37.5 \text{ J}$$

④

Given height of building $h = 20 \text{ m}$

$m = 10 \text{ kg}$; $N = 10 \text{ m/s}$

$$\begin{aligned}\text{The k.E of each ball} &= \text{P.E} \\ &= mgh \\ &= 10 \times 10 \times 20 \\ &= 2000 \text{ J} \\ &= 2 \text{ kJ}\end{aligned}$$