9^{th} -ws-5 integrated

Task

①

Refractive index of glass $\mu_g = \frac{3}{2}$

Time taken by light to travel in glass $t_g = ?$

Time taken by light to travel in air $t_a = 4$ sec

Refractive index of air $\mu_a = 1$

∴ Given distance travelled by the light in air and glass same

$$x_{air} = x_{glass}$$

$$\Rightarrow v_a t_a = v_g t_g$$

But Velocity $\propto \frac{1}{\mu}$

$$\frac{v_a}{v_g} = \frac{\mu_g}{\mu_a}$$

$$\therefore \Rightarrow \mu_g t_a = \mu_a t_g$$

$$\Rightarrow \frac{3}{\cancel{2}} \times \cancel{4}^{2} = 1 \times t_g$$

$$\Rightarrow t_g = 6 \text{ sec.}$$

②

Given wavelength of light $\lambda = 6000 A^\circ$

Refractive index of air $\mu_a = 1.0003$

let the thickness of air column 't'

we know that no. of wavelengths $n = \frac{t}{\lambda}$

For air $n_{air} = \frac{t_a}{\lambda_a} \Rightarrow t_a = n_{air}\lambda_a$

For vacumn $n_v = \frac{t_v}{\lambda_v} \Rightarrow t_v = n_v \lambda_v$

Given $n_a = 1 + n_v$ $\quad [t_a = t_v]$

$$\Rightarrow \frac{t_a}{\lambda_a} = 1 + \frac{t_v}{\lambda_v}$$

$$\frac{t_a}{\lambda_a} - \frac{t_v}{\lambda_v} = 1$$

We know $\mu \propto \frac{1}{\lambda}$

$\Rightarrow \frac{\mu_v}{\mu_a} = \frac{\lambda_a}{\lambda_v}$

$\Rightarrow \lambda_a = \lambda_v \frac{\mu_v}{\mu_a}$

$= \frac{\lambda_v}{\mu_a}$ $[\mu_v = 1]$

$$\Rightarrow t\left[\frac{1}{\lambda_a} - \frac{1}{\lambda_v}\right] = 1$$

$$\Rightarrow t\left[\frac{\mu_a}{\lambda_v} - \frac{1}{\lambda_v}\right] = 1$$

$$\Rightarrow \frac{t}{\lambda_v}[\mu_a - 1] = 1$$

$$\Rightarrow t = \frac{\lambda_v}{\mu_a - 1} = \frac{6000\times10^{-10}}{1.0003-1} = \frac{6\times10^{-7}}{.0003} = \frac{6\times10^{-7}}{3\times10^{-4}} = 2 \text{ mm}$$

(3)

Let the two medias are A and B.

Given $\frac{\text{Distance travelled by a light in A}}{\text{Distance travelled by a light in B}} = \frac{2}{3}$

$\Rightarrow$ Distance $\propto$ velocity $\propto \frac{1}{\mu}$.

$$\therefore \frac{d_A}{d_B} = \frac{\mu_B}{\mu_A}$$

$$\Rightarrow \frac{\mu_B}{\mu_A} = \frac{2}{3}$$

$$\Rightarrow \frac{\mu_A}{\mu_B} = \frac{3}{2}$$

(4)

Thickness of slab $t_s = 4cm$

Thickness of water $t_w = 5cm$

Refractive index of water $\mu_w = \frac{4}{3}$

$$\text{No. of waves} = \frac{\text{thickness of medium}}{\text{wavelength of light}}$$

Given that No. of waves in slab = No. of waves in water

$$\Rightarrow \frac{t_s}{\lambda_s} = \frac{t_w}{\lambda_w}$$

$$\Rightarrow \frac{\lambda_w}{\lambda_s} = \frac{t_w}{t_s}$$; we know that $\mu \propto \frac{1}{\lambda}$

$$\Rightarrow \frac{\lambda_w}{\lambda_s} = \frac{\mu_s}{\mu_w}$$

$$\Rightarrow \frac{\mu_s}{\mu_w} = \frac{t_w}{t_s}$$

$$\Rightarrow \mu_s = \mu_w \times \frac{t_w}{t_s}$$

$$\Rightarrow \mu_s = \frac{\cancel{4}}{3} \times \frac{5}{\cancel{4}}$$

$$\Rightarrow \mu_s = \frac{5}{3}$$

(5)

wavelength of light in vacumn $\lambda_v = 5700 A^\circ$

Refractive index of ~~k~~glass $\mu_g = \frac{3}{2}$

Refractive index of vacumn $\mu_v = 1$

we know that $\mu \propto \frac{1}{\lambda}$

$$\Rightarrow \frac{\lambda_g}{\lambda_v} = \frac{\mu_v}{\mu_g} \Rightarrow \lambda_g = \lambda_v \times \frac{\mu_v}{\mu_g} = \overset{1900}{\cancel{5700}} \times \frac{2}{\cancel{3}}$$

$$\Rightarrow \lambda_g = 3800 A^\circ$$

(6)

$\angle i = 25^\circ$; $\angle r = 32^\circ$

$$\mu = \frac{\sin i}{\sin r} = \frac{\sin 25^\circ}{\sin 32} = \frac{0.433}{0.551} \simeq 0.79$$

$$\simeq 0.8$$

(7)

$\angle r = 14^\circ$; $\mu = 1.2$

$$\mu = \frac{\sin i}{\sin r} \Rightarrow \sin i = \mu \sin r$$

$$= 1.2 \times \sin 14$$

$$= 1.2 \times 0.24$$

$$\sin i = 0.28$$

$$\Rightarrow i = 16.7^\circ$$

(8)

Given

$\mu = 1.14$

$\angle i = 48°$

$\angle r = 39$

$$\frac{\mu_r}{\mu_d} = \frac{\sin i}{\sin r}$$

$$\Rightarrow \mu_r = \mu_d \frac{\sin 48}{\sin 39}$$

$$= 1.14 \times \frac{0.74}{0.629}$$

$$= 1.346.$$

(9)

$\mu_w = 1.33$ $\angle i = 10°$

$\mu_a = 1$

$$\frac{\mu_w}{\mu_a} = \frac{\sin i}{\sin r} \Rightarrow \sin r = \sin i \times \frac{\mu_a}{\mu_w}$$

$$= \sin(10°) \times \frac{1}{1.33}$$

$$= \frac{0.17368}{1.33}$$

$$\sin r = 0.131$$

$$r = 7.5°$$

(10)

(10) The shift produced in the path of the ray is given by $d = \frac{t}{\cos r} \sin(i-r) \rightarrow (1)$

Given $\angle i = 60^\circ$; Refractive index of glass slab = $\mu_g = \sqrt{3}$

thickness $t = \sqrt{3}$ cm

From Snell's law $\frac{\mu_g}{\mu_a} = \frac{\sin i}{\sin r}$

$\Rightarrow \sqrt{3} = \frac{\sin 60}{\sin r}$

$\Rightarrow \sqrt{3} \sin r = \frac{\sqrt{3}}{2} \Rightarrow \sin r = \frac{1}{2}$

$\Rightarrow r = 30^\circ$

$\therefore$ From (1)

$d = \frac{\sqrt{3}}{\cos 30} \sin(60-30)$

$= \frac{\sqrt{3}}{\frac{\sqrt{3}}{2}} \times \sin 30$

$\Rightarrow 2 \times \frac{1}{2} = 1$ cm

Refractive index $= \frac{}{\mu_{m_2}} = {}_{m_1}\mu_{m_2} = \frac{\sin C_2}{\sin C_1}$

(17)

Given that real depth $h = 1m.$

Apparent depth $=$ Real depth $-$ shift

$= 1 - 0.1 = 0.9\,m$

we know that Refractive index $\mu = \frac{\text{Real depth}}{\text{apparent depth}}$

$\Rightarrow \mu = \frac{1}{0.9} = \frac{10}{9}.$

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x_0

$\Rightarrow \quad c = \sin^{-1}\left[\frac{x}{x_0}\right]$

(19)

we know that when we view from underwater

(12) $\mu = \dfrac{\text{apparent height}}{\text{real height}}$

Apparent height from surface $= 36-12 = 24\,m.$

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

$\therefore \quad \frac{4}{3} = \frac{24}{\text{real height}}$

$\Rightarrow$ Real height $= 24 \times \frac{3}{4} = 18\,m.$

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Given $_a\mu_{gly} = 1.4$; $_a\mu_{dia} = 2.4$.

(17)

Velocity of light in air $c = 3\times10^8$ m/s

$\therefore$ we know that velocity $\propto \frac{1}{\mu}$

$\therefore$ Refractive index of glycerine with respect to air

$$_a\mu_{gly} = \frac{\mu_a}{\mu_{gly}} = \frac{v_{gly}}{c}$$

velocity in glycerine $\Rightarrow$ $v_{gly} = c \times \frac{\mu_a}{\mu_{gly}} = 3\times10^8 \times \frac{1}{1.4}$

$$\Rightarrow v_{gly} = 2.143\times10^8 \text{ m/s}$$

11^{ly} velocity of light in diamond $= c \times \frac{\mu_a}{\mu_{dia}} = \frac{3\times10^8 \times 1}{2.4}$

$$v_{dia} = 1.25\times10^8 \text{ m/s}$$

Refractive index of diamond with respect to glycerine

$$_{gly}\mu_d = \frac{\mu_{gly}}{\mu_{dia}} = \frac{1.4}{2.4} = 0.5833$$

Refractive index of glycerine with respect to diamond

$$_d\mu_{gly} = \frac{\mu_d}{\mu_{gly}} = \frac{2.4}{1.4} = 1.714.$$

(18)

we know that No. of waves $= \dfrac{\text{thickness of the medium}}{\text{wavelength of light}}$

Thickness of glass slab $t_g = 4cm.$

Thickness of water $t_w = 5cm.$

Refractive index of water $\mu_w = \frac{4}{3}$; $\mu_g = ?$

Given

No. of waves in glass slab = No. of waves in water

$$\Rightarrow \frac{t_g}{\lambda_g} = \frac{t_w}{\lambda_w}$$

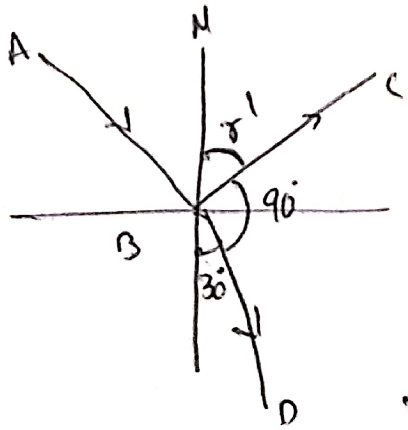
$$\Rightarrow t_g = \frac{\lambda_g}{\lambda_w} t_w \quad [\because \lambda \propto \frac{1}{\mu}]$$

$$\Rightarrow t_g = \frac{\mu_w}{\mu_g} t_w$$

$$\Rightarrow \mu_g = \mu_w \times \frac{t_w}{t_g} = \frac{4}{3} \times \frac{5}{4} = \frac{5}{3}$$

(20)

(19)



Given angle between Refracted ray and Reflected ray is 90°

Angle of refraction = 30° = $\angle r$

r' is Angle of reflection.

From fig $\angle r' + 90° + 30° = 180° \Rightarrow \angle r' = 60°$

we know that Angle of incidence = $\angle r'$ = 60°.

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(20) Given $\mu_1 = \mu_2$ if the refractive indices for the two media's are same, then no refraction (or) bending takes place

$\mu_1 > \mu_2 \rightarrow$ If light travels from 1^{st} medium ~~to~~ [denser] to 2^{nd} medium [rarer] it bends away from normal.

$\mu_1 < \mu_2 \Rightarrow$ If light travels from I^{st} medium [rarer] to 2^{nd} medium [denser]. It bends towards normal.

L Task

jee Mains level

(1) we know that optical path $\Delta x = c \times t$

$\Rightarrow \mu d = c \times t$

where 'd' $\rightarrow$ distance travelled (or) thickness of medium

't' $\rightarrow$ time taken $= 10^{-9}$ sec.

Refractive index $\mu = 1.5$.

$\therefore \Rightarrow 1.5 \times d = 3 \times 10^{8} \times 10^{-9}$

$\Rightarrow d = \frac{3}{1.5} \times 10^{-1} \Rightarrow \frac{30}{15} \times 10^{-1}$ ~~=0~~.

$\Rightarrow d = 0.2$ m

(2)

Time taken by the light in air $t_a = 9 \times 10^{-6}$ sec.

Refractive index of air $\mu_a = 1$.

Refractive index of water $\mu_w = \frac{4}{3}$.

Given that

distance travelled by light in air = distance travelled by light in water

$$\therefore \mu_w t_a = \mu_a t_w$$

$$\Rightarrow \frac{4}{\cancel{3}} \times \overset{3}{\cancel{9}} \times 10^{-6} = 1 \times t_w$$

$$\Rightarrow 12 \times 10^{-6} = t_w \Rightarrow t_w = 12\ \mu\text{sec}.$$

(3)

Refractive index of slab $= \mu_g = \frac{3}{2}$.

Thickness of glass $= d_g = 90$ cm ; time taken in glass $= t_1 = t_g$

Refractive index of water $= \mu_w = \frac{4}{3}$; time taken in water $= t_2 = t_w$

Given

we know that path length $= c \times t = \mu d$

$$\Rightarrow t = \frac{\mu d}{c} \Rightarrow t_g = \mu_g \frac{d}{c}$$

$$\text{and } t_w = \mu_w \frac{d}{c}$$

$$\therefore t_g - t_w = (\mu_g - \mu_w)\frac{d}{c}$$

$$= \left(\frac{3}{2} - \frac{4}{3}\right) \times \frac{\cancel{90}\ 30}{\cancel{3} \times 10^{10}}$$

$$\Rightarrow \frac{9-8}{6} \times 30 \times 10^{-10}$$

$$\Rightarrow \frac{1}{\cancel{6}} \times \overset{5}{\cancel{30}} \times 10^{-10} = 5 \times 10^{-10}\ \text{sec}.$$

(5)

The refractive index of glass $\mu_g = 1.5 = \frac{3}{2}$

$\lambda_a = 6000\,A^{\circ}$

Velocity of light in air $C = 3\times10^8\,m/s$

we know that $\mu \propto \frac{1}{\lambda}$

$$\Rightarrow \frac{\lambda_g}{\lambda_a} = \frac{\mu_a}{\mu_g}$$

$$\Rightarrow \lambda_g = \lambda_a \times \frac{\mu_a}{\mu_g} \Rightarrow 6000 \times \frac{1}{\frac{3}{2}}$$

$$= \cancel{6000}^{2} \times \frac{2}{\cancel{3}}$$

$$= 4000\,A^{\circ}$$

(6)

Distance travelled by the light in a medium is called path length $\Delta x = \mu d = ct$

$\therefore$ time taken by the light $t = \frac{\mu d}{c}$

Here $d = x$ $\quad\therefore t = \frac{\mu x}{c}$

(7)

Refractive index of glass $\mu_g = \frac{3}{2}$

Refractive index of water $\mu_w = \frac{4}{3}$

$\therefore$ Refractive index of glass with respect to water

$$\cancel{{}_w\mu_g = \frac{\mu_w}{\mu_g} = \frac{\frac{4}{3}}{\frac{3}{2}} = \frac{8}{9}} \quad {}_w\mu_g = \frac{\mu_g}{\mu_w} = \frac{\frac{3}{2}}{\frac{4}{3}}$$

$$= \frac{9}{8}$$

(8)

Speed of light in glass $V_g = 2\times10^8$ m/s

Speed of light in liquid $V_L = 2.5\times10^8$ m/s

Refractive index of glass $\mu_g = 1.5 = \frac{3}{2}$.

We know that $\mu \propto \frac{1}{V}$

$$\Rightarrow \frac{\mu_L}{\mu_g} = \frac{V_g}{V_L}$$

$$\Rightarrow \mu_L = \mu_g \times \frac{V_g}{V_L}$$

$$= \frac{3}{\cancel{2}} \times \frac{\cancel{2}\times\cancel{10^8}}{2.5\times\cancel{10^8}}$$

$$\mu_L = \frac{3}{2.5} = \frac{30}{25} = \frac{6}{5} = 1.2$$

(9)

Given wavelength of light in air $\lambda_a = 7200 A^\circ$

Refractive index of air $\mu_a = 1$

Refractive index of glass $\mu_g = 1.5 = \frac{3}{2}$.

we know that $\lambda \propto \frac{1}{\mu}$

$$\Rightarrow \frac{\lambda_g}{\lambda_a} = \frac{\mu_a}{\mu_g}$$

$$\Rightarrow \lambda_g = \lambda_a \times \frac{\mu_a}{\mu_g}$$

$$= 7200 \times \frac{1}{\frac{3}{2}} = \overset{24}{\cancel{7200}} \times \frac{2}{\cancel{3}}$$

$$= 2400 \times 2$$

$$\lambda_g = 4800 A^\circ$$

(10)

Given thickness of window $= 4mm$

$= 4\times10^{-3}m.$

Refractive index of glass $\mu_g = 1\cdot5 = \frac{3}{2}$

$\therefore$ Distance travelled by the light $= \mu d = ct$

$\Rightarrow t = \frac{\mu d}{c}$

$\Rightarrow t = \frac{1\cdot5\times4\times10^{-3}}{3\times10^{8}} = \frac{6\times10^{-11}}{3} = 2\times10^{-11}$ sec

(11)

Thickness of glass slab $d_g = 4cm$

Thickness of water $d_w = 5cm$

Refractive index of water $\mu_w = \frac{4}{3}$

Given that no. of waves in a glass slab = no. of waves in water

$\Rightarrow \mu_g d_g = \mu_w d_w$

$\Rightarrow \mu_g\times\cancel{4} = \frac{\cancel{4}}{3}\times5$

$\Rightarrow \mu_g = \frac{5}{3}.$

(12)

Thickness of glass slab $d_g = 8$ cm

Thickness of water $d_w = 10$ cm

Refractive index of water $\mu_w = \frac{4}{3}$

Given no. of waves in glass = no. of waves in water

$$\Rightarrow \mu_g d_g = \mu_w d_w$$

$$\Rightarrow \mu_g \times \cancel{8}^{2} = \frac{\cancel{4}}{3} \times \cancel{10}^{5}$$

$$\Rightarrow \mu_g = \frac{5}{3}$$

(13)

Thickness of glass slab $t = 4$ cm.

Refractive index of glass $\mu_g = \sqrt{3}$.

Angle of incident $\angle i = 60^\circ$

From snell's law $\mu_g = \frac{\sin i}{\sin r}$

$$\Rightarrow \sqrt{3} = \frac{\sin 60^\circ}{\sin r}$$

$$\Rightarrow \sin r \sqrt{3} = \frac{\sqrt{3}}{2} \rightarrow \sin r = \frac{1}{2}$$

$$\Rightarrow r = 30^\circ$$

lateral displacement $= \frac{t}{\cos r} \sin(i-r)$

$$\Rightarrow \frac{4}{\cos 30} \sin 30 = \frac{4}{\frac{\sqrt{3}}{\cancel{2}}} \times \frac{1}{\cancel{2}}$$

$$\Rightarrow \frac{4}{\sqrt{3}} \text{ cm.}$$

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(17)

Velocity of light in water > velocity of light in glass

Because Refractive index of water $\mu_w = \frac{4}{3} = 1.33$

Refractive index of glass $\mu_g = \frac{3}{2} = 1.5$

Clearly $\mu_w < \mu_g$ and we know that $V \propto \frac{1}{\mu}$

Due to this speed changes

(18)

Given Refractive index of glass with respect to water

$${}_w\mu_g = \frac{9}{8} \rightarrow (1)$$

wavelength of light in glass is $\lambda_g = 4000\,A^\circ$

From (1) $\frac{\mu_g}{\mu_w} = \frac{9}{8}$ we know that $\mu \propto \frac{1}{\lambda}$

$$\frac{\mu_g}{\mu_w} = \frac{\lambda_w}{\lambda_g}$$

$$\Rightarrow \frac{\lambda_w}{\lambda_g} = \frac{9}{8}$$

$$\Rightarrow \lambda_w = \frac{9}{8} \times \lambda_g = \frac{9}{\cancel{8}} \times \overset{5}{\cancel{4}}000$$

$$\Rightarrow \lambda_w = 4500\,A^\circ$$

(19)

Given optital path length of light in glass and liquid are same. i.e

$\Delta x = \mu d = \text{constant}$

$\Rightarrow \mu_g d_g = \mu_L d_L$

$\Rightarrow (1.5) \times 4 = \mu_L \times \cancel{4.5}\, 3$

$\Rightarrow \mu_L = \frac{4}{3}.$

(20).

Given Refractive index of denser medium with respect to rarer medium $_r\mu_d = \frac{\mu_d}{\mu_r} = 1.125 \rightarrow (1)$

$V_r - V_d = 0.25 \times 10^8 \, m/s \rightarrow (2)$

we know that $\mu \propto \frac{1}{V} \Rightarrow \frac{\mu_d}{\mu_r} = \frac{V_r}{V_d}$

$\Rightarrow 1.125 = \frac{V_r}{V_d} \Rightarrow V_r = 1.125 V_d$

sub 'V_r' value in (2) we get

$\Rightarrow 1.125 V_d - V_d = 0.25 \times 10^8$

$\Rightarrow 0.125 V_d = 0.25 \times 10^8$

$\Rightarrow V_d = \frac{0.25}{0.125} \times 10^8 = 2 \times 10^8 \, m/s$

$\therefore$ Velocity in rarer medium $V_r = 1.125 \times V_d$

$= 1.125 \times 2 \times 10^8$

$V_r = 2.25 \times 10^8 \, m/s$

$2.25 \cancel{\times} 10^8$

ar) $\cancel{v}$

20(iii) $$\frac{\mu_r}{\mu_a} = \frac{V_{air}}{V_r} = \frac{3 \times 10^8}{2.25 \times 10^8} = \frac{3}{2.25} = 1.333$$

9th integrated ①

WS-6

Thask.

①

No. of steps = 40 : width $w = 35$ cm

$m = 20$ kg. height $h = 25$ cm

Total height he ascends $= n \times h = 40 \times 25$
$= 1000$ cm $= 10$m

$\therefore$ work done $= mgh = 20 \times 10 \times 10$
$= 2 \times 10^3$ J

②

$M_{Rain} = \frac{1}{10}$ gm $= 10^{-4}$ kg : $h = 100$m.

$g = 9.8$ m/s^2

work done by gravity $= mgh$
$= 10^{-4} \times 9.8 \times 100$
$= 0.098$ J

③

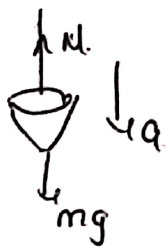
$a = \frac{g}{4}$; displacement $= d$.

work done $= F \times S \times \cos\theta$ [$\theta = 0°$ F & S are in same direction]

$= m(a-g) \times d \times \cos 0$

$= m(\frac{g}{4} - g) d \times 1$

$\Rightarrow -\frac{3mgd}{4}$



(4)

$u = 0$; $F = 2N$: $m = 5$ kg

$t = 10 sec$

$a = \frac{F}{m} = \frac{2}{5} m/s^2$

From $S = ut + \frac{1}{2}at^2$

$\Rightarrow S = 0 \times 10 + \frac{1}{\cancel{2}} \times \frac{\cancel{2}}{5} \times (10)^2$

$= \frac{1}{5} \times 100 = 20m$

work done $= F \times S = 2 \times 20 = 40J$

(5)

$\frac{m_1}{m_2} = \frac{1}{2}$: $\frac{S_1}{S_2} = \frac{2}{1}$: $\frac{F_1}{F_2} = \frac{1}{2}$ $\frac{\theta_1}{\theta_2} = \frac{30°}{60°}$

work done $= F S \cos\theta$

$\Rightarrow W \propto F S \cos\theta$

$\Rightarrow \frac{W_1}{W_1} = \frac{F_1}{F_2} \frac{S_1}{S_2} \frac{\cos\theta_1}{\cos\theta_2}$

$= \frac{1}{\cancel{2}} \times \frac{\cancel{2}}{1} \frac{\cos 30}{\cos 60°}$

$= \frac{\frac{\sqrt{3}}{2}}{\frac{1}{2}} = \frac{\sqrt{3}}{1}$

(6)

length of hanging part $= \frac{1}{5} L$. $= [\frac{1}{nth} L$ ie $n = 5]$

If $\frac{1}{n}$th Part of chain is hanging from the edge of a table work done to bring hanging part $= \frac{mgL}{2n^2}$

$W = \frac{mgL}{2(5)^2} = \frac{mgL}{2 \times 25} = \frac{mgL}{50}$

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(7)

$m = 10\,kg$

From $x = 0 \rightarrow 8\,cm$

displacemen $= 8\,cm = 8\times10^{-2}\,m$

work done $= F \times$ displacement

$\Rightarrow m\,a \times s$

$= m \times$ Area of given graph

$= 10 \times [8\times10^{-2} \times 20\times10^{-2}]$

$\Rightarrow 16\times10^{-2}\,J$

(8)

length of hanging Part $= \frac{1}{3^{rd}} L$ $[n = 3]$

If $\frac{1}{n^{th}}$ Part of chain is hanging from edge of a table, then the work done to Pull hanging Part

$$W = \frac{mgL}{2n^2} = \frac{mgL}{2\times3^2}$$

$$W = \frac{mgL}{2\times9} = \frac{mgL}{18}.$$

(9)

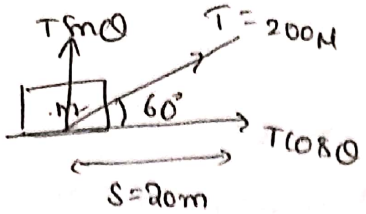
$m = 70\,kg$; $n = 36$; $h = 20\,cm = 20\times10^{-2}\,m$

work done $= nmgh \Rightarrow 36 \times 70 \times 20\times10^{-2} \times 9.8$

$\Rightarrow 36 \times 14 \times 9.8.$

$= 4939\,J$

(10)



$T\sin\theta$ & displacement are Perpendicular to each other

$\therefore$ work done by $T\sin\theta$ component is zero.

$\therefore$ work done by $T\cos\theta$ $= T\cos\theta \times S$

$= 200 \times \cos 60 \times 20$

$= 200 \times \frac{1}{2} \times \cancel{20}\ 10$

$= 2000\,J$

(11)

(a)

frictional force always acts in a direction opposite to the motion of a body (displacement)

ie, $\theta = 180° \Rightarrow \cos 180° = -1$

$W = f_r\, S \cos\theta = -ve$

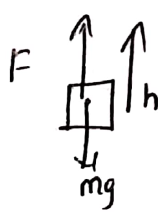
(b)

For vertically Projected body displacement of the body and force due to gravity are opposite. here also $\theta = 180°$

(12)

(a)

work done by applied force $= F S$



$F = -F_g = -mg$ [For Every action an equal and opposite reaction]

$S = h$

$W = mgh$ [F & S are in same direction $\theta = 0°$]

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(b)

work done by gravity $= -mgh$

[G.F and displacement are in opposite direction]

(c)

$$\omega_{Total} = \omega_{applied} + \omega_{gravity}$$

$$= mgh + (-mgh)$$

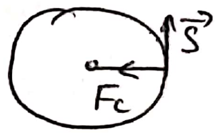
$$= mgh - mgh = 0$$

(15)

(a)

Work done by centripetal force $= 0$ because centripetal force and displacement are almost Perpendicular

$\theta = 90°$



$\cos 90° = 0$ $\Rightarrow \omega = F_c \, s \cos\theta$

$= F_c \, s \cos 90 = 0$

(b)

Here also Tension in the string of Pendulum and displacement of Pendulum are perpendicular. [$\theta = 90°$]

(c)

The weight of Person + load [Gravitational force] and displacement of him are Perpendicular [$\theta = 90°$]

(14)

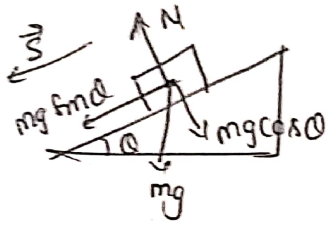
(a) Since frictional force always opposes motion of a body [displacement] i.e. $\theta = 180^\circ$

$\therefore$ $W_{friction}$ = friction × displacement $\cos\theta$

$= f s \cos 180^\circ$

$= -fs$.

(c)



work done = $F_g\, s \cos\theta$

$= mg\sin\theta\, s \cos 0^\circ$

$= (mg\sin\theta)\, s$

Here $mg\sin\theta$ & $\vec{s}$ are in same direction so $\theta = 0^\circ$

$mg\cos\theta \perp^{er} \vec{s}$ so $\theta = 90^\circ$

$W = F_g\, s\cos\theta$

$= (mg\cos\theta)\, s \cos 90^\circ$

$= 0$

(16)

A :- Because for one round displacement is zero

R :- Even the body is rotating centripetal force is acting

(17)

A :- If a man pushes wall due to reaction from ~~a~~ wall, the man moves back so the angle between displacement of man and force applied by man are opposite [$\theta = 180^\circ$]

$W = FS\cos 180^\circ = -FS = -ve$.

(18)

We know $W = FS\cos\theta$

$W \propto \cos\theta$

(a) $\theta = 0^\circ$ $W \propto \cos 0 \Rightarrow W \propto 1$ +ve

(b) $\theta = 180^\circ$ $W \propto \cos 180^\circ \Rightarrow W \propto -1(-ve)$

(c) $\theta = 90^\circ$ $W \propto \cos 90^\circ \Rightarrow W = 0$.

(d) other than $\theta = 0^\circ$ $W \propto \cos\theta$ finite work

(19)

$m = 300$ kg. $u = 0$; $v = 90$ kmph $S = 1.5$ km

$t = 5$ sec $= \cancel{90}^{5} \times \frac{5}{\cancel{18}}$ $= 15 \times 10^2$ m

$= 25$ m/s

From $v = u + at$

$\Rightarrow 25 = 0 + a \times 5 \Rightarrow \cancel{5}a = \cancel{25}^{5} \Rightarrow a = 5\ m/s^2$

Force $F = ma = 300 \times 5 = 1500$ N

work done $= F \cdot S \Rightarrow 1500 \times 15 \times 10^2$

$\Rightarrow 225 \times 10^4$ J

L Task

Jee mains level

①

$S = 5m$, $F = 50N$

work don = $F \times S = 50 \times 5 = 250\ J$

②

$S = 30m$; $F = 3N$

work done = $F \times S = 3 \times 30 = 90\ J$

③

since the man is waiting by holding a box.

∴ displacement $= 0$

$W = FS\cos\theta = F(0)\cos\theta = 0$

④

$m = 50\ kg$; $h = 20\ m$; $n = 4$ bags

∴ work done in lifting the bags $= n \times mgh$

$= 4 \times 50 \times 9.8 \times 20$

$\Rightarrow 4000 \times 9.8$

$\Rightarrow 39.2\ kJ$

⑤

$m = 60\ kg$: $\vec{S} = 30m$:

$\vec{F} = 3N$ $\theta = 60°$

work done by the applied force $W = FS\cos\theta$

$= 3 \times 30 \times \cos 60$

$\Rightarrow 3 \times 30 \times \frac{1}{2} = 45J$

6

Force $\vec{F} = 5\hat{i} - 3\hat{j} + 2\hat{k}$ N

$r_1 = 2\hat{i} + 7\hat{j} + 4\hat{k}$; $r_2 = 5\hat{i} + 2\hat{j} + 8\hat{k}$

displacement $\vec{s} = \vec{r_2} - \vec{r_1} = 5\hat{i} + 2\hat{j} + 8\hat{k} - 2\hat{i} - 7\hat{j} - 4\hat{k}$

$= 3\hat{i} - 5\hat{j} + 4\hat{k}$

$\therefore$ work done $= \vec{F} \cdot \vec{s}$

$= (5\hat{i} - 3\hat{j} + 2\hat{k}) \cdot (3\hat{i} - 5\hat{j} + 4\hat{k})$

$\Rightarrow (5)(3) + (-3)(-5) + (2)(4)$

$\Rightarrow 15 + 15 + 8 = 38$ J

7

$F = 2\hat{i} + 4\hat{j} + 3\hat{k}$ N. displacement $= 6$m along z-axis

$= 6\hat{k}$.

$\therefore$ work done $= \vec{F} \cdot \vec{s}$

$= (2\hat{i} + 4\hat{j} + 3\hat{k}) \cdot 6\hat{k}$

$\Rightarrow 3 \times 6 = 18$ J.

8

$m = 20$ kg : $u = 0$: $F = 5$N : $t = 1$ sec.

$a = \frac{F}{m} = \frac{\cancel{20}\,5}{20} = \frac{1}{4}$ m/s^2

$S = u \times t + \frac{1}{2}at^2 \Rightarrow 0 \times 1 + \frac{1}{2} \times \frac{1}{4} \times 1^2 = \frac{1}{8}$ m

$\therefore W = F \cdot S = ma\,s$

$= \cancel{20}\,5 \times \frac{1}{\cancel{4}} \times \frac{1}{8}$

$= \cancel{160J}$ $5 \times \frac{1}{8}$

$= \frac{5}{8}$ J

(9)

displacement $S = 10m$; $F = 5N$

work done = 25 J

we know that $W = FS\cos\theta$

$\Rightarrow \cancel{25}^{5} = \cancel{5}\times 10 \cos\theta$

$\Rightarrow 5 = 10\cos\theta$

$\Rightarrow \cos\theta = \frac{5}{10} = \frac{1}{2}$

$\Rightarrow \theta = 60^\circ$

(10)

$\vec{F} = 6\hat{i} - 8\hat{j}$ N

Along x-axis $\vec{S}_x = 4\hat{i}$

along y-axis $\vec{S}_y = 6\hat{j}$.

$\therefore \vec{S} = S_x + S_y$

$\vec{S} = 4\hat{i} + 6\hat{j}$

work done $= (6\hat{i} - 8\hat{j})\cdot(4\hat{i} + 6\hat{j})$

$\Rightarrow (6\cdot 4) + (-8)\cdot 6$

$\Rightarrow 24 - 48 = -24J$

Advanced

(1) work done by the man on suitcase depends on weight of the suit case because work done by conservative force does not rely upon the path taken.

Also while lifting only conservative forces comes into play. so it depends on the initial and final position and the force required that in turn will be equal to weight of suit case.

Scanned with OKEN Scanner

(2)

(6)

a, d are correct

As the gravitational force acts downward and the displacement of the bucket is upward, force acts opposite to the displacement of the body, the work done being a dot product of force and displacement vectors becomes negative as cosine $\cos 180° = -1$

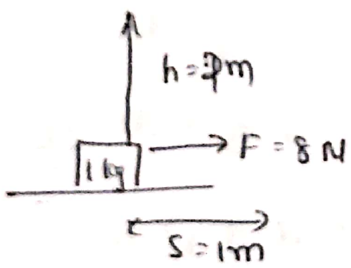
$$W = FS\cos\theta = FS\cos 180 = -FS$$

(6)

Here both x and y are identical and are raised through same height

$W = mgh$ ∴ W is same for x & y

(8)(9),(10)



work done: $FS\cos\theta \Rightarrow 8 \times 1 \times \cos 0 = 8J$ {horizontal}

work done: $FS\cos\theta = mgh = 1 \times 2 \times 10 = 20J$ (vertical)

Total work done $= W_{Horizontally} + W_{vertical}$

$= 8J + 20J$

$= 28J$

WS-7 Integrated 9th class ①

Thask

①

$d = 0.8 \text{ kg/cc}$

$= 0.8 \times 10^6 \text{ kg/m}^3$

$V = 2 \text{ m/s}$

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

$\Rightarrow K.E = \frac{1}{2} \times d \times vol \times v^2$

$\Rightarrow \frac{K.E}{vol} = \frac{1}{2} \times d \times v^2$

$= \frac{1}{\cancel{2}} \times 0.8 \times 10^6 \times (2)^{\cancel{2}}$

$\Rightarrow 1.6 \times 10^6 \text{ J/m}^3$

$\Rightarrow 1.6 \text{ J/cc}$

②

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

$= \frac{1}{2} \times \text{density} \times \text{volume} \times v^2$

$= \frac{1}{2} \times d \times \frac{4\pi}{3} r^3 \times v^2$

$\therefore K.E \propto d r^3 v^2$

$K_1 \propto d r^3 v^2$

$K_2 \propto d\left(\frac{r}{2}\right)^3 \left(\frac{v}{2}\right)^2 \Rightarrow K_2 \propto d \frac{r^3}{8} \frac{v^2}{4} \Rightarrow K_2 \propto \frac{d r^3 v^2}{32}$

$K_3 \propto \frac{d}{2} (2r)^3 (v)^2 \Rightarrow K_3 \propto \frac{d}{2} \times 8 r^3 \times v^2 \Rightarrow K_3 \propto 4 d r^3 v^2$

K_3, K_1, K_2 [Descending order]

(3)

work done = change in k.E

$\Rightarrow F \cdot S = \frac{1}{2} m(v^2 - u^2)$ [$v = 0$ because the body is coming to rest]

$\Rightarrow F \cdot S = -\frac{1}{2} m u^2$

$\Rightarrow S = -\frac{1}{2} m \frac{u^2}{F} \Rightarrow S \propto \frac{u^2}{F}$

$S_1 \propto \frac{v^2}{F}$; $S_2 \propto \frac{(2v)^2}{\frac{F}{2}}$

$\Rightarrow S_2 \propto 4 \frac{v^2}{\frac{F}{2}} \Rightarrow S_2 \propto 8 \frac{v^2}{F}$

$S_3 \propto \frac{[\frac{v}{2}]^2}{2F} \Rightarrow S_3 \propto \frac{v^2}{4 \times 2F} \Rightarrow S_3 \propto \frac{v^2}{8F}$

Ascending order $\rightarrow S_3, S_1, S_2$.

(4)

$m' = \frac{1}{8} m$

$v' = 2v$

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

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

$\Rightarrow \frac{k.E}{k.E'} = \frac{\frac{1}{2} m v^2}{\frac{1}{2} m' v'^2} = \frac{m v^2}{m' v'^2} = \frac{m v^2}{\frac{m}{8} \times (2v)^2}$

$\Rightarrow \frac{k.E}{k.E'} = \frac{\cancel{m v^2}}{\frac{4}{8} \times \cancel{m v^2}} = \frac{8}{4} = \frac{2}{2}$

$\Rightarrow k.E' = \frac{2}{2} k.E \times 100 = 200\%\ k.E = [100+100]\%\ k_E$

100% increased

(5)

$m_1 = 2\,gm$; $m_2 = 8\,gm$

Given $K \cdot E_1 = K \cdot E_2$.

we know that $K \cdot E = \frac{p^2}{2m}$

$\Rightarrow 2m\, K \cdot E = p^2$

$\Rightarrow p^2 \propto m$

$\Rightarrow \left(\frac{P_1}{P_2}\right)^2 = \frac{m_1}{m_2}$

$\Rightarrow \frac{P_1}{P_2} = \sqrt{\frac{m_1}{m_2}} =$

$\Rightarrow \frac{P_1}{P_2} = \sqrt{\frac{2}{8}} = \frac{1}{2}.$

(6)

$m = 2\,kg$; $u = 0$

$a = 2\,m/s^2$

$t = 2\,sec.$

From $v = u + at$

$v = 0 + 2 \times 2 = 4\,m/s$

Gain in $K \cdot E = \frac{1}{2} m (v^2 - u^2)$

$= \frac{1}{\cancel{2}} \times \cancel{2} (4^2 - 0^2)$

$= 16 - 0$

$= 16\,J.$

(7)

$m = 0.5\,kg$; $u = 2\,m/s$

$v = 0$; $s = 2\,m$

we know According to W-E theorem

$W = \Delta K \cdot E$

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

$= \frac{1}{2} \times 0.5 \times (0^2 - 2^2)$

$= \frac{1}{2} \times \frac{1}{2} \times (0 - 4)$

$= \frac{-4}{4} = -1\,J$

Force is resistive force

(8)

$m_1 = 3\,kg$; $m_2 = 2\,kg$

$K \cdot E_{Initial} = 600\,J.$

According to Law of conservation of linear momentum

$m_1 v_1 = m_2 v_2$

$\Rightarrow 3 v_1 = -2 v_2$

$\Rightarrow v_2 = -\frac{3}{2} v_1$

we know $K \cdot E \propto m v^2$

$\Rightarrow \frac{K \cdot E_1}{K \cdot E_2} = \frac{m_1 v_1^2}{m_2 v_2^2} = \frac{3}{2} \frac{v_1^2}{(-\frac{3}{2} v_1)^2}$

$\frac{K \cdot E_1}{K \cdot E_2} = \frac{3}{2} \times \frac{4}{9} \times \frac{\cancel{v_1^2}}{\cancel{v_1^2}} = \frac{2}{3}$

8^{th} continuation

$$\underline{k.E_2} = \frac{3}{2} k.E_1$$

Given Total $k.E = 600\,J$

$$\Rightarrow k.E_1 + k.E_2 = 600\,J$$

$$\Rightarrow k.E_1 + \frac{3}{2} k.E_1 = 600$$

$$\Rightarrow \frac{5}{2} k.E_1 = 600$$

$$\Rightarrow k.E_1 = 2 \times \frac{\overset{12}{\cancel{600}}}{\cancel{5}} = 2 \times 120 = 240\,J$$

(9)

$m = 200\ gm$ $\quad l = 1\,m,\ \theta = 60^\circ$

$= 200 \times 10^{-3}\ kg$

As the pendulum passing through mean position

$k.E = \frac{1}{2} m v^2 \qquad v = \sqrt{2gl(1-\cos\theta)}$

$$\Rightarrow k.E = \frac{1}{\cancel{2}} \times \cancel{2} \times 10^{-1} \times \left(\sqrt{2gl(1-\cos\theta)}\right)^{\cancel{2}}$$

$$= 10^{-1} \times [2 \times 9.8 \times 1 (1 - \cos 60)]$$

$$= 10^{-1} \times 19.6 \times (1 - \tfrac{1}{2}] = 19.6 \times 10^{-1} \times \frac{1}{2} = 0.98\,J$$

$$\simeq 1\,J$$

(10)

$m_{Bullet} = m \ ; \ u_{Bullet} = u$

According to law of conservation of linear momentum

$$P_{gun} = -P_{Bullet}$$

$$\Rightarrow M_g V_g = -m_{Bullet} u_{Bullet}$$

$$\Rightarrow M V_g = -mu$$

$$\Rightarrow V_g = -\frac{m}{M} u.$$

$$\frac{k.E_{Bullet}}{k.E_{gun}} = \frac{\frac{1}{2} m_B u_B^2}{\frac{1}{2} M_g V_g^2} = \frac{m u^2}{M (\frac{m}{M} u)^2}$$

$$\Rightarrow \frac{m}{\cancel{M}} \frac{M^{\cancel{2}}}{m^{\cancel{2}}} \times \frac{\cancel{u^2}}{\cancel{u^2}} = \frac{M}{m}$$

L Task

Jee main level

(1)

Given $m = 40\ kg$

$F_1 = 4N$; $F_2 = 3N$; $\theta = 90°$

Resultant force $F = \sqrt{F_1^2 + F_2^2 + 2F_1F_2\cos\theta}$

$\Rightarrow F = \sqrt{4^2 + 3^2 + 2\times4\times3\times\cos 90°}$

$= \sqrt{16+9} = \sqrt{25} = 5N$

$\therefore$ Acceleration of the body $a = \frac{F}{m} = \frac{\cancel{40}}{5} = \cancel{8\ m/s^2}\ \frac{5}{10} = \frac{1}{2}$

After $t = 10$ sec velocity $v = u + at$

$\Rightarrow v = 0 + \frac{\cancel{8}\times \overset{5}{\cancel{10}}}{\cancel{2}} = \cancel{80\ m/s}\ 5\ m/s$

$\therefore$ $\cancel{k.E = \frac{1}{2}mv^2 = \frac{1}{\cancel{2}}\times \overset{20}{\cancel{40}}\times(80)^2}$

$\cancel{= 20\times 6400 = 128000}$

$= \cancel{128}\ kJ.$

$k.E = \frac{1}{2}mv^2 = \frac{1}{2}\times10\times(5)^2 = 125J.$

(2)

Given Percentage increase in momentum

$\frac{\Delta P}{P} = 0.01\%$ $\because k.E \propto P^2$

we know $\frac{\Delta k.E}{k.E} = 2\frac{\Delta P}{P}$

$= 2\times0.01$

$\Rightarrow 0.02\%$

(3)

let p^1 be the New momentum of a body

then $p^1 = P_0 + \frac{100}{100} P_0 = \frac{200}{100} P_1^1 = 2P_0$

$k \cdot E$ be initial kinetic Energy.

$k \cdot E \propto p^2 \Rightarrow \frac{k \cdot E}{k \cdot E^1} = \left[\frac{P}{P^1} \right]^2$

$\Rightarrow \frac{k \cdot E}{k \cdot E^1} = \left[\frac{P^1}{2P} \right]^2 = \frac{1}{2^2}$

$\Rightarrow \frac{k \cdot E}{k \cdot E^1} = \frac{1}{4} \Rightarrow k \cdot E^1 = 4 \, k E$

$= 400\% \, k \cdot E$

$= [100 + 300]\% \, k \cdot E$

$\therefore$ k.E increased by 300%

(4)

$m = 40 \, kg$, $k \cdot E = 21 \, kJ$ $\quad \eta = 28\%$

$= 21 \times 10^3 \, J$

we know efficiency $\eta = \frac{E_{out}}{E_{in}}$

$\Rightarrow \frac{28}{100} = \frac{mgh}{21 \times 10^3}$

$\Rightarrow mgh = 21 \times 10^{3} \times \frac{28}{\cancel{100}}$

$\Rightarrow 40 \times \cancel{10} \times h = 21 \times \cancel{10} \times 28$

$\Rightarrow h = \frac{21 \times 28}{40} = 14.7 \, m$

$\simeq 15 m$

(5)

$\vec{F} = 3\hat{i} + 4\hat{j}$ N.

$\vec{s} = 3\hat{i} + 4\hat{j}$ m

work done $= \vec{F} \cdot \vec{s} = (3\hat{i} + 4\hat{j}) \cdot (3\hat{i} + 4\hat{j})$

$= 3 \cdot 3 + 4 \cdot 4$

$= 9 + 16$

$= 25$ J

(6)

$h = 19.6$ m, $\quad u = ?$

here water falls like a freely falling body

$\therefore$ velocity with which water reaching ground

$v = \sqrt{2gh} = \sqrt{2 \times 9.8 \times 19.6}$

$= \sqrt{19.6 \times 19.6}$

$v = 19.6$ m/s

(7)

Given $h = 12.4$ m $\quad$: From $v^2 - u^2 = 2gh \Rightarrow v^2 = u^2 + 2gh$

$\Rightarrow v^2 = u^2 + 2 \times 9.8 \times 12.4 = u^2 + 243.04$

K.E of the ball when it just hits the wall $= \frac{1}{2}mv^2$

K.E of the ball After impact $= 85\% \cancel{\text{E}}\ \frac{1}{2}mv^2$ [it looser 15%]

$= \frac{85}{100} \times \frac{1}{2} \times m[u^2 + 234.04]$

let v_2 be the velocity just after collision with ground

so $\frac{1}{\cancel{2}}\cancel{m}v_2^2 = \frac{85}{100} \times \frac{1}{\cancel{2}}\cancel{m}(u^2 + 234.04]$

7^{th} — continuation

$$V_2^2 = \frac{85}{100}\left(u^2 + 234.04\right)$$

Now for upward motion $V = 0;\ u = V_2$.

From $V^2 - u^2 = 2as$ $\quad (a = -g)$

$\Rightarrow 0^2 - V_2^2 = -2gh$

$\Rightarrow \cancel{-} V_2^2 = \cancel{-} 2gh$ $\quad [h = 12.4\,m]$

$\Rightarrow \frac{85}{100}\left[u^2 + 234.04\right] = 2 \times 9.8 \times 12.4$

$\Rightarrow u^2 + 234.04 = \frac{100}{85} \times 19.6 \times 12.4$

$\Rightarrow u^2 + 234.04 = 285.93$

$\Rightarrow u^2 = 275.93 - 234.04$

$\Rightarrow u^2 = 41.99 \Rightarrow u = \sqrt{41.99} \simeq 6.55\,m/s$

8

Given $P.E = K.E$

or $K.E = P.E$

$\Rightarrow \frac{1}{2}\cancel{m}v^2 = \cancel{m}gh$

$\Rightarrow \frac{v^2}{2} = 10 \times 10$

$\Rightarrow v^2 = 200$

$\Rightarrow v = \sqrt{200} = 10\sqrt{2}\,m/s$

$\simeq 14.14\,m/s$

(9)

According to law of conservation of Energy

$\Rightarrow$ K.E + P.E = constant.

At maximum height Total Energy = P.E = mgh

At a height $\frac{3h}{4}$, P.E = $mg\left[\frac{3h}{4}\right] = \frac{3}{4}mgh$

$\therefore$ K.E = T.E − P.E

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

K.E $= \frac{1}{4}mgh$

$\therefore$ At a height $\frac{3h}{4}$ $\frac{K.E}{P.E} = \frac{\frac{1}{4}\cancel{mgh}}{\frac{3}{\cancel{4}}\cancel{mgh}} = \frac{1}{3}$

(10)

Given at h = 400 $\frac{P.E}{K.E} = \frac{5}{2}$

$\Rightarrow \frac{mgh}{\frac{1}{2}\cancel{m}v^2} = \frac{5}{2}$

$\Rightarrow \frac{2gh}{v^2} = \frac{5}{2}$

$\Rightarrow v^2 = \frac{2}{5} \times 2gh$

$= \frac{4}{5} \times 9 \times 400$

$= \frac{4}{\cancel{5}} \times 10 \times 400$

$\Rightarrow v^2 = 3200 \Rightarrow v = 40\sqrt{2}$ m/s

$\simeq 56$ m/s

Advanced

8

d

$P.E + K.E = $ constant at any point.

a

$P.E = K.E$

At a height $\frac{h}{2}$ $\quad P.E = mg\frac{h}{2}$

we know $T.E = P.E = mgh$ at maximum height

$\therefore$

At $\frac{h}{2}$ $\quad K.E = T.E - P.E$

$= mgh - mg\frac{h}{2}$

$K.E = mg\frac{h}{2}$

c $\quad K.E = 2PE$

at $\frac{h}{3}$ $\quad P.E = mg\frac{h}{3}$

$K.E = T.E - P.E = mgh - mg\frac{h}{3}$

$= \frac{3mgh - mgh}{3}$

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

$\Rightarrow K.E = 2P.E \rightarrow$

b

$PE = 2K.E$

at $\frac{2h}{3}$ $\quad P.E = mg\left(\frac{2h}{3}\right) = \frac{2}{3}mgh \rightarrow (1)$

$K.E = T.E - P.E = mgh - \frac{2}{3}mgh$

$= \frac{1}{3}mgh \rightarrow (2)$

From (1) & (2) $\quad PE = 2K.E$

(9)

$m = 5\ kg$; $P_I = 10\ kgm/s$. $F = 0.2\ N$

$mu = 10$

$u = \frac{10}{5} = 2\ m/s$.

$\therefore$ acceleration $a = \frac{F}{m} = \frac{0.2}{5}\ m/s^2$

After '10' sec velocity $v = u + at$

$\Rightarrow v = 2 + \frac{0.2}{5} \times 10$

$= 2 + 0.4 = 2.4\ m/s$

$\therefore$ change in momentum $= m(v-u)$

$= 5(2.4 - 2]$

$= 5[0.4] = 2\ kgm/s$

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

$= \frac{1}{2} \times 5\ ((2.4)^2 - 2^2)$

$= \frac{5}{2}[2.4+2][2.4-2]$

$= \frac{5}{\cancel{2}} \times 4.4 \times \overset{0.2}{\cancel{0.4}}$

$= 4.4J$