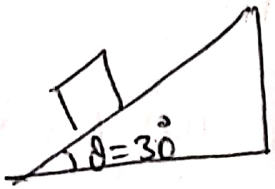
ws-7 8th foundation (1)

7 task

(1)

Given



velocity of projection $u = 9.8$ m/s

acceleration $a = -g \sin\theta$

$\Rightarrow a = -g \sin 30° = -9.8 \times \frac{1}{2}$

$= -4.9$ m/s²

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

$\Rightarrow 0^2 - (9.8)^2 = 2(-4.9)s$

$\Rightarrow \cancel{-} \cancel{9.8} \times 9.8 = \cancel{-9.8}\, s$

$\Rightarrow s = 9.8$ m $\rightarrow$ C.

(2)

(3)

Angle of inclination $\theta = 30^\circ$

mass $m = 10\,kg$; acceleration $= 1\,m/s$

Force applied parallel to the plane $= F = mg\sin\theta$

$\Rightarrow F = 10 \times 9.8 \times \sin 30$

$\Rightarrow 98 \times \frac{1}{2}$

$\Rightarrow 49\,N \rightarrow C.$

(4)

we know that for smooth inclined plane

time of descent $t_d = \sqrt{\frac{2l}{g\sin\theta}}$

$t_d \propto \frac{1}{\sqrt{\sin\theta}}.$

$\Rightarrow \frac{t_1}{t_2} = \sqrt{\frac{\sin\theta_2}{\sin\theta_1}} = \sqrt{\frac{\sin 60^\circ}{\sin 45^\circ}} = \sqrt{\frac{\frac{\sqrt{3}}{\cancel{2}}\sqrt{2}}{\frac{1}{\sqrt{2}}}} \quad \sqrt{\frac{\sqrt{3}}{\sqrt{2}}} = \left[\frac{3}{2}\right]^{\frac{1}{4}} =$

$\Rightarrow \frac{t_1}{t_2} = \left[\frac{3}{2}\right]^{0.25} \Rightarrow t_2 = t_1\left[\frac{2}{3}\right]^{0.25} \Rightarrow \left(\frac{2}{3}\right)^{0.25} t$

$\rightarrow D$

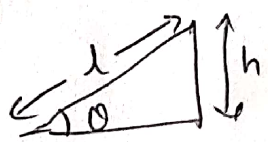
(2)

I^{st} body is a freely falling body.

$\therefore$ Time of descent $T_d = \sqrt{\frac{2h}{g}} = t$

2^{nd} body is sliding on smooth inclined surface

$T_d' = \sqrt{\frac{2l}{g\sin\theta}}$



From fig

$\sin\theta = \frac{h}{l}$

$\Rightarrow l = \frac{h}{\sin\theta}.$

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2nd continuation

$$T_d' = \sqrt{\frac{2h}{g(\sin\theta)\sin\theta}} = \frac{1}{\sin\theta}\sqrt{\frac{2h}{g}} = 2t$$

$$\Rightarrow \frac{1}{\sin\theta}\sqrt{\frac{2\cancel{h}}{\cancel{g}}} = 2\sqrt{\frac{2\cancel{h}}{g}}$$

$$\Rightarrow \frac{1}{\sin\theta} = 2 \Rightarrow \sin\theta = \frac{1}{2}$$

$$\Rightarrow \theta = 30^\circ \rightarrow A.$$

(5)

Given length of smooth inclined plane $l = 4m$.

Angle of inclination $\theta = 30^\circ$

we know that when a body is sliding down on inclined plane. acceleration $a = g\sin\theta = 9.8 \times \sin 30^\circ$

$$= 9.8 \times \frac{1}{2}$$

$$= 4.9\ m/s^2$$

$\therefore$ velocity with which the body reaching ground is

$$v = \sqrt{2gl\sin\theta} = \sqrt{2l\,g\sin\theta} = \sqrt{2la}$$

$$= \sqrt{2\times4\times4.9} = 6.25\ m/s \rightarrow C.\ \&\ D\ \text{also}$$

correct for $g = 10$ we get

$$v = 6.32\ m/s$$

(6)

Given length of the plane is $= 5m$.

Angle of inclination $\theta = 30^\circ$

$W_{up} = 100J$.

For a body to move with uniform speed then resultant force $= 0$

$\therefore \quad F = mg\sin\theta$

$W_{up} = F \times l$

$\Rightarrow \quad 100 = m \times g \times \sin 30 \times 5$

$\Rightarrow \quad \cancel{100}^{4} = m \times \cancel{10}^{5} \times \frac{1}{\cancel{2}} \times \cancel{5}$

$\Rightarrow \quad m = 4\,kg$

Now Force required to move up the body with certain acceleration $a = 4\,m/s^2$

$W = m(g\sin\theta + a) \times l$

$= 4(10 \times \sin 30 + 4) \times 5$

$= 20[\cancel{10}^{5} \times \frac{1}{\cancel{2}} + 4] \Rightarrow 20 \times 9 = \underline{180}\,J \rightarrow B$

(7)

Given force acting parallel to inclined plane $= \sqrt{3}$ N

$\Rightarrow \quad mg\sin\theta = \sqrt{3}\,mg\cos\theta$

$\Rightarrow \quad \sin\theta = \sqrt{3}\cos\theta$

$\Rightarrow \quad \tan\theta = \sqrt{3} \rightarrow$ slope of the plane.

$\Rightarrow \quad \theta \quad \rightarrow A.$

(8)

Here given Angle of inclination = θ

Given Force required to move up the body = 2 Force required to just Prevent the body sliding down

$\Rightarrow \quad mg(\sin\theta + \mu\cos\theta) = 2\,mg(\sin\theta - \mu\cos\theta)$

$\Rightarrow \quad \sin\theta + \mu\cos\theta = 2\sin\theta - 2\mu\cos\theta$

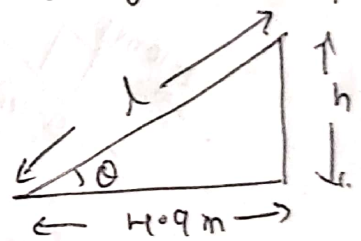
$\Rightarrow \quad 2\mu\cos\theta + \mu\cos\theta = 2\sin\theta - \sin\theta$

$\Rightarrow \quad 3\mu\cos\theta = \sin\theta$

$\Rightarrow \quad \mu = \frac{1}{3}\frac{\sin\theta}{\cos\theta} = \frac{1}{3}\tan\theta \rightarrow D$

(9)

Given base = 4.9m ; l = length of inclined plane.



Time taken by the body To reach bottom of the inclined plane is

$t_d = \sqrt{\frac{2l}{g\sin\theta}}$

$\tan\theta = \frac{h}{4.9}$

$\Rightarrow \frac{\sin\theta}{\cos\theta} = \frac{h}{4.9}$

$\Rightarrow \sin\theta = \frac{h}{4.9}\cos\theta$

$\Rightarrow t_d = \sqrt{\frac{2l}{g \times \frac{h}{4.9}\cos\theta}}$

$\Rightarrow t_d = \sqrt{\frac{2 \times 4.9 \times l}{g \times h\cos\theta}} = \sqrt{\frac{l}{h\cos\theta}}$

For minimum time $h\cos\theta$ should be maximum $= l$.

[For the given plane]

$t_d = \sqrt{\frac{l}{l}} = 1$ sec.

(10)

I^{st} body is a freely falling body

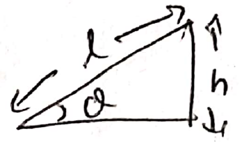
Velocity with which freely falling body reaches ground $v = \sqrt{2gh}$.

2^{nd} body is smooth inclined plane.

Angle of inclination $\theta = 30^\circ$.

Velocity of body with which it reaches the bottom of a smooth inclined plane is $v' = \sqrt{2lg\sin\theta}$.

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



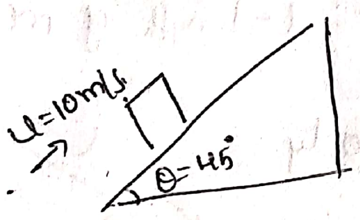
$\Rightarrow v' = v. \rightarrow B$

$\sin\theta = \frac{h}{l}$

$h = l\sin\theta$.

[Given height from which FFB falls and height of inclined plane are same]

(15)



As the body moving up $a = g\sin\theta$

$\Rightarrow a = 10\sin 45^\circ = 10 \times \frac{1}{\sqrt{2}}$

$\Rightarrow a = 5\sqrt{2}\ m/s^2$

Time of ascent $= \sqrt{\frac{2l}{g\sin\theta}}$ (or) From $v = u + at$

$\Rightarrow 0 = 10 - g\sin\theta\, t$

$\Rightarrow 10 = 10\sin\theta\, t$

$\Rightarrow t = \frac{1}{\sin\theta} = \frac{1}{\sin 45^\circ} = \frac{1}{\frac{1}{\sqrt{2}}} = \sqrt{2}\ sec$

a, c are correct $\rightarrow$ A

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(16)

we know that $\mu = \tan\theta$.

and $a = -g[\sin\theta + \mu\cos\theta]$

'$-ve$' sign shows that motion is against gravity.

$\therefore \quad a = g[\sin\theta + \tan\theta\cos\theta]$

$\Rightarrow a = g[\sin\theta + \frac{\sin\theta}{\cancel{\cos\theta}}\cancel{\cos\theta}]$

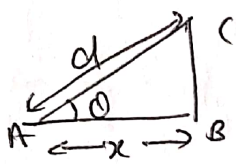
$\Rightarrow a = g[\sin\theta + \sin\theta] \Rightarrow a = 2g\sin\theta.$

Time of ascent $= \sqrt{\frac{2l}{a}} = \sqrt{\frac{2l}{2g\sin\theta}} = \sqrt{\frac{l}{g\sin\theta}}$.

a, c correct $\rightarrow$ A

(17), (18)

base x-meter



$\cos\theta = \frac{x}{d}$; $a = g\sin\theta$

$\Rightarrow d = \frac{x}{\cos\theta}$

$\Rightarrow x = d\cos\theta$

$\Rightarrow \frac{dx}{d\theta} = d[-\sin\theta] \rightarrow (1)$

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

$\Rightarrow d = 0 \times t + \frac{1}{2}g\sin\theta\, t^2$

$\Rightarrow d = \frac{g}{2}\sin\theta\, t^2$

$\Rightarrow t = \sqrt{\frac{2d}{g\sin\theta}} \rightarrow (2)$

From (2)

$\frac{dt}{d\theta} = \sqrt{\frac{2d}{g}}\frac{d}{d\theta}\left[\frac{1}{\sqrt{\sin\theta}}\right]$

$= \sqrt{\frac{2d}{g}}\left[-\frac{1}{2}(\sin\theta)^{-\frac{3}{2}} \times \cos\theta\right]$ $\left[\frac{d}{dx}\sqrt{x} = \frac{1}{2}x^{\frac{1}{2}-1} = \frac{1}{2}x^{\frac{1}{2}}\right]$

For minimum value of time

$\frac{dt}{d\theta} = 0$

$\Rightarrow -\frac{1}{2}(\sin\theta)^{-\frac{3}{2}} \times \cos\theta \times \sqrt{\frac{2d}{g}} = 0$

From ① $\quad \frac{dx}{d\theta} = -d\sin\theta$

$\Rightarrow \theta = 120^\circ$

(18)

$a = g\sin\theta$

$a = g\sin 45^\circ$

$a = \frac{g}{\sqrt{2}}\ m/s^2$

(19)

Given $m = 2kg$; $\theta = 60^\circ$;

Force required parallel to plane $= mg\sin\theta$

$\Rightarrow 2 \times 10 \times \sin 60^\circ$

$= 2 \times 10 \times \frac{\sqrt{3}}{2} = 10\sqrt{3}$ m.

(20)

Given length of inclined plane $l = \sqrt{3}$ m; $\theta = 60^\circ$.

Time of descent $= \sqrt{\frac{2l}{g\sin\theta}} = \sqrt{\frac{2 \times \sqrt{3}}{g \times \sin 60^\circ}}$

$= \sqrt{\frac{2 \times \sqrt{3}}{10 \times \frac{\sqrt{3}}{2}}} = \sqrt{\frac{2}{5}} = \sqrt{0.8}$

$= (0.8)^{\frac{1}{2}}$ sec.

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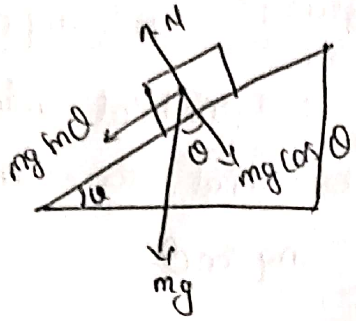
L Task

CUQ's

(1), (2)



when a body placed on smooth inclined surface

$N = mg\cos\theta$

The only force acting on the body is

$F = mg\sin\theta$

$\Rightarrow$ From Newton's II^{nd} law $F = ma$

$\Rightarrow \cancel{m}a = \cancel{m}g\sin\theta$

$\Rightarrow a = g\sin\theta$

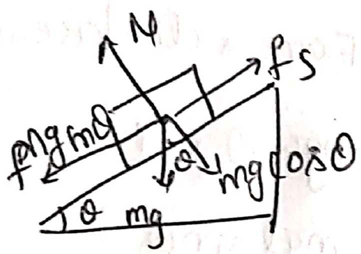
If the body is sliding up $a = -g\sin\theta$; sliding down $a = +g\sin\theta$

(4)

when a body is sliding down on inclined plane with uniform velocity

acceleration = 0

$\Rightarrow$ Net force acting on the body is zero



$\therefore N = mg\cos\theta$

$f_s = mg\sin\theta$

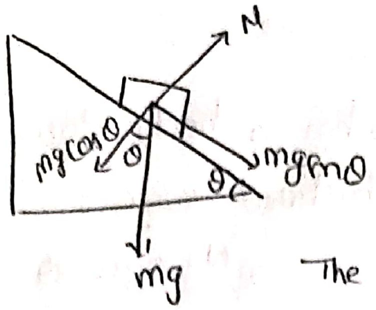
$\therefore \dfrac{f_s}{N} = \dfrac{\cancel{mg}\sin\theta}{\cancel{mg}\cos\theta} = \dfrac{\sin\theta}{\cos\theta} = \tan\theta \rightarrow (1)$

we know Acc to law of static friction $f_s = \mu_s N$

$\Rightarrow \mu_s = \dfrac{f_s}{N} \rightarrow (2)$

From (1) & (2) $\mu_s = \tan\theta. \rightarrow B$

⑥ , ⑦



when a body sliding on smooth surface

$N = mg\cos\theta$

$u \rightarrow$ initial velocity of projection

The only external force acting on the body

$F = mg\sin\theta$

$\Rightarrow \quad ma = -mg\sin\theta$

$\Rightarrow \quad a = -g\sin\theta$

From $\quad v = u + at \quad$ After reaching to top of inclined plane $v = 0$

$\therefore \quad 0 = u - g\sin\theta\, t$

$\Rightarrow \quad u = g\sin\theta\, t \quad \Rightarrow \boxed{t = \dfrac{u}{g\sin\theta}} \rightarrow$ time of ascent.

If l = length of inclined plane = displacement of the body as it is sliding up (or) down.

$\therefore \quad$ work done = Force × displacement

$= mg\sin\theta \times l$

$W = mgl\sin\theta$

6 – D

7 – B

⑨

Given $\quad \alpha = 45°$

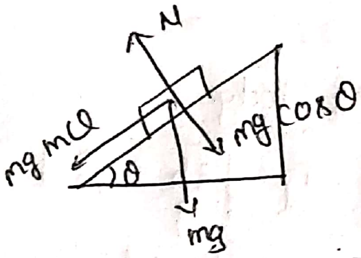
we know that $\quad \mu_s = \tan\theta$ (or) $\tan\alpha$

$\mu_s = \tan 45°$

$\Rightarrow \mu_s = 1. - D$

(6)

(10)



$N = mg\cos\theta$

The only external force acting on the body is $\underline{mg\sin\theta}$ which acts along The length of the inclined plane. → $\underline{B}$

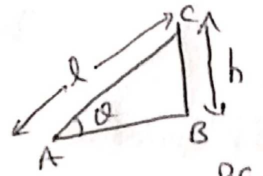
<u>Jee mains level</u>

(1)

Given Angle of inclination $\theta = 45°$

velocity of Projection $u = 19.6$ m/s ∴ $v = 0$.

From $u = \sqrt{2gl\sin\theta}$



$\sin\theta = \frac{BC}{AC}$

$\Rightarrow \sin\theta = \frac{h}{l}$

$\Rightarrow h = l\sin\theta$

$\Rightarrow 19.6 = \sqrt{2g \times h}$

$\Rightarrow (19.6)^2 = 2 \times 9.8 \times h$

$\Rightarrow 19.6 \times \cancel{19.6} = \cancel{19.6} \times h$

$\Rightarrow h = 19.6$m → A

(4)

Given angle of inclination $\theta = 45°$.

Body is at rest means static friction is developed between the surfaces.

From law of static friction $\mu_s = \tan\theta$

$\Rightarrow \mu_s = \tan 45°$

$\Rightarrow \mu_s = 1$ → A.

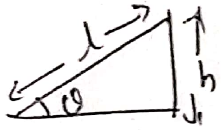
(2)

I^{st} body is a free falling body

Time of descent $T_d = \sqrt{\frac{2h}{g}} = \sqrt{2}\, t \rightarrow$ (1)

2^{nd} body is sliding down the inclined plane. so it's

time of descent $T_d = \sqrt{\frac{2l}{g \sin\theta}} = 2t \rightarrow$ (2)



$$\Rightarrow 2t = \sqrt{\frac{2h}{g(\sin\theta)^2}}$$

$\sin\theta = \frac{h}{l}$

$\Rightarrow l = \frac{h}{\sin\theta}$

$$\Rightarrow \cancel{2}^{\sqrt{2}} \frac{1}{\cancel{\sqrt{2}}} \sqrt{\frac{2\cancel{h}}{\cancel{g}}} = \sqrt{\frac{2\cancel{h}}{\cancel{g}(\sin\theta)^2}} \quad \text{[From (1)]}$$

$$= \sqrt{2} = \sqrt{\frac{1}{\sin^2\theta}} \Rightarrow \frac{1}{\sin\theta} = \sqrt{2}$$

$$\Rightarrow \sin\theta = \frac{1}{\sqrt{2}}$$

$$\Rightarrow \theta = 45^\circ - B$$

(3)

In the Problem they had given that time taken to reach bottom of the plane (ie) time of descent $t_d = 4$ sec.

$$\Rightarrow \sqrt{\frac{2l}{g\sin\theta}} = 4 \text{ sec.} = t_d$$

Clearly $t_d \propto \sqrt{l}$

Given distance covered $= l' = \frac{l}{4}$

$$\therefore \frac{t_d'}{t_d} = \sqrt{\frac{l'}{l}} \Rightarrow \frac{t_d'}{4} = \sqrt{\frac{l/4}{l}}$$

$$\Rightarrow \frac{t_d'}{4} = \frac{1}{\sqrt{4}} = \frac{1}{2}$$

$$\Rightarrow t_d' = \frac{4}{2} = \underline{2 \text{ sec}} \rightarrow B$$

5

Given $\mu = 1.732 = \sqrt{3}$

From $\mu = \tan\theta$

$\Rightarrow \sqrt{3} = \tan\theta$

$\Rightarrow \theta = 60^\circ \rightarrow$ c

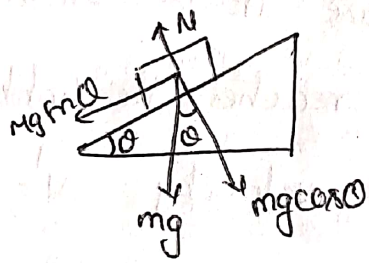
6

As the body sliding down the plane $a = g\sin\theta$

$\Rightarrow a = g\sin 30^\circ = \frac{g}{2} = \frac{10}{2} = 5\ m/s^2$ — A

7

when a body sliding down a smooth inclined plane $mg\sin\theta$ is the force acting parallel to inclined plane



$N = mg\cos\theta$

Given $\cancel{mg}\sin\theta = 2\cancel{mg}\cos\theta$

$\Rightarrow \sin\theta = 2\cos\theta$

$\Rightarrow \frac{\sin\theta}{\cos\theta} = 2 \rightarrow$ A

$\Rightarrow \tan\theta = 2$ which is the slope of a plane.

⑧

Given $\theta = 30$: length of inclined plane $l = 9.8\,m$

Time taken by the wood to slide down a smooth inclined plane

$$T_d = \sqrt{\frac{2l}{g\sin\theta}} = \sqrt{\frac{2\times 9.8}{9.8\times\sin 30}}$$

$$\Rightarrow T_d = \sqrt{\frac{2}{\frac{1}{2}}} = \sqrt{2\times 2}$$

$$\Rightarrow T_d = 2\text{ sec.} \rightarrow B$$

⑨

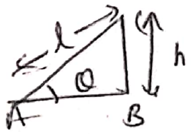
I^{st} body is a freely falling body.

velocity with which it reaches ground $v = 2V = \sqrt{2gh}$

In 2^{nd} case it is sliding down from inclined plane

It reaches the bottom of a inclined plane

with a velocity $v' = \sqrt{2gl\sin\theta}$ $[\theta = 30^\circ]$



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

$$\boxed{v' = 2V} \rightarrow A$$

$\sin\theta = \frac{h}{l}$

$h = l\sin\theta$

⑩

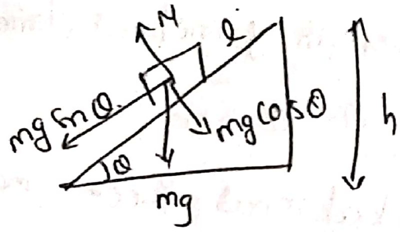
we know that the velocity with which it reaches the bottom of plane $v^b = \sqrt{2gl\sin\theta} \Rightarrow v^b \propto \sqrt{l}$

$l' = \frac{3}{4}l$ $\therefore \frac{v'}{v} = \sqrt{\frac{l'}{l}}$ $\Rightarrow \frac{v'}{v} = \frac{\sqrt{3}}{2}$

$$\Rightarrow \frac{v'}{v} = \sqrt{\frac{\frac{3}{4}\cancel{l}}{\cancel{l}}}$$

$$\Rightarrow v' = \frac{\sqrt{3}}{2}v \rightarrow A$$

(11), (13)



Force acting parallel to plane

$$\boxed{F = mg\sin\theta}$$

From Newton's IInd law $F = ma$

$$ma = mg\sin\theta$$

$$\Rightarrow \boxed{a = g\sin\theta}$$

$$\sin\theta = \frac{h}{l}$$

As the body reaches to the top of a inclined plane

Final velocity $v=0$, $a = -g\sin\theta$

From $v = u + at$

$$\Rightarrow 0 = u - g\sin\theta\, t$$

$$\Rightarrow u = g\sin\theta\, t$$

$$\Rightarrow \boxed{t_a = \frac{u}{g\sin\theta}}$$

(or)

From $S = ut + \frac{1}{2}at^2$ $S = l$ = distance travelled by the body

$$\Rightarrow l = g\sin\theta\, t^2 - \frac{1}{2}g\sin\theta\, t^2$$ $[u = g\sin\theta\, t]$

$$\Rightarrow l = \frac{1}{2}g\sin\theta\, t^2$$

$$\Rightarrow \boxed{t = \sqrt{\frac{2l}{g\sin\theta}} \text{ (or) } \sqrt{\frac{2h}{g\sin^2\theta}} = \frac{1}{\sin\theta}\sqrt{\frac{2h}{g}}}$$

velocity with which the body reaches bottom of the plane is determined by using $v^2 - u^2 = 2as$

$$\Rightarrow v^2 - 0^2 = 2g\sin\theta\, l$$

$$\Rightarrow v^2 = 2gl\sin\theta$$

$$\Rightarrow \boxed{v = \sqrt{2gl\sin\theta}}$$

(15), (16)

Given $m = 2\,kg$; length of inclined plane $l = 5m$

Angle of inclination $\theta = 30°$

work done by gravitational force $= mg\sin\theta\, l$

$$W = 2 \times 10 \times \sin 30 \times 5$$

$$= 2 \times 50 \times \frac{1}{2}$$

$$= 50J \rightarrow A$$

Time taken to reach bottom $= \sqrt{\frac{2l}{g\sin\theta}}$

$$= \sqrt{\frac{2\times5}{10\times\sin 30}} = \sqrt{\frac{1}{\frac{1}{2}}} = \sqrt{2}\ sec. \rightarrow C$$

(17)

Given $h = 19.6m$; Angle of inclination $\theta = 45°$

Time of descent $= \frac{1}{\sin\theta}\sqrt{\frac{2h}{g}}$

$$= \frac{1}{\sin 45}\sqrt{\frac{2\times 19.6}{9.8}} = \frac{1}{\frac{1}{\sqrt{2}}}\sqrt{2\times2}$$

$\Rightarrow 2\sqrt{2}$ sec.

(18), (19)

Given $h = 19.6$; angle of inclination $\theta = 45°$

acceleration $a = g\sin\theta = 9.8\sin 45° = \frac{9.8}{\sqrt{2}}$

$$a = 4.9\sqrt{2}\ m/s^2$$

Velocity with which it reaches bottom $= \sqrt{2gh}$

$$u = \sqrt{2\times9.8\times19.6} = \sqrt{19.6\times19.6} = 19.6\ m/s$$

(20)

we know

acceleration $a = g\sin\theta$

(a) $\theta = 30^\circ$ $\rightarrow a = g\sin 30^\circ = \frac{g}{2}$. $\rightarrow$ h

(b) $\theta = 45^\circ$ $\rightarrow a = g\sin 45^\circ = \frac{g}{1.414}$ $\rightarrow$ g.

(c) $\theta = 60^\circ$ $\rightarrow a = g\sin 60 = \frac{g(1.732)}{2}$ $\rightarrow$ f

(d) $\theta = 90$ $\rightarrow a = g\sin 90^\circ = g$ $\rightarrow$ e.

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