

ws-7 8th foundation

①

Task

①

Given



velocity of projection $u = 9.8 \text{ m/s}$

acceleration $a = -g \sin \theta$

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

$$= -4.9 \text{ m/s}^2$$

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

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

$$\Rightarrow 9.8 \times 9.8 = 9.8 s$$

$$\Rightarrow s = 9.8 \text{ m} \rightarrow c.$$

②

③

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

mass $m = 10 \text{ kg}$; acceleration $= 1 \text{ m/s}^2$

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

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

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

$$\Rightarrow 49 \text{ N} \rightarrow \text{c.}$$

④

we know that for smooth inclined plane

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

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

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

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

②

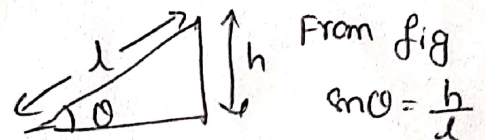
$\rightarrow \text{D}$

1st body is a freely falling body.

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

2nd body is sliding on smooth inclined surface

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



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

2nd continuation

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

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

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

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

⑤

Given length of smooth inclined plane $l = 4\text{ m}$

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

we know that when a body is sliding down on inclined

plane. acceleration $a = g \sin \theta = 9.8 \times \sin 30^\circ$

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

$$= 4.9 \text{ m/s}^2$$

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

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

$$= \sqrt{2 \times 4 \times 4.9} = 6.25 \text{ m/s} \rightarrow C \text{ and D also}$$

correct for $g=10$ we get

$$v = 6.32 \text{ m/s}$$

(6)

Given length of the plane is $= 5\text{m}$.

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

$$W_{\text{up}} = 100\text{J}.$$

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

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

$$W_{\text{up}} = F \times l$$

$$\Rightarrow 100 = m \times g \times \sin 30^\circ \times 5$$

$$\Rightarrow 100 = m \times 10 \times \frac{1}{2} \times 5$$

$$\therefore m = 4\text{ kg}$$

Now force required to move up the body with certain acceleration $a = 4\text{ m/s}^2$

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

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

$$= 20 \left[10 \times \frac{1}{2} + 4 \right] \Rightarrow 20 \times 9 = \underline{180\text{ J}} \rightarrow B$$

(7)

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

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

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

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

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

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

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

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

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

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

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

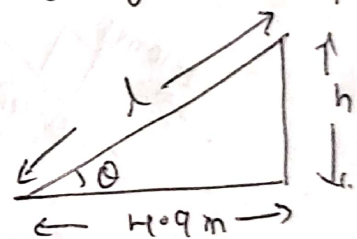
9

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

Time taken by the body

To reach bottom of

The inclined plane is



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

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

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

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

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

$$\Rightarrow t_d = \sqrt{\frac{2 \times 4.9 \times l}{g \times h \cos\theta}} = \sqrt{\frac{1}{h \cos\theta}}$$

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

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

[For the given plane]

(10)

1st body is a freely falling body

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

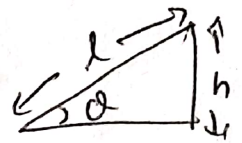
2nd body is smooth inclined plane.

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

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

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

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

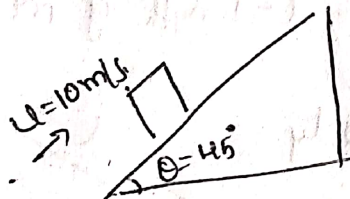


$$\sin \theta = \frac{h}{l}$$

$$h = l \sin \theta$$

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

(15)



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

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

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

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

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

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

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

a, c are correct $\rightarrow A$

(4)

(16)

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

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

've' sign shows that motion is against gravity.

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

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

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

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

a, c correct $\rightarrow A$

(17), (18)

base x -meter

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

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

$$\Rightarrow x = d \cos \theta$$

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

From (2)

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

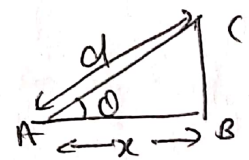
$$= \sqrt{\frac{2d}{g}} \left[-\frac{1}{2} (\sin \theta)^{-\frac{3}{2}} \times \cos \theta \right]$$

$$\left(\frac{d}{dx} \sqrt{x} = \frac{1}{2} x^{\frac{1}{2}-1} \right)$$

$$= \frac{1}{2} x^{-\frac{1}{2}}$$

For minimum value of time

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



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

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

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

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

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

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

$$\Rightarrow \theta = 120^\circ$$

(18)

$$a = g \sin\theta$$

$$a = g \sin 45^\circ$$

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

(19)

$$\text{Given } m = 2 \text{ kg} \quad ; \quad \theta = 60^\circ$$

$$\text{Force required Parallel to plane} = mg \sin\theta$$

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

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

(20)

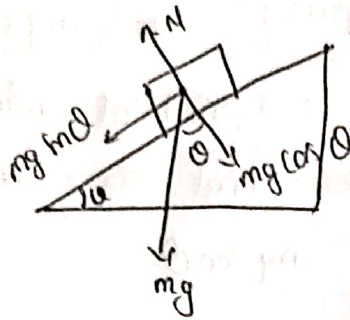
$$\text{Given length of inclined plane } l = \sqrt{3} \text{ m, } \theta = 60^\circ$$

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

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

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

①, ②



when a body placed on smooth inclined surface

$$N = mg \cos \theta$$

The only force acting on the body is

$$F = mg \sin \theta$$

⇒ From Newton's IInd law $F = ma$

$$ma = mg \sin \theta$$

$$a = g \sin \theta$$

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

④

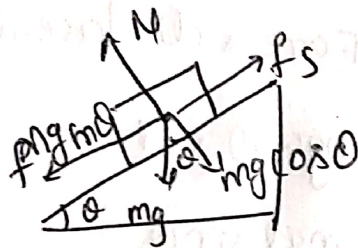
when a body is sliding down on inclined plane with uniform velocity

acceleration = 0

⇒ Net force acting on the body is zero

$$\therefore N = mg \cos \theta$$

$$f_s = mg \sin \theta$$



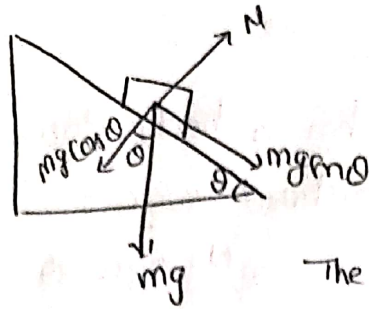
$$\therefore \frac{f_s}{N} = \frac{mg \sin \theta}{mg \cos \theta} = \frac{\sin \theta}{\cos \theta} = \tan \theta \rightarrow$$

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

$$\Rightarrow \mu_s = \frac{f_s}{N} \rightarrow ②$$

$$\text{From ① \& ② } \mu_s = \tan \theta \rightarrow B$$

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

$$F = mg \sin \theta$$

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

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

From

$$v = u + at$$

After reaching to top of

inclined plane $v = 0$

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

$$\Rightarrow u = g \sin \theta t \Rightarrow \boxed{t = \frac{u}{g \sin \theta}} \rightarrow \text{time of ascent.}$$

If $l =$ length of inclined plane $\equiv$ displacement of the body as it is sliding up or down.

$\therefore$ work done = Force $\times$ displacement

$$= mg \sin \theta \times l$$

$$W = mgl \sin \theta$$

6-D

7-B

⑨

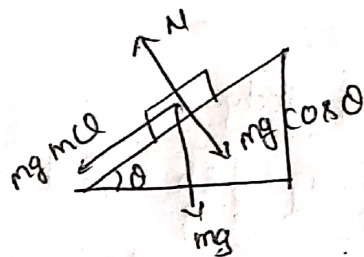
Given $\alpha = 45^\circ$

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

$$\mu_s = \tan 45^\circ$$

$$\Rightarrow \mu_s = 1.0$$

(10)



$$N = mg \cos \theta$$

The only external force acting on the body is $mg \sin \theta$ which acts along

The length of the inclined plane. $\rightarrow B$

See main level

(6)

(1)

Given angle of inclination $\theta = 45^\circ$

velocity of Projection $u = 19.6 \text{ m/s} \therefore u = 0$.

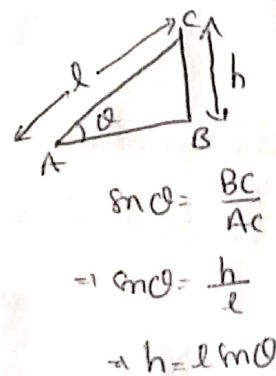
From $u = \sqrt{2gh \sin \theta}$

$$\Rightarrow 19.6 = \sqrt{2gh}$$

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

$$\Rightarrow 19.6 \times 19.6 = 19.6 \times h$$

$$\Rightarrow h = 19.6 \text{ m} \rightarrow A$$



(4)

Given angle of inclination $\theta = 45^\circ$

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

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

$$\Rightarrow \mu_s = \tan 45^\circ$$

$$\Rightarrow \mu_s = 1.0$$

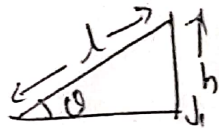
(2)

1st body is a free falling body

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

2nd body is sliding down the inclined plane so it's

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



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

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

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

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

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

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

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

(3)

In the problem they had given that time taken to reach bottom of the plane (i.e.) time of descent $t_d = 4 \text{ sec.}$

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

$$\text{clearly } t_d \propto \sqrt{l}$$

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

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

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

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

⑤

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

From $u = \tan \theta$

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

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

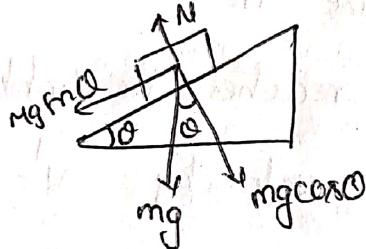
⑥

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

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

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

$$mg \sin \theta = 2 mg \cos \theta$$

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

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

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

⑧

Given $\theta = 30^\circ$: length of inclined plane $l = 9.8 \text{ m}$

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

1st body is a freely falling body.

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

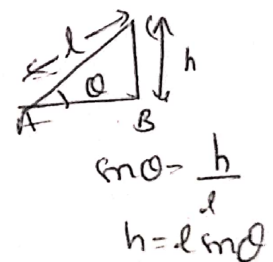
in 2nd case it is sliding down from inclined plane

it reaches the bottom of a inclined plane

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

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

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



⑩

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

$$l' = \frac{3}{4} l$$

$$\therefore \frac{v'}{v} = \sqrt{\frac{l'}{l}}$$

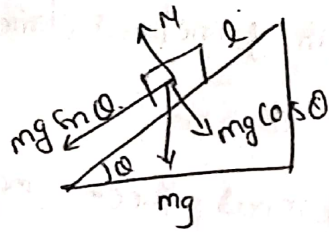
$$\Rightarrow \frac{v'}{v} = \sqrt{\frac{3}{4}}$$

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

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

⑪, ⑬

⑤



Force acting parallel to plane

$$F = mg \sin \theta$$

From Newton's IInd law $F = ma$

$$ma = mg \sin \theta$$

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

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

As the body reaches to the top of inclined plane

$$\text{Final velocity } v = 0 \quad \text{and } a = -g \sin \theta$$

$$\text{From } v = u + at$$

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

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

$$\Rightarrow t = \frac{u}{g \sin \theta}$$

(or)

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

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

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

$s = l = \text{distance}$

travelled by the body

$$[u = g \sin \theta t]$$

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

velocity with which the body reaches bottom of the plane

is determined by using $v^2 - u^2 = 2as$

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

$$\Rightarrow v^2 = 2g l \sin \theta$$

$$\Rightarrow v = \sqrt{2g l \sin \theta}$$

(15), (16)

Given $m=2\text{ kg}$: length of inclined plane $l=5\text{ m}$

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

work done by gravitational force $= mgl \sin \theta$

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

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

$$= 50\text{ J} \rightarrow \text{A}$$

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

$$= \sqrt{\frac{2 \times 5}{10 \times \frac{1}{2}}} = \sqrt{\frac{1}{\frac{1}{2}}} = \sqrt{2} \text{ sec} \rightarrow \text{C}$$

(17)

Given $h=19.6\text{ m}$: angle of inclination $\theta=45^\circ$

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

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

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

(18), (19)

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

$$\text{acceleration } a = g \sin \theta = 9.8 \sin 45^\circ = \frac{9.8}{\sqrt{2}}$$

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

velocity with which it reaches bottom $= \sqrt{2ah}$

$$u = \sqrt{2 \times 4.9 \times 19.6} = \sqrt{19.6 \times 19.6} = 19.6 \text{ m/s}$$

(20)

we know

acceleration $a = g \sin \theta$

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

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

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

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