9th foundation

WS-6 work

Task

(1)

$F = 10N$ ; $S = 2m$ The body is displacing in the direction of force $\therefore \theta = 0°$

$W = FS\cos\theta$

$= 10 \times 2 \times \cos 0$

$= 20J$

(2)

$S = 5m$ ; $W = 25J$ F & S are in same direction

$\theta = 0°$

$\therefore W = FS\cos\theta$

$\Rightarrow 25 = F \times 5 \times \cos 0°$

$\Rightarrow \frac{25}{5} = 5F$

$\Rightarrow F = 5N.$

(3)

Given $F = 15N$ ; $W = 45J$

F and S are in same direction

$\theta = 0°$

$\therefore W = FS\cos\theta$

$\Rightarrow 45 = 15 \times S \times \cos 0$

$\Rightarrow 3 = S \times 1 \Rightarrow S = 3m$

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(4)

In 12 hrs the hours hand completes one rotation

So displacement $s = 0$

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

$$W = F \cos\theta = 0$$

(5)

Given $m = 2\,kg$ ; $h = 2m$ ; $g = 10\,m/s^2$

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

$= mg\, h \cos 180^\circ$

Here G.F is acting downwards and body displacement is upwards so that $\theta = 180^\circ$

$$W = -mgh$$

$$= -2 \times 10 \times 2$$

$$= -40\,J$$

-ve sign shows work is done against gravity.

(6)

Given $h = 10m$ ; $W = 50\,J$ ; $g = 10\,m/s^2$

$\therefore$ work done $= F\, s \cos\theta$

F = gravitational force and s = h are in opposite direction, $\theta = 180^\circ$

$$W = mgh \cos 180$$

$$\Rightarrow 50 = m \times 10 \times 10 \quad (-1)$$

$$\Rightarrow m = 50 \times 10^{-2} = 0.5\ kg$$

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(7)

Given $W = 30\ J$ $m = 1\ kg$.

From $W = F S \cos\theta$ $F = mg$ ; $S = h$

$\theta = 180°$

$\Rightarrow 30 = mgh \cos 180$

$\Rightarrow 30 = 1 \times 10 \times h \times (-1)$ work is done against gravity

$\Rightarrow 30 = 10h$ So we get -ve sign.

$\Rightarrow h = 3m$

(8)

$m_m = 3\ kg$ ; $h_m = 5\ m$

$W_m = 5\ J$

From $W = mgh$

$\Rightarrow 5 = 3 \times g_m \times 5$

$\Rightarrow 1 = 3 g_m \Rightarrow g_m = \frac{1}{3}$

(9)

$\frac{W_e}{W_m} = \frac{5}{3}$ $h_e = h_m$.

we know work done in lifting the body is

$W = mgh$

$\frac{W_e}{W_m} = \frac{g_e}{g_m}$

$\Rightarrow \frac{g_e}{g_m} = \frac{5}{3}$

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(10)

$h_e = 1m$ ; $h_m = 6m$.

we know work done in lifting the body is

$W = mgh$ [$W$ = same, $m$ = constant]

$g \propto \frac{1}{h}$

$\Rightarrow \frac{g_e}{g_m} = \frac{h_m}{h_e}$

$\Rightarrow \frac{g_e}{g_m} = \frac{6}{1} \Rightarrow g_m = \frac{1}{6} g_e$.

Advanced

(11)

(a)

Since the direction of frictional force is always opposite to the motion of a body so the angle between frictional force and displacement is 180°

Since $\cos 180° = -1$

$W_{friction} = f s \cos 180 = -fs$

(b)

If the body is projected vertically up Gravitational force and displacement are opp

$\therefore \theta = 180°$

$W_{G.F} = \vec{F_g} s \cos 180$

$= mg h (-1)$

$= -mgh = -ve.$

a, d are correct

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(12)

(a) As the body lifted up a force of equal in magnitude as that of weight (mg) of the body is applied in upward direction.

$\therefore F_{applied}$ and displacement are in same direction so $\theta = 0°$

$\therefore W = F_{app} \, s \cos 0°$

$\Rightarrow mgh(1) = mgh = +ve$

(b)

Here gravitational force and displacement are in opposite direction. Hen $\theta = 180°$

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

$= F_g \, s \cos(180°) = -F_g s = -ve.$

$W_{Total} = W_{app} + W_g = +mgh + (-mgh) = 0$

(13) (13)

(a) The direction of centripetal force and displacement are Perpendicular so work done $= F_c \, s \cos 90°$

$= 0$

(b) Tension in string and displacement are perpendicular,

$W = T \, s \cos 90° = 0$

(c) Displacement of person is $= 0$ $\therefore W = F_g \, s \cos\theta = 0$

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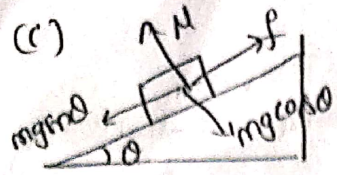
(8) (14)

(c) 


work done by the gravity

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

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

(a) Direction of friction is opposite to that of direction of motion of the body. So $\theta = 180^\circ$

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

$= f \, s \cos 180^\circ \Rightarrow W = -fs = -ve$

(9) (15)

a) If $\theta = 0 \rightarrow W = FS\cos\theta = FS\cos 0 = FS = +ve$

b) If $\theta = 180^\circ \rightarrow W = FS\cos 180^\circ = FS(-1) = -FS = -Ve$

c) If $\theta = 90^\circ \rightarrow W = FS\cos 90^\circ = FS(0) = 0.$

(9), (10)

Given $m = 3\,kg$; $h = 10m$; $F = 5\,N$

work done by gravity $= F_g S\cos\theta = mgh\cos(180)$

$= -mgh = -3 \times 10 \times 10 = -300\,N$

work done by applied force $W = F_{app} S\cos\theta = 5 \times 10 \times \cos 0$

$= 50\,N.$

$F_{app}$ & S are in same direction so $\theta = 0^\circ$

$F_g$ & S are in opposite direction so $\theta = 180^\circ$
body is lifting.

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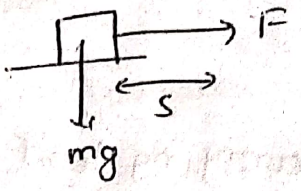
③

we know work done $W = FS\cos\theta$




Here s and mg are perpendicular

$\theta = 90$

$W = FS\cos 90 = 0$

④

If any body is in rotatory motion force and displacement are perpendicular $\theta = 90$

$W = FS\cos 90 = 0$

⑧

when box lifted from ground

work done = mgh

mg → weight of box.

⑩

we know Work done = $FS\cos\theta$

If $\theta = 0$ ; $\cos\theta = \cos 0 = 1$

$\theta = 90$ ; $\cos 90 = 0$. when force and displacement are perpendicular then $W = FS\cos 90$

$= 0$

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Jee mains level

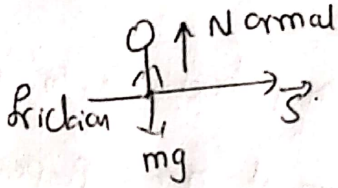
(1)

work done $\omega = F S \cos\theta$

work done does not depends on mass.

(3)

when a person carrying load on his head walks on a horizontal road




Here Normal force and gravitational force displacement are perpendicular so $\theta = 90^\circ$ ; $\cos 90^\circ = 0$

$\omega = 0$.

Friction and displacement are antiparallel

$\theta = 180^\circ$ $\cos 180^\circ = -1$ $\omega = -ve$.

(4)

when electron is revolving around the orbit

Force and displacement are perpendicular so $\theta = 90$

$\omega = FS \cos 90^\circ = 0$.

when porter carrying a suitcase there is a gravitational force acting perpendicular to displacement of porter.

$\therefore \theta = 90^\circ$ $\omega = FS \cos 90^\circ$

$\omega = 0$

Both A & B are true

## Task

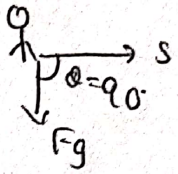
### Jee mains level

(5)

(a) As the porter is walking displacement of porter $\vec{s}$ is $\perp^{r}$ to gravitational force $F_g$

$\theta = 90^\circ$

$W = F_g s \cos 90 = 0$




(b)

Here suitcase was lifting i.e) displacement (h) is upwards and gravitational force is downward ↓

$\therefore \theta = 180^\circ \quad W = F_g s \cos 180 = -F_g h$

(c)

work done by external force F to move suitcase along inclined plane through a vertical height h

$W = F s \cos\theta$

c, a, b option D

(6)

Given $F = 20N$ ; $s = 2m$ ; F & s are in same direction

$\therefore \theta = 0^\circ$

$W = F s \cos\theta$

$\Rightarrow W = 20 \times 2 \times \cos 0$

$= 40J$

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(7)

Given $S = 2m$ ; $W = 10J$ : [F & S are in same direction]

$W = FS\cos\theta$ $\quad \theta = 0^\circ$

$\Rightarrow 10 = F \times 2 \times \cos 0$

$\Rightarrow 10 = 2F \Rightarrow F = 5N$

(8)

Given $F = 25N$ ; $W = 75J$ $\quad \theta = 0^\circ$

$W = FS\cos\theta$

$\Rightarrow \frac{75}{3} = 25\, S\cos 0$

$\Rightarrow 3 = S \Rightarrow S = 3m$

(9)

In 1 hr the minute hand completes one rotation so. displacement is zero.

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

(10)

Given $m = 3kg$ ; $h = 5m$

$W_{g.p} = mgh$

$= 3 \times 10 \times 5$

$= 150J$

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(4)

(5)

(a)

$$W = FS\cos 90^\circ = 0$$

(b) work done by the g.F of a suitcase when it is lifted from the ground to a height

$$W = mgh\cos 180^\circ = -mgh.$$

(c)

work done by the external force along an inclined plane through a vertical height 'h'

$$W = mgl\sin\theta = mgh$$

Decreasing order c, a, b

(6)

Given $F = 20N$, $S = 2m$. F & S are in same direction.

$$W = FS\cos\theta$$

$$= 20 \times 2 \times \cos 0$$

$$= 40J$$

(7)

work done $= 10J$ ∴ displacement $S = 2m$.

We know $W = FS\cos\theta$

$$\Rightarrow 10 = F \times 2 \times \cos 0^\circ$$

$$\Rightarrow F = 5N.$$

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(8)

Given $F = 25N$; $W = 75J$,

we know $W = FS\cos\theta$

$\Rightarrow 75^{3} = 25 \times S\cos 0$

$\Rightarrow 3 = S \Rightarrow S = 3m$.

(9)

In 1 hr Time for one rotation of min hand completes $S = 0$.

$W = FS\cos\theta = 0$.

(10)

Given $m = 3kg$; $h = 5m$

work done $= mgh = 3 \times 10 \times 5 = 150J$.

(11)

Given $m = 1kg$; $S = 1m$. $F = 8N \rightarrow$ horizontal

Vertical distance $S = 2m$

work done by Gravitational force $= mgh$

$= 1 \times 10 \times 2 = 20J$

work done to displace horizontally $W = F \cdot S$

$= 8 \times 1$

$= 8J$

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(18)

Given $F = 5\,N$ ; $V = 2\,m/s$ ; $m = 10\,kg$.

$t = 60$ sec. ; $a = \frac{V}{t} = \frac{2}{60}$.

$a = \frac{F}{m} = \frac{5}{10} = \frac{1}{2}\,m/s^2$

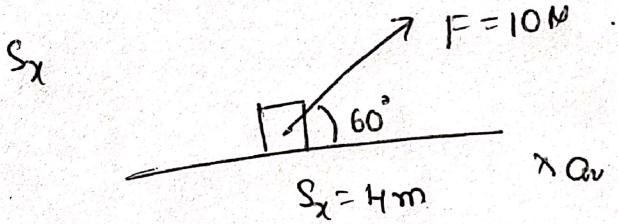
$S = ut + \frac{1}{2}at^2$

$= 2 \times 60 + \frac{1}{2}(0)\,t^2 = 120\,m$

$W = F \cdot S = 120 \times 5 = 600\,J$

(19)

Given $m = 5\,kg$




Work done $= FS\cos\theta$

$= 10 \times 4 \cos 60°$

$= 40 \times \frac{1}{2}$

$= 20\,J$