# WS-6 work

## Task

(1)

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

$W = F S \cos\theta$

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

$= 20 J$

(2)

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

$\theta = 0°$

$\therefore W = F S \cos\theta$

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

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

$\Rightarrow F = 5N.$

(3)

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

F and S are in same direction

$\theta = 0°$

$\therefore W = FS \cos\theta$

$\Rightarrow \frac{45}{15} = \frac{15 \times S \times \cos 0}{15}$

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

(4)

In 12 hrs the hours hand completes one rotation

So displacement $s = 0$

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

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

(5)

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

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

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

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

$$W = mgh \cos 180$$

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

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

(7)

Given

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

From $W = F S \cos\theta$

$F = mg ; \ S = h$

$\theta = 180^\circ$

$\Rightarrow 30 = mgh \cos 180$

$\Rightarrow 30 = 1 \times 10 \times h \times (-1)$

$\Rightarrow 30 = 10h$

$\Rightarrow h = 3m$

work is done against gravity

So we get -ve sign.

(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)

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

we know work done in lifting the body is

$W = mgh$

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

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

(10)

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

we know work done in lifting the body is

$$W = mgh$$

$$g \propto \frac{1}{h} \qquad [W = \text{same}, \; m = \text{constant}]$$

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

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

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 $180^\circ$

Since $\cos 180^\circ = -1$

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

(b)

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

$\therefore \theta = 180^\circ$

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

$$= mgh(-1)$$

$$= -mgh = -ve.$$

a, d are correct

(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 $\theta = 0°$

$\therefore$ $\omega = F_{app} \, s \cos 0°$

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

(b)

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

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

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

$\omega_{Total} = \omega_{app} + \omega_g = +mgh + (-mgh) = 0$

(13)

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

$= 0$

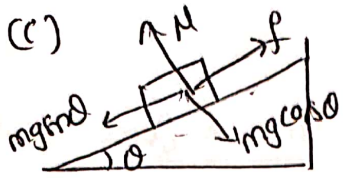
(b) Tension in string and displacement are perpendicular,

$\omega = T \, s \cos 90° = 0$

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

(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 $\theta = 180^\circ$

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

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

(8) (18)

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

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 $W = F_{app} S\cos\theta = 5 \times 10 \times \cos 0$

$= 50\,N.$

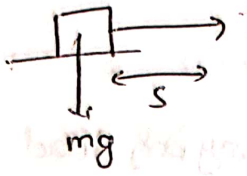
$F_{app}$ & S are in same direction so $\theta = 0^\circ$

$F_g$ & S are in opposite direction so $\theta = 180^\circ$

body is lifting.

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 $W = FS\cos 90$

$= 0$.

Jee mains level

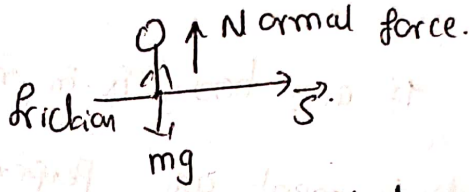
①

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

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 $\theta = 90^\circ$ ; $\cos 90^\circ = 0$

$W = 0$.

Friction and displacement are antiparallel

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

④

When electron is revolving around the orbit

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

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

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

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

$W = 0$

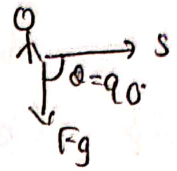
Both A & B are true.

## L 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 ie) 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 $F = 20N \quad : s = 2m$ : F & S are in same direction

$\therefore \theta = 0^\circ$

$W = F s \cos\theta$

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

$= 40J$

(7)

Given $S = 2m$ ; $W = 10J$ ; [F & S are in same direction] $\theta = 0^\circ$

$W = FS\cos\theta$

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

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

(8)

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

$W = FS\cos\theta$

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

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

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

$W_{g.p} = mgh$

$= 3 \times 10 \times 5$

$= 150J$

(5)

(a)

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

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

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

(c)

workdone by the external force along an incli plane through a vertical height 'h'

$$W = mg\,l\sin\theta = mgh.$$

Decreasing orde 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 $W = FS\cos\theta$

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

$$\Rightarrow F = 5N.$$

(8)

Given $F = 25N$; $\omega = 75J$,

we know $\omega = FS\cos\theta$

$\Rightarrow 75 = 25 \times S\cos 0$

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

(9)

In 1 hr Time for one rotation of min

han completes $S = 0$.

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

(10)

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

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

(F)