I task

① Given No. of steps $N = 40$

width $w = 35cm$; height $h = 25cm = 25\times10^{-2}m$

mass $m = 20kg$ ; Total height to which he ascends $= nh$

work done $= MgH$

$= nMgh$

$= 40\times20\times10\times25\times10^{-2}$

$= 40\times50 = 2000 = 2\times10^{3} J.$

② Given mass of rain drop $= \frac{1}{10} gm = \frac{1}{10}\times10^{-3} = 10^{-2} kg$

displacement $s = 100m$ = height from which it falls

∴ workdone by gravity $w = mgh$

$\Rightarrow w = 10^{-2}\times9.8\times100 = 9.8 J$

③

Acceleration of bucket $a = \frac{g}{4}$

displacement of bucket $\vec{s} = d$.

work done $=$ F × displacement

$= m(g-a)d$

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

$w = \frac{-3mgd}{4}$

(4)

Given

mass $m = 5$ kg ; initial speed $u = 0$.

Force $F = 2$ N. , time $t = 10$ sec

Acceleration $a = \frac{F}{m} = \frac{2}{5}$

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

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

$\Rightarrow S = 0 + \frac{1}{5} \times 100 = 20$ m

work done by the force $W = F \cdot S = 2 \times 20 = 40$ J

(5)

Given

$\frac{m_1}{m_2} = \frac{1}{2}$ ; $\frac{S_1}{S_2} = \frac{2}{1}$ ; $\frac{F_1}{F_2} = \frac{1}{2}$ $\theta_1 = 30^\circ$ $\theta_2 = 60^\circ$

we know $W = F S \cos\theta$

$\Rightarrow \frac{W_1}{W_2} = \frac{F_1}{F_2} \frac{S_1}{S_2} \frac{\cos\theta_1}{\cos\theta_2}$

$\Rightarrow \frac{W_1}{W_2} = \frac{1}{2} \times \frac{2}{1} \times \frac{\cos 30^\circ}{\cos 60^\circ} = \frac{\frac{\sqrt{3}}{2}}{\frac{1}{2}} = \frac{\sqrt{3}}{1}$

(6)

Given $\frac{1}{5^{th}}$ Part of chain is hanging from the table.

If $\frac{1}{n^{th}}$ Part is hanging, the amount of work done to left hanging Part is $W = \frac{mgL}{2n^2} = \frac{MgL}{2(5)^2} = \frac{MgL}{50}$

(7)

Given $m = 10$ kg

work done = Area of graph × m

$= \frac{1}{2} \times b \times h \times m$

$\Rightarrow W = \frac{1}{2} \times 8 \times 20 \times 10 \times 10^{-2} \times 10^{-2}$

$= 8 \times 10^{-2}$ J

$[W = FS = ma\underbrace{S}_{\text{Area of graph}}]$

## Task Advanced level

(11) Direction of friction and displacement are in opposite direction.

$$w = F S \cos\theta \quad [\theta = 180^\circ]$$

$$w = F S \cos 180^\circ = -F S = -ve$$

For a vertically projected body gravitational force displacement are opposite

$$w = F_g S \cos\theta \quad [\theta = 180^\circ]$$

$$w = F_g S \cos 180^\circ = -F_g S = -ve$$

(12)

Given mass = m

$F_g = mg$ ; height = h.

work = $-mgh$ [Because gravity and displacement are in opp direction. $\theta = 180^\circ$ ; $\cos 180 = -1$]

work done by applied force $W_{app} = F S \cos\theta \quad [\theta = 0^\circ]$

$= mgh \cos 0^\circ = mgh$

$\therefore W_{total} = -mgh + mgh = 0$

(13)

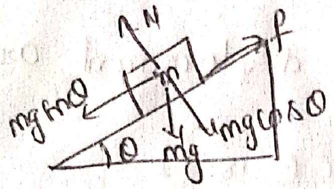
(a) centripetal force and displacement are perpendicular to each other $\theta = 90^\circ$ $\quad w = F_c S \cos\theta = F S \cos 90 = 0$.

(b) Tension and displacement are perpendicular to each other $\theta = 90^\circ$ $\quad w = T S \cos\theta = T S \cos 90^\circ = 0$

(c) when a carrying load on his head and standing at a place. is $w = 0$ [displacement $S = 0$]

$$w = F S = F(0) = 0\,J.$$

(14)




work done = $\frac{\text{Force}}{\text{friction}}$ × displacement cos θ

= (mg sinθ) s

workdone by frictional force is −ve.

workdone by gravity ~~ω~~ = 0.

(16)

Since work done = F S cos θ

Displacement is zero for round trip.

There is a centripetal force acting on the body.

(17)

A man pushes wall and fails to ~~displacement~~ displace it

the wall exert a force on man and displace hime.

Work done by wall on man = F S cosθ

= F S cos180°

= − F S

=// END //

(19) Given m = 300 kg; initial speed u = 0 ; v = 90 kmph = 25 m/s

time = 5 sec ; displacement = 1.5 km = $1.5 \times 10^3$ m

From v = u + at

⇒ 25 = 0 + a × 5

⇒ a = 5 m/s²

Force = m a = 300 × 5 = 1500 N

work done = F S = 1500 × $1.5 \times 10^3$

= $225 \times 10^4$ J

LTask CUQh

(1)

we know work done $w = Fs\cos\theta$ it mean's that work done depends on Force (F), displacement (s) and angle between F & S so it is independent on time.

work done by a force is dependent on the frame of reference.

For ex:- If an object is falling under ~~Gof~~ gravity, there will be a GoF acting on the object such that it is constant whether we are moving in a frame of refference along with the falling object (or) whether we are stationary w.r.t ground.

(2)

we know Power $= \frac{w}{t}$ ~~so~~ so slope of w-time given Power

(3)

work done in lifting the box from ground = mgh

here mg → weight of the box.

(4)

when a body projected vertically upward Force and displacement are opposite to each other [$\theta = 180°$] so it follows a straightline Path.

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(6), (7)

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

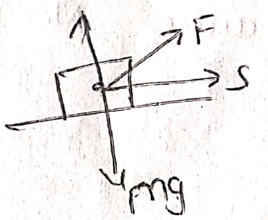
If force and displacement are perpendicular $[\theta = 90^\circ]$

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

If bothe force and displacement are in same direction $\theta = 0^\circ$ $\omega = FS\cos 0^\circ = \underline{FS}$

(9)

when a body is pulled on level surface




G.F (mg) and $\vec{S}$ are in perpendicular direction $\theta = 90^\circ$ $\omega = mg\,s\cos 90^\circ$

$\omega = 0$

(10)

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

$\omega = mg\,s\cos\theta$ clearly workdone is independent on velocity of the body.

(8)

The force acts on body to displace, it moves through a certain distance.

it experience an increase in energy through a mechanical influence.

Jee main level

(1)

Given force $F = 50N$ ; displacement $s = 5m$.

work done $= F\,S \Rightarrow 50 \times 5 = 250\,J$.

(2)

Given force $= 3N$ ; displacement $S = 30\,m$

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

(3) workdone by a man by holding a box on his head is zero because No displacement.

(4)

No. of cement bags $N = 4$.

mass $m = 50$ ; height $h = 20m$.

workdone $= N\,mg\,h$

$= 4 \times 50 \times 10 \times 20$

$\Rightarrow 4 \times 10^4\,J = 40\,kJ$ If

we take $g = 9.8\,m/s^2$ we will get $\omega = 39.2\,kJ$

(5)

Given $m = 60\,kg$ ; displacement $s = 30\,m$ ; Force $(F) = 3N$

$\theta = 60^\circ$

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

$\Rightarrow 3(30)\cos 60^\circ$

$\Rightarrow 90 \times \frac{1}{2}$

$\Rightarrow 45\,J$.

6

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

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

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

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

work done $= \vec{F} \cdot \vec{s} = (5\hat{i} - 3\hat{j} + 2\hat{k}) \cdot (3\hat{i} - 5\hat{j} + 4\hat{k})$

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

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

7

Force $F = 2\hat{i} + 4\hat{j} + 3\hat{k}$ N.

It is constrained to move along z-axis by 6m

$\therefore S_z = 6\hat{k}$ m

work done $= \vec{F} \cdot \vec{s} = (2\hat{i} + 4\hat{j} + 3\hat{k}) \cdot 6\hat{k}$

$= 3 \cdot 6 = 18$ J

8

Initial speed $u = 0$ ; mass $m = 20$ kg.

Force $F = 5$ N. ; time $t = 1$ sec

From $F = ma \Rightarrow a = \frac{F}{m} = \frac{5}{20} = \frac{1}{4}$ m/s$^2$

From $S = ut + \frac{1}{2}at^2 \Rightarrow S = 0 \times 1 + \frac{1}{2} \times \frac{1}{4} (1)^2$

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

$\therefore$ work done $= F \times S = 5 \times \frac{1}{8} = \frac{5}{8}$ J.

(9)

Given displacement $\vec{s} = 10m$ ; Force $F = 5N$.

work $w = 25J$

$w = FS\cos\theta$

$\Rightarrow 25 = 5\times10\times\cos\theta$

$\Rightarrow \cos\theta = \frac{25}{50} = \frac{1}{2} \Rightarrow \theta = 60^\circ$

(10)

Given Force $F = 6\hat{i} - 8\hat{j}$ N.

displacement $\vec{s} = 4\hat{i} + 6\hat{j}$.

work done $w = \vec{F}\cdot\vec{s} \Rightarrow (6\hat{i} - 8\hat{j})\cdot(4\hat{i} - 6\hat{j})$

$w = 6\times4 + (-8)(-6) = 24 + 48 = 72J$

<u>Advanced level</u>

(2)

work done by the gravitational force is -ve because Force and displacement are in opposite directions

$\theta = 180^\circ$ ; $w = FS\cos180^\circ = -FS$.

work done by the applied force is +ve because $F_{appl.}$ and displacement are in same directions.

(8), (9), (10)

Given $m = 1kg$ ; horizontal distance $S_x = 1m$, Force = 8

vertical distance $S_y = 2m$.

$w_{Horizontally} = F_x S_x \Rightarrow 8\times1 = 8J$

$W_{vertically} = mg\,F_y\times S_y = mgh = 1\times10\times2 = 20J$

$w_{net} = W_H + W_V = 8J + 20J = 28J$