foundation class 9th

cos-8 → Power

Thank.

(1)

Given mass $m = 10^3$ kg ; No. of floors = 6.

height of each floor = 3.5 m. ; time to cross each floor = 6 sec.

Total height to which lift was lifting load = 6×3.5 = 21 m.

$$P = \frac{W}{t} = \frac{mgh}{t} = \frac{10^3 \times 10 \times 21}{6} = 35 \times 10^3$$

If we take $g = 9.8\ m/s^2$ we get $P = 3.43 \times 10^3$ W

→ A

(2)

Given force = 40N.

distance travelled S = 30m ; time = 1min = 60sec.

$$\text{Power} = \frac{W}{t} = \frac{F.S}{t} = \frac{40 \times 30}{60} = \frac{40}{2} = 20\ W.$$

→ C

(3)

Given Speed $V = 20$ m/s . Resistance = 600 N.

Power = F.V = 600×20 = 12000W = 12 kW

→ C

(4)

Given mass m = 100 kg ; time t = 10s ; h = 100m

$$\text{Power} = \frac{mgh}{t} = \frac{100 \times 9.8 \times 100}{10} = 9.8 \times 10^3 = 9800\ W$$

→ A

(5)

Given speed $v = 30^{0} m/s$

Resistance = 300N

Power: $F\,v = 300 \times 300 = 90000 W$

$= 90 kW$ — B

(6)

Given mass $m = 300 kg$; time = 60 sec.

depth $h = 20m$ height = 20m.

work done $w = mg(h+d) = 300 \times 9.8 (20+20)$

$= 300 \times 9.8 \times 40$

Power = $\frac{\text{work}}{\text{time}} = \frac{\cancel{300}^{100} \times 9.8 \times \cancel{40}^{2}}{\cancel{60}_{3}} = 19.6 \times 100$

$= 1.96 \times 10^3 w = 1.96 kw \rightarrow C$

(7)

Given mass $m = 200 kg$; height $h = 200m$

$t = 10 s$

Power $= \frac{w}{t} = \frac{mgh}{t} = \frac{200 \times 200 \times \cancel{10}}{\cancel{10}}$

$= 4 \times 10^3 w = 40 kw \rightarrow A$

(8)

depth = 20m. vol = 2238 lit = $2238 \times 10^{-3} m^3$

height = 10m ; Power = 1 Hp = 748 w.

$(m = d\,v$

$= 2238 \times 10^{-3} \times 10^3$

$P = \frac{w}{t} = \frac{mg(d+h)}{t}$

$\Rightarrow 748 = \frac{2238 \times 10 \times (20+30)}{t} \Rightarrow t = \frac{2238 \times 10 \times 30}{748} = 15 min$

$= 897 sec$

(9)

Given $m = 2.05 \times 10^6$ kg ; speed = $u = 5$ m/s

time = 5 min = 5×60 sec $\qquad v = 25$ m/s

$$\text{Power} = \frac{W}{t} = \frac{\text{change in K.E}}{\text{time}}$$

$$= \frac{\frac{1}{2} m (v^2 - u^2)}{t} = \frac{\frac{1}{2} \times 2.05 \times 10^6 (25^2 - 5^2)}{5 \times 60}$$

$$= \frac{2.05 \times 10^6 \times 30 \times 20}{10 \times 60 \times 2} = 2.05 \times 10^6 = 2.05 \text{ MW}$$

(10)

Given $m = 2$ kg starts from rest i.e. $u = 0$

$v = 20$ m/s $\qquad t = 4$ s $\qquad$ <u>From</u> $v = u + at$

$$\Rightarrow 20 = 0 + 4a$$

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

$$\text{Power} = \frac{W}{t} = \frac{\text{change in K.E}}{\text{time}}$$

$$= \frac{\frac{1}{2} m (v^2 - u^2)}{t} = [illegible]$$

= [illegible]

At the end of 2 sec

$v = u + at = 0 + 2 \times 5 = 10$ m/s

$$\therefore \; W = \frac{\frac{1}{2} \times 2 (10^2 - 0^2)}{2} = \frac{100}{2} = 50 \text{ W}$$

Advanced

(1)

A body can have energy without having momentum if it Posess P.E but if body Possess momentum then it must Posses K.E. momentum and energy have different dimension. A body can not have energy without having momentum but it can have momentum without having energy.

(d)

Due to law of conservation of linear momentum both gun and bullet have same momentum but in opposite directions.

(2)

(a) Given $m = 100\,kg$; $t = 10\,sec$; $h = 100m$.

$$P = \frac{mgh}{t} = \frac{100 \times 10 \times 100}{10} \; 10000W = 10\,kW$$

(6)

Given

speed $v = 20\,m/s$. Power $= 3\,kW$.

From $P = F \cdot v$

$3 \times 10^3 = F \times 20$

$$F = \frac{300\cancel{0}}{2\cancel{0}} = 150N$$

(7)

Number of bullets per min $= \frac{N}{t} = \frac{300}{60} = 5$ /sec

velocity $v = 100$ m/s

power $= 250$ w.

$\therefore P = \frac{N \frac{1}{2} m v^2}{t}$

$\Rightarrow \cancel{250}^{50} = \cancel{5} \times \frac{1}{\cancel{2}} \times m \times (100)^2$

$\Rightarrow 10\cancel{0} = m \times (100)^{\cancel{2}}$

$\therefore m = \frac{1}{100}$ kg $= 10$ gm

LTask

CUQ X

(8)

Given Power $= 0.392$ w ; $h = 10$m

$= 392 \times 10^{-3}$ ~~K~~w $t = 60$ sec

$P = \frac{mgh}{t}$

$\Rightarrow 392 \times 10^{3} = \frac{m \times 9.8 \times 10}{60}$

$\Rightarrow m = \frac{\cancel{392}^{4} \times 10^{3} \times 60}{\cancel{98}} = 240 \times 10^{-3} \times 10^{3}$

$= 240$ kg [power 392×10^{-2} Kw
$= 392$ w]

(10)

The rate of the water flowing through pipe is $\frac{dm}{dt} = AV\rho$

where $A \to$ Area of cross section

$V \to$ velocity of water

$\rho \to$ density of water.

Power $= F\,V$

$= \frac{dm}{dt} V\,V$

$P = V^2 \frac{dm}{dt}$

To get 'n' times of water from same pipe

Rate of flow of water $\frac{dm'}{dt} = n\frac{dm}{dt}$

$\Rightarrow AV'\rho = n\,AV\rho$

velocity of water becomes $V' = nV$.

so Power $P' = F'V' = \left[V'\frac{dm'}{dt}\right]V'$

[From newton's II law]

$P' = \frac{dm'}{dt} V'^2 = n\frac{dm}{dt}(nV)^2$

$P' = n\,n^2\,V^2\frac{dm}{dt}$.

$P' = n^3\,P$

Jee main's level

(1)

Given $T = 4500\,N.$: $V = 2\,m/s$

Power $= T \times V = 4500 \times 2 = 9000\,W$

$= 9\,kW$

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(2)

Given $V = 20\ m/s$: Power $= 7500W$.

From $P =$ Force $\times$ velocity

$\Rightarrow 7500 = F \times 20$

$F = 375\ N.$

(3)

Given $\frac{dm}{dt} = 100\ kg/s$: $h = 100m.$

Power delivered to turbine - $W = \frac{mgh}{t}$

$W = 100 \times 10 \times 100$

$= 100\ kW$

(4)

Given Power $= 10\ kW = 10^4 W$: $m = 200\ kg$: $h = 40m$

we know Power $= \frac{mgh}{t}$

$\Rightarrow t = \frac{mgh}{P} = \frac{200 \times 10 \times 40}{10^4}$

$\Rightarrow t = 2 \times 4 = 8\ sec$

(5)

velocity $= 7.2\ kmph = 7.2 \times \frac{5}{18} = 2\ m/s$

slope $= \sin\theta = \frac{1}{20}$: $m = 100\ kg$

power $= mg \sin\theta\, v = 100 \times 9.8 \times \frac{1}{20} \times v$

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

$= 98\ W$

⑥

volume = 4000×10^{-6} m3

time = 1 min = 60 sec. ; Pressure = 130 mm of Hg

$\rho_{Hg} = 13.6 \times 10^{3}$ kg / m3

Power = $\rho g \times V \times t$

$= 13.6 \times \cancel{10^3} \times 10 \times 4\cancel{000} \times \cancel{10^{-6}} \times 60$

$= 136 \times 60$

$= \frac{8160}{748} = 1.1$ H.P → c.

⑦

Tension = 4500 N: V = 22 m/s

Power = T V

= 4500×22

= 99 kw → B

⑧

Power = 100 Hp: speed = 72 kmph.

$= 100 \times 748$ W $= 72 \times \frac{5}{18} = 20$ m/s

Power = Force × thrust

$\Rightarrow 748 \times \cancel{100}^{5} = F \times 20$

$\Rightarrow F = 3740$ N → D

(9)

$V = 9\text{ kmph} = 9 \times \frac{5}{18} = \frac{5}{2}\text{ m/s}$

$m = 100\text{ kg}$; $\theta = 30^\circ$

Power $= mg\sin\theta\, V$

$= 100 \times 10 \times \sin 30 \times \frac{5}{2}$

$\Rightarrow \overset{50}{\cancel{100}} \times \overset{5}{\cancel{10}} \times \frac{1}{\cancel{2}} \times \frac{5}{\cancel{2}}$

$= 1250\text{ W}$

(10)

~~$m = 7200\text{ kg}$~~ $t = 1\text{ hr} = 3600\text{ sec}$; depth $= 100\text{ m}$

~~$\eta = 50\% = \frac{50}{100} = \frac{1}{2}$~~

$\Rightarrow \frac{P_{out}}{P_{in}} = \frac{1}{2} \Rightarrow P_{out} = \frac{P_{in}}{2}$

~~$\Rightarrow P_{out} = \frac{mgh}{2t} = \frac{7200 \times 10 \times 100}{3600 \times 2} = 1000\text{ W}$~~

(10)

Given $m = 7200\text{ kg}$; $t = 1\text{ hr} = 3600\text{ sec}$; depth $= 100\text{ m}$

$\eta = 50\% \Rightarrow \frac{P_o}{P_{in}} = 0.5$

$\Rightarrow P_o = 0.5\, P_{in}$

$\Rightarrow \frac{mgh}{t} = 0.5 \times P_{in}$

$\Rightarrow \frac{\overset{2}{\cancel{7200}} \times 10 \times 100}{\cancel{3600}} = 0.5\, P_{in}$

$P_{in} = \frac{2 \times 10^3}{0.5}$

$= 4 \times 10^3$

$= 4\text{ kW}$

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Advanced level

②

$m_1 = 50$ kg ; $m_2 = 30$ kg . $h = 20$m ; $t = 40$ sec.

work done in lifting $= (m_1+m_2)gh$

$= (50+30) \times 10 \times 20$

$= 80 \times 10 \times 20$

$= 16000$ J.

Power $= \frac{W}{t} = \frac{16000}{40} = 400$ W

③

At maximum height Total K.E is converted into P.E , because Energy is conserved.

④

Given $F = \hat{i}+\hat{j}+\hat{k}$ N. ; $\vec{v} = \hat{i}-\hat{j}+\hat{k}$ m/s

Power $= F \cdot V = (\hat{i}+\hat{j}+\hat{k}) \cdot (\hat{i}-\hat{j}+\hat{k})$

$= 1\times1 + 1\times(-1) + 1\times1$

$= 1-1+1 = 1$ W

6, 7, 8 8

when body reaches maximum height

$$T.E = mgh$$

$$\Rightarrow K.E + P.E = mgh.$$

At a height $\frac{3h}{4}$; $P.E = mg\left(\frac{3h}{4}\right) = \frac{3}{4}mgh \rightarrow A$

$$\therefore K.E + P.E = mgh$$

$$\Rightarrow K.E = mgh - P.E = mgh - \frac{3}{4}mgh = \frac{1}{4}mgh \rightarrow B$$

$$\therefore \frac{K.E}{P.E} = \frac{\frac{3}{4}mgh}{\frac{3}{4}mgh} = \frac{1}{3}.$$

9 10

Rate of amount of water flowing per sec $= \frac{dm}{dt} = Av\rho$

where $A \rightarrow$ Area , $v \rightarrow$ velocity; $\rho \rightarrow$ density of water

$$\text{Force} = \frac{dp}{dt} = \frac{d}{dt}(mv) = v\frac{dm}{dt}$$

$$\text{Power } P = F \times V = v\frac{dm}{dt}v = v^2\frac{dm}{dt}.$$

To obtain 'n' times of water from same Pipe

$$\left(\frac{dm}{dt}\right)' = n\frac{dm}{dt} = Av'\rho$$

$$\therefore Av'\rho = n\,Av\rho \Rightarrow \boxed{v' = nv}$$

$$\text{force } F' = v'\left(\frac{dm}{dt}\right)' = (nv)\left(n\frac{dm}{dt}\right) = n^2 v\frac{dm}{dt}$$

$$\boxed{F' = n^2 F}$$

$$\text{Power } P' = F'v' = (n^2F)(nv) = n^3 FV = n^3 P$$