WS-17 → 7th and WS-11 . 8th class are same.
WS-14 7th foundation + PO

Power Thank

(1)

Given weight of boy = 600 N = mg

height = 10m : time = 12 sec

we know power = $\frac{w}{t} = \frac{mgh}{t}$

$P = \frac{\overset{50}{\cancel{600}} \times 10}{\cancel{12}} = 500\,w$ → B

(2)

Power of human heart = P = 10w

mass m = 70 kg

Time = 1 year = 365×86400 sec

or = 365×24 hrs.

we know Power = $\frac{\text{Energy}}{\text{time}}$

⇒ E = P × time

⇒ 10 × 365 × 24

= 87600

⇒ 87.6 kw

≃ 88 kw ≃ 100 kw → B

(3)

Given efficiency $\eta = 80\% = \frac{80}{100} = \frac{4}{5}$

volume of water $V = 800$ lit $= 800 \times 10^{-3}$ m^3

time $t = 19.6$ sec

$h = 20$ m

mass of water = density × volume

$= 10^3 \times 800 \times 10^{-3}$

$= 800$ kg.

output Power $= \frac{W}{t} = \frac{mgh}{t} = \frac{800 \times 9.8 \times 20}{19.6} = 8000$ kW

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

$= \frac{5}{4} \times 8000$

$= 10000 = 10$ kW → A.

(4)

mass of car $M = 10^3$ kg.

slope $= \frac{2}{25} \Rightarrow \sin\theta$.

speed $v = 18$ kmph $= 18 \times \frac{5}{18} = 5$ m/s

Power $= f\, v$

$= mg \sin\theta \times v$

$= 10^3 \times 9.8 \times \frac{2}{25} \times 5 = 10^3 \times 9.8 \times 0.4$

$= 3.92 \times 10^3$

$\simeq 4 \times 10^3$ [For $g = 10$ m/s^2]

$\simeq 4$ kW → A.

(5)

Given $m_{coal} = 10^4$ kg ; time = 1 hr = 3600 sec

depth = 180 m $\eta_{crane} = 80\% = \frac{80}{100} = \frac{4}{5}$

$P_{out} = \frac{mgh}{t} = \frac{10^4 \times 10 \times 180}{3600} = 5 \times 10^3$ W

$\eta = \frac{P_{out}}{P_{in}} \Rightarrow P_{out} = \eta P_{in}$

$\Rightarrow P_{in} = \frac{5}{4} \times 5 \times 10^3 = 6.25 \times 10^3$

$= 6.25$ kW → B

(6)

Given No. of bullets per min $= \frac{240}{60}$

$m_{bullet} = 10$ gm $= 10 \times 10^{-3}$ kg ; Power $= 7.2$ kW $= 7.2 \times 10^3$ W

From Power $= \frac{W}{t} = \frac{N \frac{1}{2} m v^2}{t}$

$\Rightarrow 7.2 \times 10^3 = \frac{240}{60} \times \frac{1}{2} \times 10^{-2} \times v^2$

$\Rightarrow 72 \times 10^2 = 2 \times 10^{-2} v^2$

$\Rightarrow v^2 = 36 \times 10^4 \Rightarrow v = \sqrt{36 \times 10^4} = 600$ m/s → B

(7)

According to given data $m_2 = 2m_1$; $V_2 = \frac{1}{2} V_1$

we know $P = \frac{W}{t} = \frac{\frac{1}{2} m v^2}{t}$

$\frac{P_1}{P_2} = \frac{m_1}{m_2} \left(\frac{V_1}{V_2}\right)^2 \Rightarrow \frac{P_1}{P_2} = \frac{m_1}{2m_1} \left[\frac{V_1}{\frac{V_1}{2}}\right]^2 = \frac{1}{2} \times 2^2 = \frac{2}{1}$ → D

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(8)

Given $h = 20m$ volume $v = 10m^3$

time = 20 min = $20 \times 60 s$ efficiency $\eta = 60\%$ $= \frac{3}{5}$

we know $\eta = \frac{P_{out}}{P_{in}}$

$\Rightarrow P_{in} = \frac{1}{\eta} P_{out} = \frac{5}{3} \times \frac{mgh}{t}$

$= \frac{5}{3} \times \frac{d \times vol \times g \times h}{t}$

$= \frac{5}{3} \times \frac{10^3 \times 10 \times 10 \times 20}{20 \times 60}$

$= \frac{50}{18} \times 10^3 W = 2.74 kW$

(9)

we know Power $= \frac{W}{t} = \frac{\frac{1}{2} mv^2}{t}$

Power $= \frac{1}{2} \times \frac{d \times vol \times v^2}{t}$

$= \frac{1}{2} \times d \times A \times \frac{l}{t} v^2$

$= \frac{1}{2} dAv^3 \rightarrow D$

where $l \rightarrow$ distance covered by air

(10)

efficiency $\eta = \frac{\text{Power load}}{\text{Power of effort}} \times 100 = \frac{2 \times 10^3 \times 0.2}{5 \times 10^2} \times 100$

$= 80\% \rightarrow C$

Advanced

①

(a) we know $K.E = \frac{p^2}{2m}$ and $p = mv$.

Energy $\propto p^2$. where p = momentum.

A body can have energy without having momentum if it posess P.E but if body possess momentum then it must posses K.E.

∴ A body can not have energy without having momentum.

(c) Inorder to start train and accelerate it to a given speed, the locomotive(s) must develop sufficient tractive force to overcome the trains resistance.

(d) when a gun fires a bullet both gain equal momentum but in opposite direction due to law of conservation of linear momentum.

②

Given mass = 100 kg; time t = 10 sec; height = 100m

$$\text{Power} = \frac{W}{t}$$

$$= \frac{mgh}{t} = \frac{100 \times 10 \times 100}{10} = 10 \times 10^3 \, W$$

$$= 10 \, kW$$

(6) (8), (7):

In case of vertically projected body

$$T.E = K.E + P.E$$

Here $T.E = \frac{1}{2}mu^2$ $\quad h = H_{max} = \frac{u^2}{2g}$

$$= \frac{1}{2} m\, 2gH$$

$$= mgH = mgh$$

at a height $H = \frac{3h}{4}$

$$P.E = mgH = \frac{3mgh}{4}$$

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

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

LTask

CUQ's

(2)

Given mass = M ; velocity = v

$$\text{Power} = Fv = Mgv$$

(4)

Given mass = M; height = h.

$$\text{Power} = \frac{W}{t} = \frac{mgh}{t} = mg\frac{h}{t}$$

$$= mgv$$

(6)

Given angle between force and velocity is $\theta = 90^\circ$

$$\text{Power} = f v \cos\theta$$
$$= f v \cos 90^\circ = 0$$

(8)

Given power $= .392\ kW = 0.392 \times 10^3 = 392\ W$.

height $h = 10m$; $t = 60$ sec

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

$$\Rightarrow 392 = \frac{mgh}{t}$$

$$\Rightarrow m = \frac{392 \times t}{gh} = \frac{392 \times 60}{9.8 \times 10}$$

$$\Rightarrow M = 240\ kg \rightarrow A$$

(10)

If a liquid of density d is flowing through a pipe of cross section A, at speed v.

The mass coming per sec $\frac{dm}{dt} = \rho A v$

In order to get n times of water $\left(\frac{dm}{dt}\right)' = n \frac{dm}{dt}$

i.e. $A v' \rho = n A v \rho$

$\Rightarrow v' = nv$

$\therefore F = \text{Force} = v \frac{dm}{dt}$; Power $= F \cdot v = P$

After mass increased by 'n' times force $F' = v' \left(\frac{dm}{dt}\right)'$

$$F' = nv\, n \frac{dm}{dt} = n^2 v \frac{dm}{dt} = n^2 F$$

$$P' = \text{Power} = F' v' = n^2 F n v$$
$$= n^3 F v = n^3 P$$

Jee main level

(1)

Given $m = 50\,kg$ height $h = 40m$; $t = 25s$

Power = 1568 W

$\Rightarrow$ Power = $\frac{Mgh}{t}$ $\Rightarrow 1568 = \frac{(50+m) \times 10 \times 40}{25}$

$\Rightarrow 50 + m = \frac{1568}{16} = 98$

$\Rightarrow m = 98 - 50 = 48\,kg \simeq 50\,kg \rightarrow D$

(2)

Given $T = 4500\,N$; $v = 2\,m/s$

Power = force × velocity = $4500 \times 2 = 9000\,W$

$= 9\,kW \rightarrow B$

(4)

Number of bullets fired per sec $= \frac{N}{t} = 3$.

velocity $v = 10\,m/s$; $m_{bullet} = 0.05\,kg$

Power $= \frac{W}{t} = \frac{N \frac{1}{2} m v^2}{t}$

$= 3 \times \frac{1}{2} \times 0.05 \times 10^2$

$= \frac{3}{2} \times 5 \Rightarrow 7.5\,W$

(5)

volume of water $V = 2400\,lit = 2400 \times 10^{-3}\,m^3$

time $t = 6\,min$; height $h = 12m$

Power $= \frac{W}{t} = \frac{mgh}{t} = \frac{d \times vol \times g \times h}{t} = \frac{10^3 \times 2400 \times 10^{-3} \times 10 \times 12}{6 \times 60}$

$= 800\,W \rightarrow B$

(6)

$\frac{m}{t} = 2\,gm/sec = 2\times10^{-3}\,kg/sec$

speed $v = 150\,m/s$

$power = \frac{\frac{1}{2}mv^2}{t} = \frac{1}{2}\times 2\times10^{-3}\times(150)^2$

$= 10^{-3}\times 225\times100$

$= 22.5W \rightarrow B$

(7)

Given volume $= 500\,lit = 500\times10^{-3}\,m^3$

depth $d = 50m$; $t = 98\,sec$

$Power = \frac{mgh}{t} = \frac{d\times vol\times g\times h}{t}$

$\Rightarrow P = \frac{10^3\times500\times10^{-3}\times9.8\times50}{98} = 2500\,W$

$= 2.5\times10^3 W = 2.5kW \rightarrow D$

(8)

Given $T = 4000\,N$; speed $v = 3\,m/s$.

$Power = Tv = 4000\times3 = 12000 = 12\,kW$

(9)

Given Power $P = 20\,kW$. mass $= 5\,ton = 5\times10^3\,kg$

$t = 2\,sec$

$P = \frac{W}{t} = \frac{\frac{1}{2}mv^2}{t}$

$\Rightarrow 20\times10^3 W = \frac{1}{2}\times\frac{5\times10^3\times v^2}{2}$

$\Rightarrow 80 = 5v^2$

$\Rightarrow v^2 = \frac{80}{5} = 16$ $\Rightarrow v = \sqrt{16} = 4\,m/s \rightarrow B$

(10)

$\eta_{motor} = 90\%$ $\eta_{pump} = 80\%$

$\therefore$ overall efficiency $= \eta_{motor} \times \eta_{pump}$

$= 90 \times 80 = 7200\%\%$

$\approx 72\%$

Advanced

(2)

Given $m_1 = 50kg$; height $h = 20m$; time $= 40sec$.

$m_2 = 30kg$

$\text{Power} = \frac{mgh}{t} = \frac{80 \times 20 \times 10}{40} = 400W$

(4)

Given Force $= \hat{i} + \hat{j} + \hat{k}$ N; $V = \hat{i} - \hat{j} + \hat{k}$ m/s

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

$= 1 \cdot 1 + 1 \cdot (-1) + 1 \cdot 1$

$= 1 - 1 + 1 = 1W$