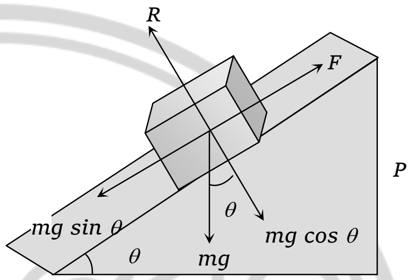
Power

1. (a)

2. (d) $P = \vec{F}.\vec{v} = ma \times at = ma^2 t$ [as u = 0]

$= m\left(\frac{v_1}{t_1}\right)^2 t = \frac{mv_1^2 t}{t_1^2}$ [As $a = v_1/t_1$]

3. (d) $v = 7.2\frac{km}{h} = 7.2 \times \frac{5}{18} = 2\ m \rightleftarrows / \rightleftarrows\ s$



Slope is given 1 in 20

$\therefore\ \sin\theta = \frac{1}{20}$

When man and cycle moves up then component of weight opposes it motion *i.e.* $F = mg\sin\theta$

So power of the man $P = F \times v = mg\sin\theta \times v$

$=100 \times 9.8 \times \left(\frac{1}{20}\right) \times 2 = 98\ Watt$

4. (b) If a motor of 12 *HP* works for 10 days at the rate of 8 *hr/day* then energy consumption = power × time

$= 12 \times 746 \frac{J}{secsec}$

$= 12 \times 746 \times 80 \times 60 \times 60\ J$ = 2.5 × 10^9 *J*

Rate of energy = $50 \frac{paisa}{kWh}$

i.e. $3.6 \times 10^6 J$ energy cost 0.5 *Rs*

So 2.5 × 10^9 *J* energy cost = $\frac{2.5 \times 10^9}{2 \times 3.6 \times 10^6} = 358\ Rs$

5. (c) $P = Fv = 500 \times 3 = 1500W = 1.5kW$

6. (a) $P = Fv = F \times \frac{s}{t} = 40 \times \frac{30}{60} = 20W$

7. (b) $P = Fv = 4500 \times 2 = 9000W = 9kW$

8. (d) $P = \frac{\text{Workdone}}{\text{Time}} = \frac{mgh}{t} = \frac{300 \times 9.8 \times 2}{3} = 1960W$

9. (d) $P = \frac{mgh}{t} \Rightarrow m = \frac{p \times t}{gh} = \frac{2 \times 10^3 \times 60}{10 \times 10} = 1200kg$

As volume = $\frac{\text{mass}}{\text{density}} \Rightarrow v = \frac{1200kg}{10^3 kg/m^3} = 1.2m^3$

Volume = $1.2m^3 = 1.2 \times 10^3 litre = 1200\ litre$

10. (c) $P = \frac{mgh}{t} = 10 \times 10^3 \Rightarrow t = \frac{200 \times 40 \times 10}{10 \times 10^3} = 8\text{ sec}$

11. (c) Force required to move with constant velocity

$\therefore$ Power = FV

Force is required to oppose the resistive force R and also to accelerate the body of mass with acceleration a.

$\therefore$ Power = $(R + ma)V$

12. (d) $P = \frac{mgh}{t} = \frac{100 \times 9.8 \times 50}{50} = 980J/s$

13. (a) $P = \left(\frac{m}{t}\right) gh = 100 \times 10 \times 100 = 10^5 W = 100\ kW$

14. (a) $p = \frac{mgh}{t} = \frac{200\times10\times200}{10} = 40kW$

15. (c)Volume of water to raise = 22380 *l* = 22380×10^{-3}m^3

$P = \frac{mgh}{t} = \frac{V\rho gh}{t} \Rightarrow t = \frac{V\rho gh}{P}$

$t = \frac{22380\times10^{-3}\times10^{3}\times10\times10}{10\times746} = 15min$

16. (c) Force produced by the engine $F = \frac{P}{v} = \frac{30\times10^3}{30} = 10^3 N$

Acceleration=$\frac{\text{Forward force by engine–resistive force}}{\text{mass of car}}$

$= \frac{1000-750}{1250} = \frac{250}{1250} = \frac{1}{5} m/s^2$

17. (b) Power=$\frac{\text{Work done}}{\text{time}} = \frac{\frac{1}{2}m(v^2-u^2)}{t}$

$P = \frac{1}{2} \times \frac{2.05\times10^6\times[(25)^2-(5^2)]}{5\times60}$

$P = 2.05 \times 10^6 W = 2.05MW$

18. (a) As truck is moving on an incline plane therefore only component of weight $(mg \sin\theta)$ will oppose the upward motion

Power = force × velocity = $mg \sin\theta \times v$

$$= 30000 \times 10 \times \left(\frac{1}{100}\right) \times \frac{30 \times 5}{18} = 25kW$$

19. (c) $P = \frac{mgh}{t} \Rightarrow \frac{P_1}{P_2} = \frac{m_1}{m_2} \times \frac{t_2}{t_1}$ (As *h* = constant)

$\therefore \frac{P_1}{P_2} = \frac{60}{50} \times \frac{11}{12} = \frac{11}{10}$

20. (c) Power of a pump= $\frac{1}{2}\rho A v^3$

To get twice amount of water from same pipe *v* has to be made twice. So power is to be made 8 times.

21. (a) $p = \frac{mgh}{t} = \frac{80\times9.8\times6}{10} W = \frac{470}{746} HP = 0.63 HP$

22. (b) Power= $\frac{\text{Work done}}{\text{time}} = \frac{\text{Increase in K.E.}}{\text{time}}$

$$P = \frac{\frac{1}{2}mv^2}{t} = \frac{\frac{1}{2}\times10^3\times(15)^2}{5} = 22500W$$

23. (a) Motor makes 600 revolution per minute

$\therefore$ $n = 600 \frac{\text{revolution}}{\text{minute}} = 10 \frac{rev}{sec}$

$\therefore$ Time required for one revolution = $\frac{1}{10} sec$

Energy required for one revolution = power × time

$$= \frac{1}{4}\times746\times\frac{1}{10} = \frac{746}{40} J$$

But work done = 40% of input

$$= 40\% \times \frac{746}{40} = \frac{40}{100}\times\frac{746}{40} = 7.46J$$

24. (a) Work output of engine = $mgh = 100\times10\times10 = 10^4 J$

Efficiency (η) = $\frac{\text{output}}{\text{input}}$ $\therefore$ Input energy = $\frac{\text{output}}{\eta}$

$$= \frac{10^4}{60}\times100 = \frac{10^5}{6} J$$

$\therefore$ Power = $\frac{\text{input energy}}{\text{time}} = \frac{10^5 \rightleftarrows / \rightleftarrows 6}{5} = \frac{10^5}{30} = 3.3\ kW$

25. (a) $P = \frac{\vec{F}.\vec{s}}{t} = \frac{(2\hat{i}+3\hat{j}+4\hat{k}).(3\hat{i}+4\hat{j}+5\hat{k})}{4} = \frac{38}{4} = 9.5\ W$

26. (a) $P = \frac{W}{t} = \frac{mgh}{t} = \frac{200\times10\times50}{10} = 10 \times 10^3 W$

27. (a) Power of gun $= \frac{\text{Total K.E. of fired bullet}}{\text{time}}$

$= \frac{n\times\frac{1}{2}mv^2}{t} = \frac{360}{60} \times \frac{1}{2} \times 2 \times 10^{-2} \times (100)^2 = 600W$

28. (a) Energy supplied to liquid per second by the pump

$= \frac{1}{2}\frac{mv^2}{t} = \frac{1}{2}\frac{V\rho v^2}{t} = \frac{1}{2}A \times \left(\frac{l}{t}\right) \times \rho \times v^2 \left[\frac{l}{t} = v\right]$

$= \frac{1}{2}A \times v \times \rho \times v^2 = \frac{1}{2}A\rho v^3$

29. (a) Power $= \frac{\text{workdone}}{\text{time}} = \frac{\text{pressure} \times \text{change in volume}}{\text{time}}$

$= \frac{20000\times1\times10^{-6}}{1} = 2 \times 10^{-2} = 0.02\ W$

30. (c) Power $= \frac{W}{t}$. If W is constant then $P \propto \frac{1}{t}$

i.e. $\frac{P_1}{P_2} = \frac{t_2}{t_1} = \frac{20}{10} = \frac{2}{1}$