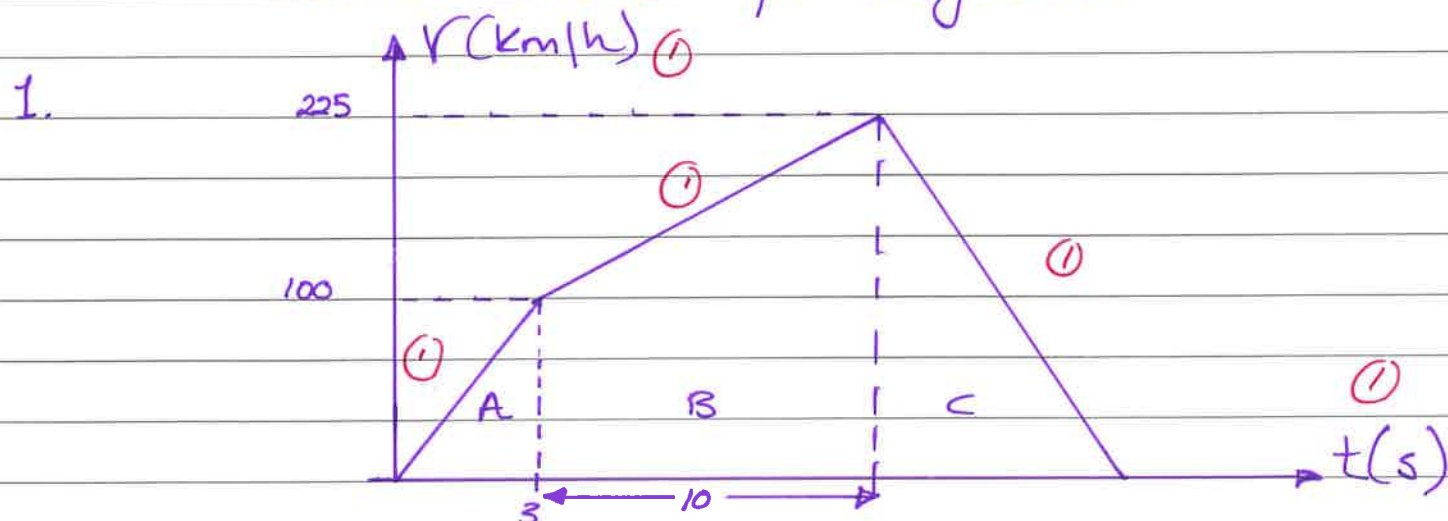


Exam 2018-2019 May. U4X01505
Further Science for Engineers.



a) Looking @ 'A':

$$u = 0$$

$$v = 100 \text{ km/h} \times \frac{1000}{3600} = 27.78 \text{ m/s (2dp)}$$

$$t = 3 \text{ s}$$

$$a = ?$$

$$v = u + at$$

$$a = \frac{v - u}{t}$$

$$a = \frac{27.78}{3} = 9.26 \text{ m/s}^2$$

b) Looking @ 'B':

$$u = 27.78 \text{ m/s}$$

$$v = 225 \text{ km/h} \times \frac{1000}{3600} = 62.5 \text{ m/s}$$

$$t = 10 \text{ s}$$

$$a = ?$$

$$a = \frac{v - u}{t}$$

$$a = \frac{62.5 - 27.78}{10}$$

$$a = 3.47 \text{ m/s}^2$$

c)

$$u = 62.5 \text{ m/s}$$

$$v = 0$$

$$s = 65 \text{ m}$$

$$t = ?$$

$$s = \frac{(u + v)t}{2}$$

$$t = \frac{2s}{(u + v)}$$

$$t = \frac{2 \times 65}{62.5} = 2.08 \text{ s}$$

d)

Looking @ 'A':

$$u = 0$$

$$v = 27.78 \text{ m/s}$$

$$t = 3 \text{ s}$$

$$s = ?$$

$$s = \frac{(u+v)t}{2} = \frac{27.78 \times 3}{2} = 41.67 \text{ m}$$

Looking @ 'B':

$$u = 27.78 \text{ m/s}$$

$$v = 62.5 \text{ m/s}$$

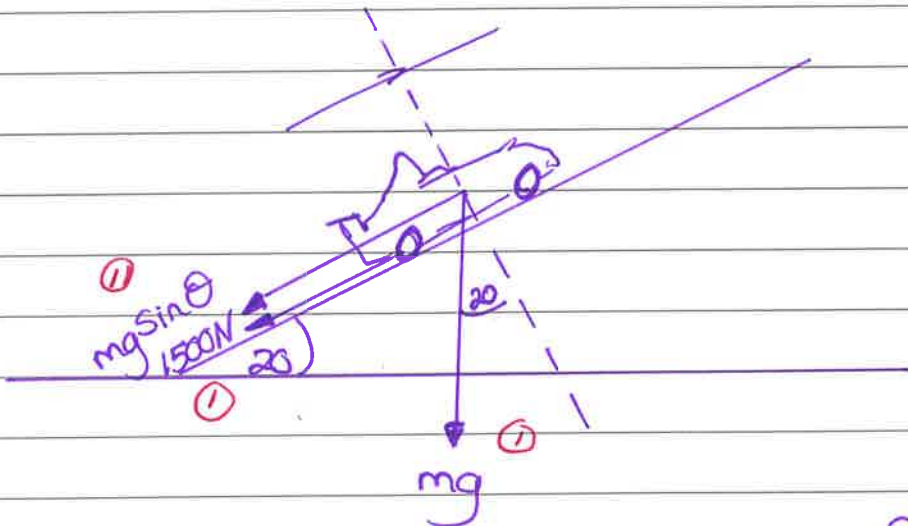
$$t = 10 \text{ s}$$

$$s = ?$$

$$s = \frac{(u+v)t}{2} = \frac{(27.78 + 62.5)10}{2} = 451.4 \text{ m}$$

$$\therefore \text{Total distance} = 41.67 + 451.4 + 65 = 558.07 \text{ m}$$

2.



$$F = mg \sin 20 + 1500$$

$$F = (888 \times 9.81 \sin 20) + 1500$$

$$F = 4479.43 \text{ N}$$

$$P = F \cdot v$$

$$v = \frac{P}{F}$$

$$v = \frac{150000}{4479.43} = 33.49 \text{ m/s}$$

3.

a) $\omega_1 = 0$

$$\omega_2 = 20000 \text{ rpm} \times \frac{2\pi}{60} = 2094.40 \text{ rad/s} \quad (2 \text{ dp})$$

$$t = 0.5 \text{ s.}$$

$$\alpha = ?$$

$$\omega_2 = \omega_1 + \alpha t$$

$$\alpha = \frac{\omega_2 - \omega_1}{t} = \frac{2094.4 - 0}{0.5} = 4188.8 \text{ rad/s}^2$$

$$T = I\alpha$$

$$I = \frac{T}{\alpha} = \frac{145}{4188.8} = 0.04 \text{ kgm}^2$$

$$b) \quad k^2 = \frac{d^2}{8} = \frac{0.26^2}{8} = 8.45 \times 10^{-3} \text{ m}^2$$

$$I = mk^2 \quad \therefore m = \frac{I}{k^2} = \frac{0.04}{8.45 \times 10^{-3}} = 4.73 \text{ kg}$$

c) $P = T\omega$

$$P = 145 \times 2094.40$$

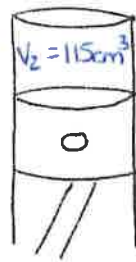
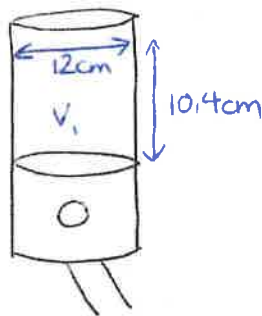
$$P = 303,688 \text{ W}$$

$$d) \quad KE = \frac{1}{2} I \omega^2 = \frac{1}{2} \times 0.04 \times 2094.40^2$$

$$KE = 87,730.23 \text{ J}$$

Question

a)



$$\begin{aligned} d &= 12\text{cm} \\ r &= 6\text{cm} \\ h &= 10.4\text{cm} \end{aligned}$$

$$\begin{aligned} V_1 &= \pi r^2 h + \text{clearance volume} \\ &= (\pi \times 6^2 \times 10.4) + 115 \\ &= 1176.21 + 115 \\ V_1 &= 1291.21\text{cm}^3 \end{aligned}$$

$$\text{Compression ratio} = \frac{V_1}{V_2} = \frac{1291.21}{115} = \frac{11.23}{1}$$

Compression ratio is 11.23 : 1

7 marks

b)

$$V_1 = 11.23$$

$$p_1 = 95\text{kN/m}^2$$

$$T_1 = 30^\circ\text{C} + 273 = 303\text{K}$$

$$V_2 = 1$$

$$p_2 = ?$$

$$T_2 = 450^\circ\text{C} + 273 = 723\text{K}$$

$$\frac{p_1 V_1}{T_1} = \frac{p_2 V_2}{T_2}$$

$$\frac{p_1 V_1 T_2}{T_1} = p_2 V_2 \quad \times T_2$$

$$\frac{p_1 V_1 T_2}{T_1 V_2} = p_2 \quad \div V_2$$

$$P_2 = \frac{P_1 V_1 T_2}{T_1 V_2} = \frac{(95 \times 11.23 \times 723)}{(303 \times 1)} \checkmark$$

$$P_2 = \frac{771332.55}{303}$$

$$P_2 = 2545.65 \text{ kN/m}^2 \checkmark$$

6 marks