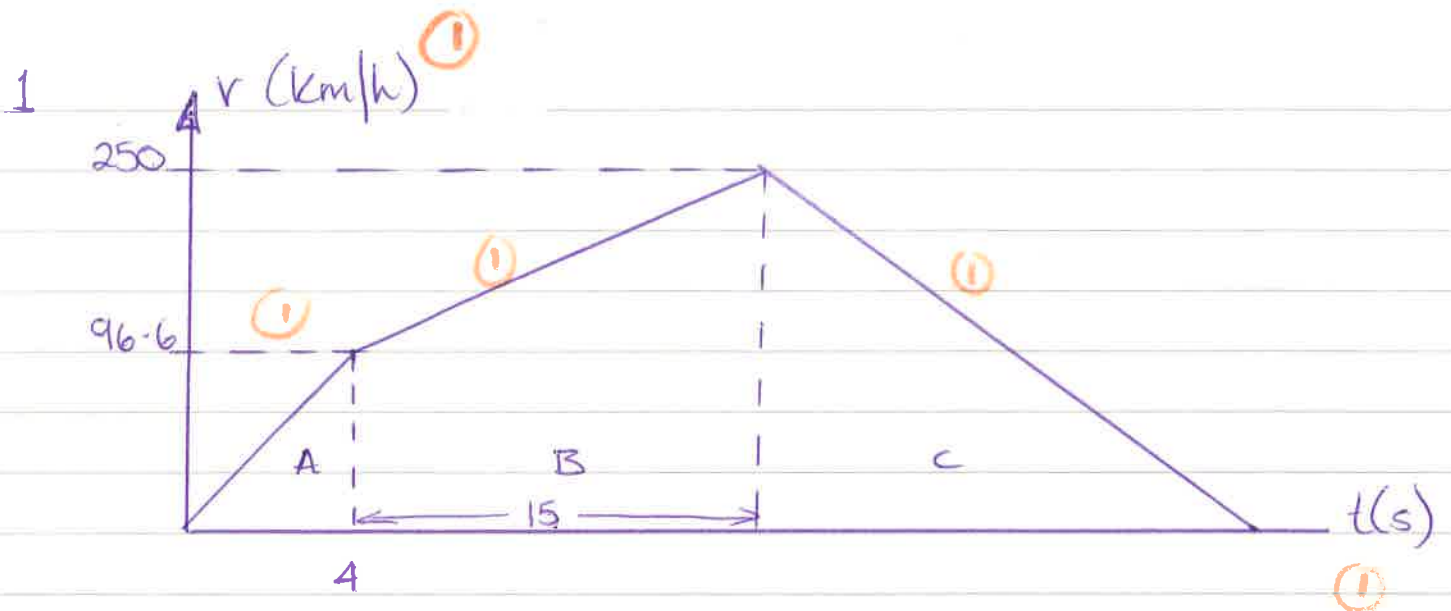




a) looking @ 'C':

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

$$u = \frac{250 \times 1000}{3600} = 69.44 \text{ m/s}$$

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

$$v = 0$$

$$s = 350 \text{ m}$$

$$t = \frac{(2 \times 350)}{(69.44)} = 10.08 \text{ s}$$

$$\therefore \text{Total time} = 4 + 15 + 10.08 = \underline{29.08 \text{ s}}$$

b) Looking @ 'A':

$$u = 0$$

$$s = \frac{(u+v)t}{2} = \frac{(26.83 \times 4)}{2}$$

$$v = \frac{96.6 \times 1000}{3600} = 26.83 \text{ m/s}$$

$$t = 4 \text{ s}$$

$$s = ?$$

$$s = 53.66 \text{ m}$$

Looking @ 'B':

$$s = \frac{(u+v)t}{2} = \frac{(26.83 + 69.44)15}{2} = 722.03 \text{ m}$$

$$u = 26.83 \text{ m/s}$$

$$v = 69.44 \text{ m/s}$$

$$t = 15 \text{ s}$$

$$s = ?$$

$$\therefore \text{Total distance} = 53.66 + 722.08 + 350 = 1125.69 \text{ m} = \underline{1.13 \text{ km}}$$

2.

$$\omega_1 = 0$$

$$\omega_2 = 18000 \text{ rpm} \times \frac{2\pi}{60} = 1884.96 \text{ rad/s}$$

$$t = 1.5 \text{ s}$$

$$\alpha = ?$$

$$d = 310 \text{ mm}$$

$$d = 0.31 \text{ m}$$

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

$$\alpha = \frac{\omega_2 - \omega_1}{t} = \frac{1884.96}{1.5}$$

$$\alpha = 1256.64 \text{ rad/s}^2$$

$$I = \frac{md^2}{8}$$

$$I = mk^2$$

$$T = I\alpha$$

$$\therefore T = \frac{md^2}{8} \cdot \alpha$$

Rearrange for m

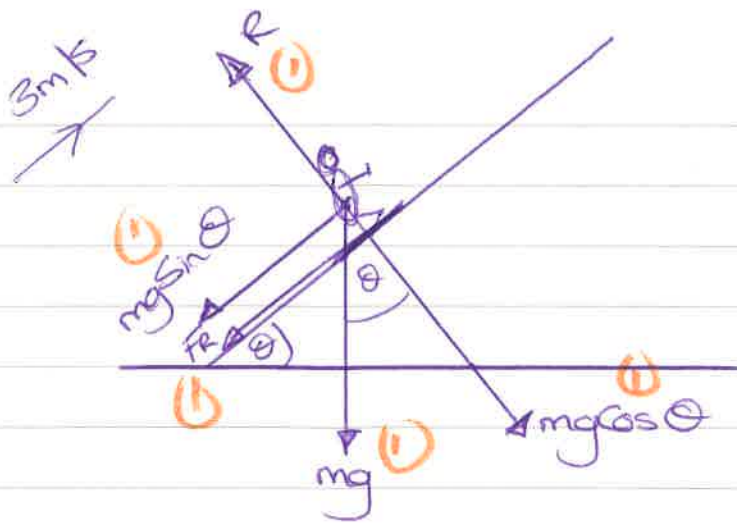
$$m = \frac{8T}{d^2 \alpha} = \frac{(8 \times 601)}{(0.31^2 \times 1256.64)} = \underline{\underline{39.81 \text{ kg}}}$$

$$KE = \frac{1}{2} I \omega^2 = \frac{1}{2} \cdot \frac{md^2}{8} \cdot \omega^2$$

$$KE = \frac{1}{2} \times 39.81 \times \frac{0.31^2}{8} \times 1884.96^2$$

$$KE = 849571.35 \text{ J} = \underline{\underline{849.57 \text{ kJ}}}$$

3.



$$P = F \cdot v$$

$$F = \frac{P}{v} = \frac{51000}{3} = 17000 \text{ N}$$

$$F = mg \sin \theta + F_R$$

$$F = mg \sin \theta + \mu R$$

$$F = mg \sin \theta + \mu mg \cos \theta$$

$$F = m [(g \sin \theta) + (\mu g \cos \theta)]$$

$$m = \frac{F}{(g \sin \theta) + (\mu g \cos \theta)}$$

$$m = \frac{17000}{(9.81 \times \sin 45) + (0.4 \times 9.81 \cos 45)}$$

$$m = 1750.52 \text{ kg}$$

$$m \text{ for 1 skier} = \frac{1750.52}{10} = \underline{\underline{175.05 \text{ kg}}}$$

$$4 \quad T_1 = (25 + 273) \text{ K} \quad (1)$$

$$P_1 = ?$$

$$V_1 = V_1 \quad (1)$$

$$T_2 = (48 + 273) \text{ K} \quad (1)$$

$$P_2 = 6 \times 10^5 \text{ Pa} \quad (1)$$

$$V_2 = V_1/6 \quad (1)$$

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2} \quad (1)$$

$$P_1 = \frac{P_2 V_2 T_1}{T_2 V_1} = \frac{6 \times 10^5 \times V_1/6 \times (25 + 273)}{(48 + 273) \times V_1} = 92.83 \times 10^3 \text{ Pa} \quad (1)$$

$$\underline{P_2 = 0.93 \text{ bar.}} \quad (1)$$

$$V_2 = 0.026 \text{ m}^3 \quad d = 0.4 \text{ m} \quad (1)$$

$$V_1 = 6 \times 0.026 \quad (1)$$

$$= 0.16 \text{ m}^3 \quad (1)$$

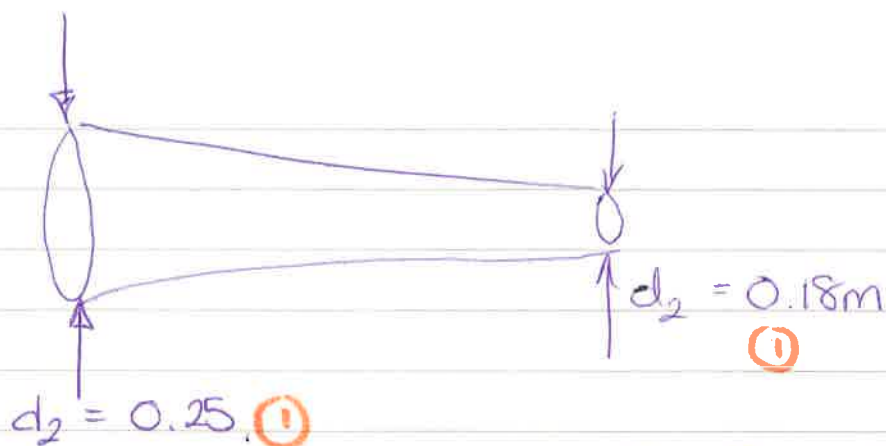
$$V_1 = \left[\left(\frac{\pi d^2}{4} \right) \times l \right] + V_2 \quad (2)$$

$$V_1 - V_2 = \frac{\pi d^2}{4} \times l \quad (1)$$

$$l = \frac{4(V_1 - V_2)}{\pi d^2} = \frac{4 \times (0.16 - 0.026)}{\pi \times 0.4^2} \quad (1)$$

$$\underline{l = 0.53 \text{ m}} \quad (1)$$

5.



$$\rho = 2400 \text{ kg/m}^3$$

$$\Delta P = 5 \times 10^3 \text{ Pa}$$

By Continuity

$$d_1^2 v_1 = d_2^2 v_2$$

$$0.25^2 v_1 = 0.18^2 v_2 \quad (1)$$

$$v_1 = \frac{0.18^2 v_2}{0.25^2} \quad (1)$$

$$v_1 = 0.52 v_2 \quad (1)$$

Substitute (1) into (2)

$$4.17 = v_2^2 - (0.52 v_2)^2$$

$$4.17 = v_2^2 - 0.27 v_2^2$$

$$4.17 = 0.73 v_2^2$$

$$v_2 = \sqrt{\frac{4.17}{0.73}} = \underline{2.39 \text{ m/s}}$$

$$\therefore v_1 = 0.52 v_2 \quad (1)$$

$$v_1 = 0.52 \times 2.39 \quad (1)$$

$$v_1 = \underline{1.24 \text{ m/s}} \quad (1)$$

By Bernoulli's

$$\frac{P_1}{\rho} + \frac{v_1^2}{2} = \frac{P_2}{\rho} + \frac{v_2^2}{2} \quad (1)$$

$$P_1 - P_2 = \rho \left[\frac{v_2^2}{2} - \frac{v_1^2}{2} \right] \quad (1)$$

$$\frac{2(P_1 - P_2)}{\rho} = v_2^2 - v_1^2 \quad (1)$$

$$\frac{2 \times 5 \times 10^3}{2400} = v_2^2 - v_1^2 \quad (1)$$

$$4.17 = v_2^2 - v_1^2 \quad (2)$$

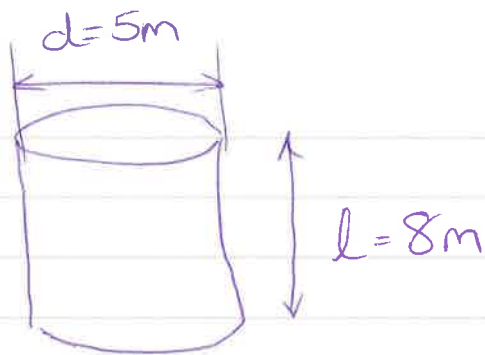
} (3)

$$Q = A v \quad (1)$$

$$Q = \frac{\pi \times 0.25^2}{4} \times 1.24 \quad (1)$$

$$Q = \underline{0.06 \text{ m}^3/\text{s}} \quad (1)$$

6



$$\begin{aligned} \text{Surface} &= \pi d h \\ \text{Area} &= \pi \times 5 \times 8 \\ &= 125.66 m^2 \end{aligned}$$

$$Q = - \frac{kA}{x} (T_2 - T_1) + hA (T_2 - T_1)$$

$$Q = \left[- \underset{0.2}{1.7 \times 125.66 (68 - 15)} \right] + \left[12 \times 125.66 (68 - 15) \right]$$

$$Q = 136529.59 W$$

$$Q = 136.53 kW$$

$$7 \quad d = 0.012 \text{ m}$$

$$\tau = 304 \times 10^6 \text{ Pa}$$

$$F = 165 \times 10^3 \text{ N}$$

$$\tau = \frac{F}{A} \quad \therefore A = \frac{F}{\tau} = \frac{165 \times 10^3}{304 \times 10^6} = 5.43 \times 10^{-4} \text{ m}^2$$

$$A = \frac{\pi d^2}{4} = \pi \times \frac{0.012^2}{4} = 1.13 \times 10^{-4} \text{ m}^2$$

$$\text{N}^\circ \text{ of bolts} = \frac{5.43 \times 10^{-4}}{1.13 \times 10^{-4}} = \underline{\underline{5 \text{ bolts}}}$$

8.

$$G = 78 \times 10^9 \text{ Pa} \quad (1)$$

$$L = 0.14 \text{ m} \quad (1)$$

$$T = 10 \text{ Nm}$$

$$\theta = ?$$

$$J = \frac{5}{8} \sqrt{3} \text{ s}^4$$

$$J = \frac{5}{8} \sqrt{3} \times 5 \times 10^{-34} = 6.77 \times 10^{-10} \text{ m}^4 \quad (1) \quad (1)$$

$$\frac{I}{J} = \frac{1}{L} = \frac{G\theta}{L}$$

$$\frac{I}{J} = \frac{G\theta}{L} \quad (1)$$

$$\theta = \frac{TL}{JG} = \frac{(10 \times 0.14)}{(6.77 \times 10^{-10} \times 78 \times 10^9)} \quad (1) \quad (1)$$

$$\theta = 0.03 \text{ radians} \quad (1)$$

$$\theta = 0.03 \times \frac{360}{2\pi} = \underline{\underline{1.52^\circ}} \quad (1) \quad (1)$$