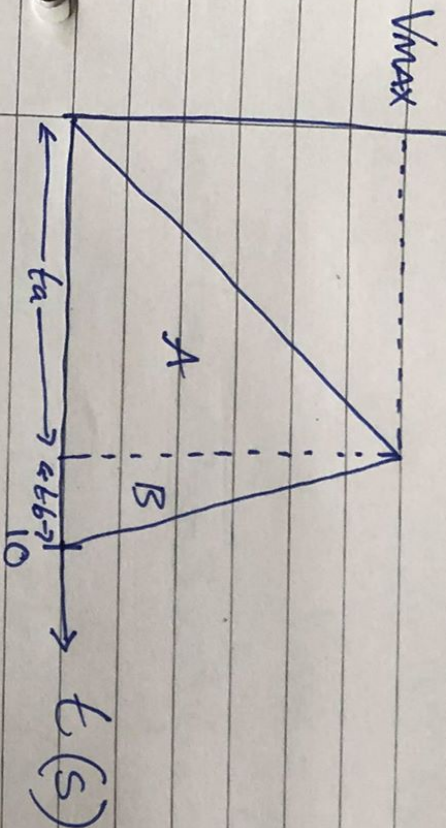


1.) $V(\text{km/h})$



$$t_a + t_b = 10 \text{ s}$$

A)

$$U = 0 \text{ m/s}$$

$$V = V_{\text{MAX}}$$

$$t = t_a$$

$$a = 5.5 \text{ m/s}^2$$

$$V = U + at$$

$$V_{\text{MAX}} = 0 + 5.5 t_a$$

$$t_a = \frac{V_{\text{MAX}}}{5.5}$$

B)

$$U = V_{\text{MAX}}$$

$$V = 0$$

$$t = t_b$$

$$a = -2.50 \text{ m/s}^2$$

$$V = U + at$$

$$0 = V_{\text{MAX}} - 2.50 t_b$$

$$t_b = \frac{V_{\text{MAX}}}{2.50}$$

$$t_a + t_b = 10$$

$$\frac{V_{\text{MAX}}}{5.5} + \frac{V_{\text{MAX}}}{2.50} = 10 \text{ s}$$

1) cont

$$V_{max} \left(\frac{1}{5.5} + \frac{1}{250} \right) = 10$$

$$0.185 V_{max} = 10$$

$$V_{max} = \frac{10}{0.19} = 52.63 \text{ m/s}$$

$$\text{impact} = 52.63 \times 3.6 = 189.47 \text{ km/h}$$

Distance traveled (s)

$$S = 0.5 \times b \times h$$

$$S = 0.5 \times 10 \times 52.63$$

$$S = 263.15 \text{ m}$$

4) Bore 125 mm = 0.125 m
Stroke 165 mm = 0.165 m

$$V_1 = \frac{\pi d^2}{4} \times h = \frac{\pi \times 0.125^2 \times 0.165}{4} = 2.27 \times 10^{-3} \text{ m}^3$$

$$V_2 = \frac{\pi d^2}{4} \times h = \frac{\pi \times 0.125^2 \times 0.020}{4} = 1.96 \times 10^{-3} \text{ m}^3$$

$$\frac{V_1 P_1}{T_1} = \frac{V_2 P_2}{T_2}$$

$P_1 = 1.008 \times 10^5 \text{ Pa}$
 $P_2 = 35.5 \times 10^5 \text{ Pa}$

$$T_2 = (550 + 273) \text{ K}$$

$$T_1 = \frac{V_1 P_1 T_2}{V_2 P_2} = \frac{2.27 \times 10^{-3} \times 1.008 \times 10^5 \times 823}{1.96 \times 10^{-3} \times 35.5 \times 10^5}$$

$$T_1 = 27.06$$

$$5) \rho = 885 \text{ kg/m}^3$$

$$d_1 = ~~50 \text{ mm}~~ 50 \text{ mm} = 0.05 \text{ m}$$

$$d_2 = 25 \text{ mm} = ~~0.025 \text{ m}~~ 0.025 \text{ m}$$

$$\Delta P = 3.5 \text{ kPa} = 3.5 \times 10^3 \text{ Pa}$$

$$A_1 = \frac{\pi d_1^2}{4} = \frac{\pi \times 0.05^2}{4} = 1.96 \times 10^{-3} \text{ m}^2$$

$$A_2 = \frac{\pi d_2^2}{4} = \frac{\pi \times 0.025^2}{4} = 4.91 \times 10^{-4} \text{ m}^2$$

$$H = \frac{(P_1 - P_2)}{\rho g} = \frac{3.5 \times 10^3}{(885 \times 9.81)} = 0.40 \text{ m}$$

$$Q = 1.96 \times 10^{-3} \sqrt{\frac{(2 \times 9.81 \times 0.4)}{[(1.96 \times 10^{-3} / 4.91 \times 10^{-4})^2 - 1]}}$$

$$= 4.49 \times 10^{-4} \text{ m}^3/\text{s} / 0.00045 \text{ m/s}$$

7)

$$D = 50 \text{ mm} = 0.05 \text{ m}$$

$$R = 1650 \text{ m}$$

$$E = 95 \text{ GN/m}^2 = 95 \times 10^9 \text{ N/m}^2$$

~~Ques~~

$$y = \frac{D}{2} = \frac{0.05}{2} = 0.025 \text{ m}$$

$$\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R} \quad \frac{\sigma}{y} = \frac{E}{R}$$

$$\sigma = \frac{E y}{R}$$

$$\sigma = \frac{95 \times 10^9 \times 0.025}{1650} \quad \sigma = \frac{1.54 \times 10^6}{154} \text{ or } 154 \text{ N/m}^2$$

$$I = \frac{\pi D^4}{64} \quad \frac{M}{I} = \frac{E}{R}$$

$$M = \frac{EI}{R} = \frac{E}{R} \times \frac{\pi D^4}{64}$$

$$M = \left[\frac{95 \times 10^9}{1650} \right] \times \left[\frac{\pi \times 0.05^4}{64} \right] = 17.66 \text{ Nm}$$

$$8) D = 60 \text{ mm} = 0.06 \text{ m}$$

$$r = \frac{D}{2} = \frac{0.06}{2} = 0.03$$

$$G = 110 \text{ GN/m}^2 = 110 \times 10^9 \text{ N/m}^2$$

$$l = 600 \text{ mm} = 0.6 \text{ m}$$

$$T = 580 \text{ N/m}$$

$$\frac{T}{J} = \frac{T}{r} \quad \therefore T = \frac{T}{J} = \left(\frac{T r}{J} \right) \quad J = \frac{\pi D^4}{32}$$

$$T = \left(\frac{580 \times 0.03}{\left(\frac{\pi \times 0.06^4}{32} \right)} \right) = 13.68 \times 10^6 \text{ N/m}^2 \text{ or } 13.68 \text{ MN/m}^2$$

$$\frac{T}{J} = \frac{G \theta}{l} \quad \frac{\pi \times 0.06^4}{32} \times 1.27 \times 10^{-6}$$

$$\theta = \frac{T l}{J G} = \frac{T l}{\left(\frac{\pi D^4}{32} \right) G} = \frac{(580 \times 0.6)}{\left[\left(\frac{\pi \times 0.06^4}{32} \right) \times 110 \times 10^9 \right]} \quad \frac{348}{139700}$$

$$\theta = 0.0025 \text{ radians} \times \frac{360}{2\pi}$$

$$\theta = 0.15^\circ$$