CT-2

Q.2

$$\text{Weight } (W) = \left[0.4 \times 1 \frac{gm}{cc} \times 10\,cm \times 10\,cm \times 275\,cm\right] \times 9.81 \frac{cm}{s^2}$$

$$\text{Buoyancy } (B) = 1 \frac{gm}{cc} \times 10\,cm \times 10\,cm \times l \times 9.81$$

Moments about the anchor point

$$B\left[\frac{l}{2}\cos\theta\right] - W\,\frac{2.75}{2}\cos\theta = 0$$

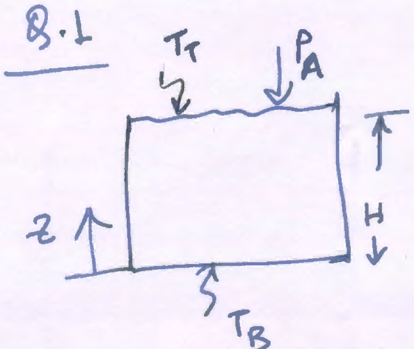
$$\Rightarrow \left\{49050\, l^2 - 1.48 \times 10^9\right\}\cos\theta = 0$$

$\Rightarrow$ Either $\theta = 90^\circ$, which is not permissible.

or $$l = \sqrt{\frac{1.48 \times 10^9}{49050}} = 173\,cm.$$

$$\Rightarrow \theta = \sin^{-1}\left(\frac{60}{173}\right) = 20.3^\circ$$

Q.1



Temperature T at any z would be

$$\frac{T - T_B}{T_T - T_B} = \frac{z}{H}$$

$$\Rightarrow (T - T_B) = (T_T - T_B)\frac{z}{H}$$

Since $\rho(T) = \rho(T_B)\left[1 - \beta(T - T_B)\right]$

$$= \rho(T_B)\left[1 - \beta(T_T - T_B)\frac{z}{H}\right]$$

$$\Rightarrow P(z) = P_A + \int_H^z -\rho(z)\,g\,dz = P_A + \int_H^z -\rho(T_B)\left[1 - \beta\left\{T_T - T_B\right\}\frac{z}{H}\right] g\,dz$$

$$= P_A + \rho_B\, g\,(H - z)\left[1 - \frac{H+z}{2H}\beta\left(T_T - T_B\right)\right]$$

For uniform temperature

$$P(z) = P_A + \rho(T_B)\, g\,(H - z).$$

Put $T_T = 88^\circ C + 273$

$T_B = 60^\circ C + 273$

$\beta = 0.0004$

$\rho(T_B) = 983.21\ kg/m^3$