

10.32

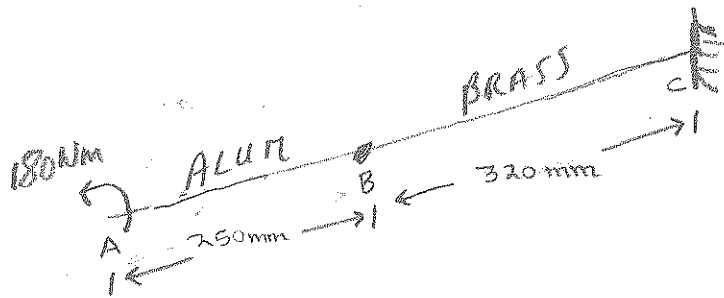
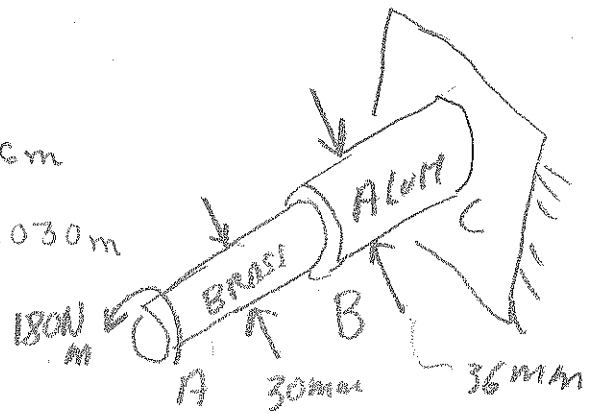
$$G_{\text{Brass}} = 39 \text{ GPa}$$

$$G_{\text{Aluminum}} = 27 \text{ GPa}$$

$$T_{AB} = T_{BC} = 180 \text{ N}\cdot\text{m}$$

$$d_{Al} = 36 \text{ mm} = 0.036 \text{ m}$$

$$d_{Br} = 30 \text{ mm} = 0.030 \text{ m}$$

(a) ϕ_B ?

$$J_{BC} = \frac{\pi}{32} [(0.036 \text{ m})^4] = 1.64 \times 10^{-7} \text{ m}^4$$

$$\phi_B = \frac{T_{BC} L_{BC}}{J_{BC} G_{Al}} = \frac{(180 \text{ N}\cdot\text{m})(0.320 \text{ m})}{(1.64 \times 10^{-7} \text{ m}^4)(27 \times 10^9 \text{ N/m}^2)} = 0.013 \text{ rad}$$

$$\phi_B = 0.013 \text{ rad} \times \frac{180^\circ}{\pi \text{ rad}} = \boxed{0.745^\circ}$$

(b) ϕ_A ?

$$J_{AB} = \frac{\pi}{32} [(0.030 \text{ m})^4] = 7.9 \times 10^{-8} \text{ m}^4$$

$$\phi_A = \sum \frac{T_i L_i}{J_i G_i}$$

$$\phi_A = 180 \text{ N}\cdot\text{m} \left(\frac{(0.25 \text{ m})}{(7.9 \times 10^{-8} \text{ m}^4)(39 \times 10^9 \text{ N/m}^2)} + \frac{(0.32 \text{ m})}{(1.64 \times 10^{-7} \text{ m}^4)(27 \times 10^9 \text{ N/m}^2)} \right)$$

From part (a)

$$= 0.0276 \text{ rad}$$

$$= 0.0276 \text{ rad} \times \frac{180^\circ}{\pi \text{ rad}} = \boxed{1.58^\circ}$$