



Name:

Serial number: Section:

Question 1

(5 marks)

A solid shaft of 150 mm diameter is used to transmit torque. Find the maximum torque transmitted by the shaft if the maximum shear stress induced to the shaft is 45 N/mm².

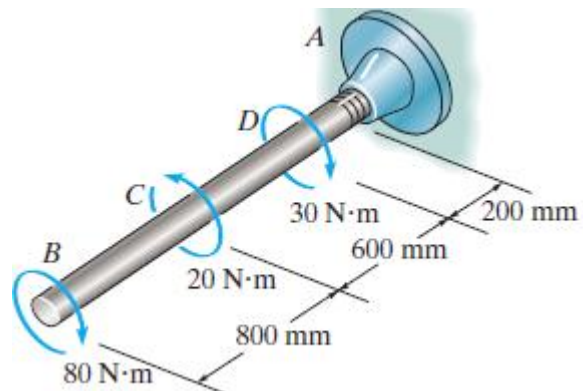
$$\tau = \frac{Tc}{J} \Rightarrow 45 = \frac{T(75)}{\frac{\pi}{2}(75)^4} \Rightarrow 45 \left(\frac{\pi}{2}\right)(75)^4 = T \cdot 75$$

$$T = \frac{\frac{\pi}{2}(45)(75)^4}{75} = \frac{2237444}{75} = 29820586 \text{ N}\cdot\text{mm} \text{ or } \boxed{T = 29820,586 \text{ N}\cdot\text{m}}$$

Question 2

(7 marks)

The 20 mm diameter A-36 steel shaft is subjected to torques shown in figure. Determine the angle of twist of the end B. (take G = 75 Gpa).



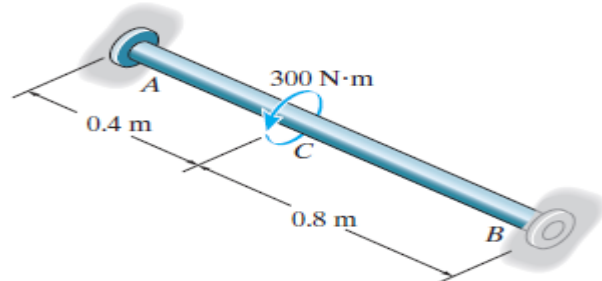
$$\phi_B = \sum \frac{TL}{JG} = \frac{1}{\frac{\pi}{2}(0.01^4)(75.0)(10^9)} [-80.0(0.8) + (-60.0)(0.6) + (-90.0)(0.2)]$$

$$= -0.1002 \text{ rad} = |5.74^\circ|$$

Question 3

(8 marks)

Find the torque reaction at ends **A** and **B**, for **50 mm** diameter steel shaft loaded as shown in figure.



$$\begin{aligned} T_A + T_B - 300 &= 0 & \phi_{C/A} &= \phi_{C/B} & \frac{T_A(0.4)}{JG} &= \frac{T_B(0.8)}{JG} & T_A &= 2.00T_B \\ T_A &= 200 \text{ N}\cdot\text{m} & T_B &= 100 \text{ N}\cdot\text{m} \end{aligned}$$