



Name:

Serial number: Section:

Question 1

(6 marks)

A rod 1500 mm long and of diameter 20 mm is subjected to an axial pull of 20 kN. If the modulus of elasticity of the material of the rod is $2 \times 10^5 \text{ N/mm}^2$; determine :

- 1- The normal stress
- 2- The strain
- 3- The elongation of the rod.

$$\textcircled{1} \quad \sigma = \frac{P}{A} = \frac{20000}{\frac{\pi}{4}(20)^2} \Rightarrow \boxed{\sigma = 63.662 \text{ N/mm}^2}$$

$$\textcircled{2} \quad \epsilon = \frac{\sigma}{E} = \frac{63.662}{2 \times 10^5} \Rightarrow \boxed{\epsilon = 0.000318}$$

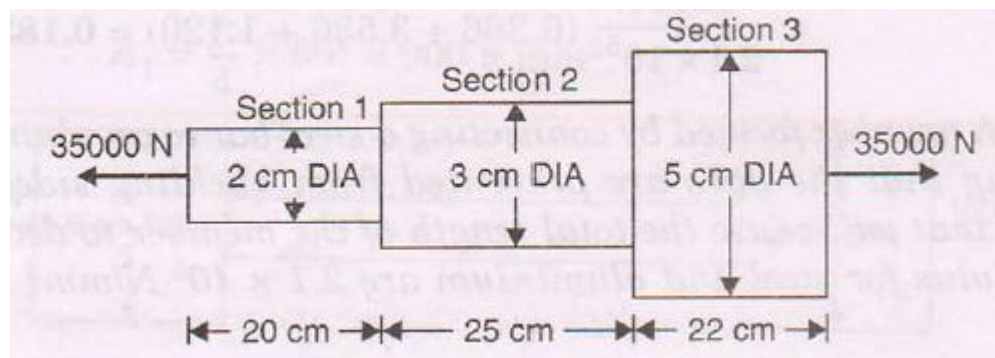
$$\textcircled{3} \quad \delta = \epsilon L$$
$$\delta = 0.000318 \times 1500 \Rightarrow \boxed{\delta = 0.477 \text{ mm}}$$

Question:2

(7 marks)

An axial tension force of 35 kN acting on the bar shown in figure, if the modulus of elasticity = 2.1×10^5 N/mm, determine:

- 1- The stress in each segment
- 2- The extension of the bar.



$$\sigma_1 = \frac{35000}{\frac{\pi}{4}(0.02)^2} \Rightarrow \sigma_1 = 111.408 \text{ N/mm}^2$$

$$\sigma_2 = \frac{35000}{\frac{\pi}{4}(0.03)^2} \Rightarrow \sigma_2 = 49.5146 \text{ N/mm}^2$$

$$\sigma_3 = \frac{35000}{\frac{\pi}{4}(0.05)^2} \Rightarrow \sigma_3 = 17.825 \text{ N/mm}^2$$

$$\delta = \frac{35000}{2.1 \times 10^5} \left(\frac{200}{\frac{\pi}{4}(0.02)^2} + \frac{250}{\frac{\pi}{4}(0.03)^2} + \frac{220}{\frac{\pi}{4}(0.05)^2} \right) \Rightarrow \delta = 0.183 \text{ mm}$$

Question:3

(7 marks)

Determine the poisson's ratio for the steel rod 13 mm in diameter and 50 mm in length, when the 50-kN tension load applied on it , the diameter is 12,99265.

Take $E_{st} = 200 \text{ Gpa}$

$$\sigma = \frac{P}{A} = \frac{50(10^3)}{\frac{\pi}{4}(0.013^2)} = 376.70 \text{ Mpa}$$

$$\epsilon_{\text{long}} = \frac{\sigma}{E} = \frac{376.70(10^6)}{200(10^4)} = 1.8835(10^{-3}) \text{ mm/mm}$$

$$\epsilon_{\text{lat}} = \frac{d - d_0}{d_0} = \frac{12.99265 - 13}{13} = -0.56538(10^{-3}) \text{ mm/mm}$$

$$V = -\frac{\epsilon_{\text{lat}}}{\epsilon_{\text{long}}} = -\frac{-0.56538(10^{-3})}{1.8835(10^{-3})} = 0.300$$