

91% Nice!

30/04/2020

11:00 AM

Engineering Science, Level 2, M4X0219C

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Question 1

$$D = 5 \text{ m}$$

$$L = 8 \text{ m}$$

$$K = 1.7 \text{ W/mK}$$

$$h = 12 \text{ W/m}^2\text{K}$$

$$\alpha = 200 \text{ m} / 0.2 \text{ m}$$

$$T_1 = 68^\circ\text{C} + 273 = 341 \text{ K}$$

$$T_2 = 15^\circ\text{C} + 273 = 288 \text{ K}$$

$$A = \frac{\pi \times D^2}{4} \times \frac{L}{4}$$

$$A = 14.63$$

$$A = \pi \times L \times D$$

$$\pi \times 8 \times 5$$

$$A = 125.66 \text{ m}^2$$

2.5

$$Q = \frac{-KA(T_2 - T_1)}{\alpha}$$

$$\frac{-1.7 \times 125.66 \times (288 - 341)}{0.2} = 56.61 \times 10^3 \text{ Units?}$$

$$Q = hA(T_2 - T_1)$$

$$12 \times 125.66 \times (288 - 341) = -76.92 \times 10^3$$

$$56.61 \times 10^3 + 76.92 \times 10^3 = -20310 \text{ W}$$

$$\text{Answer} = 20.31 \text{ kW}$$

$$Q = -20.31 \text{ kW}$$

Can't have negative heat transfer.

79.9...

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Question 2.

Bolts:

$$D = 0.012 \text{ m}$$

$$\tau = 304 \text{ MPa} / 304 \times 10^6 \text{ N m}^{-2}$$

$$F = 165 \times 10^3 \text{ N}$$

$$A = \frac{\pi D^2}{4} = \frac{\pi \times 0.012^2}{4}$$

$$\tau = \frac{F}{A}$$

$$A = 1.13 \times 10^{-4} \text{ m}^2$$

$$A = \frac{F}{\tau} = \frac{165 \times 10^3}{304 \times 10^6}$$

$$\text{area of Bolt} = 1.13 \times 10^{-4} \text{ m}^2$$

$$A = 485.29 \times 10^{-6}$$

$$A = 542.76 \times 10^{-6} \text{ m}^2$$

$$\frac{485.29 \times 10^{-6}}{1.13 \times 10^{-4}} = 4.29$$

$$\frac{542.76 \times 10^{-6}}{1.13 \times 10^{-4}} = 4.80$$

5 Bolts are needed.

Get your
units right!

$$\frac{10}{11}$$

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Question 3

$$G = 78 \times 10^9 \text{ N/m}^2 \quad S = 5 \times 10^{-3} \text{ m}$$

$$L = 0.14 \text{ m}$$

$$T = 10 \text{ Nm}$$

$$J = \frac{5\sqrt{3}}{8} \times S^4 \quad J = \frac{5\sqrt{3}}{8} \times (5 \times 10^{-3})^4$$

$$J = 6.77 \times 10^{-10} \text{ m}^4$$

$$\frac{T}{J} = \frac{G\theta}{L} = \frac{G\phi}{L} \rightarrow \frac{T}{J} = \frac{G\phi}{L}$$

$$\phi = \frac{T \times L}{J \times G} = \frac{10 \times 0.14}{6.77 \times 10^{-10} \times 78 \times 10^9} = 26.51 \times 10^{-3}$$

$$\phi = 26.51 \times 10^{-3} \text{ Radians} \times \frac{360}{2\pi} = 1.52$$

$$\phi = 1.52^\circ$$

yay!

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Question 4

$$M = 6200 \text{ Nm}$$

$$E = 210 \times 10^9 \text{ N/m}^2$$

$$\sigma = ?$$

$$R = ?$$

$$B = 0.065 \text{ m}$$

$$b = 0.04$$

$$D = 0.11 \text{ m}$$

$$d = 0.08 \text{ m}$$

$$y = 0.055$$

$$I = \frac{BD^3}{12} - \frac{bd^3}{12} = \frac{0.065 \times 0.11^3}{12} - \frac{0.04 \times 0.08^3}{12}$$

$$I = 5.50 \times 10^{-6} \text{ m}^4$$

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

$$\frac{6200 \times 0.055}{5.50 \times 10^{-6}}$$

$$= 62 \times 10^6$$

$$\sigma = 62 \times 10^6 \text{ N/m}^2$$

$$\sigma = 62 \text{ MN/m}^2$$

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

$$\frac{210 \times 10^9 \times 5.50 \times 10^{-6}}{6200} = 186.29 \text{ m}$$

$$6200$$

$$R = 186.29 \text{ m}$$

yay!