

Date & Time : 30/04/2020 at 11:00

Module : Engineering Science (M4x02192)

Student Name : Samuel James Digby

Student Number : 1901067

Q1	7	9
Q2	11	11
Q3	9	11
Q4	17	17
	44	48

Question 1

$$D = 5m$$

$$H = 8m$$

$$k = 1.7 \text{ W/m K}$$

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

$$x = 200 \text{ mm} = 0.2 \text{ m}$$

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

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

92%

Conduction

$$\frac{-1.7 \times (\pi \times 5 \times 8) \times (288 - 341)}{0.2} = 56611.49962 \text{ W} \quad \textcircled{1}$$

$$= 56.61 \text{ kW} \quad \textcircled{1}$$

Convection

$$12 \times (\pi \times 5 \times 8) \times (288 - 341) = -79922.11711 \text{ W} \quad \textcircled{1}$$

$$= -79.92 \text{ kW}$$

You needed to add them up =

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Question 2

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

$$A = \frac{\pi \times (12 \times 10^{-3})^2}{4} = 1.130973355 \times 10^{-4} \text{ m}^2$$

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

$$\tau A = F = 304 \times 10^6 \times 1.130973355 \times 10^{-4} = 34381.59 \text{ N}$$

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

$$\frac{165 \times 10^3}{34381.59} = 4.799079973$$

= 5 bolts are required

✓ yay!

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Question 3

$$G = 78 \times 10^9 \quad L = 140 \text{ mm} = 0.14 \text{ m}$$

$$S = 5 \text{ mm} = 0.005 \text{ m}$$

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

$$J = \frac{I^v}{J^v} = \frac{r^x}{r^x} = \frac{G \theta^3}{L^v}$$

$$J = \frac{5\sqrt{3}}{8} \times 0.005^4 = 6.765823467 \times 10^{-10} \text{ m}^4$$

$$\frac{I}{J} = \frac{G \theta}{L}$$

$$\theta = \frac{I L}{J G} = \frac{10 \times 0.14}{6.765823467 \times 10^{-10} \times 78 \times 10^9} = 0.02652850468 \text{ rad}$$

$$0.02652850468 \times \frac{2\pi}{360} = \underline{4.63 \times 10^{-4}^\circ}$$

$$\times \frac{360}{2\pi}$$

X. Shame.

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Question 4

$$B = 65 \text{ mm} = 0.065 \text{ m}$$

$$D = 110 \text{ mm} = 0.11 \text{ m}$$

$$b = 40 \text{ mm} = 0.04 \text{ m}$$

$$d = 80 \text{ mm} = 0.08 \text{ m}$$

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

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

$$y = 0.11 \div 2 = 0.055 \text{ m}$$

$$I = \frac{0.065 \times 0.11^3}{12} - \frac{0.04 \times 0.08^3}{12} = 5.502916667 \times 10^{-6} \text{ m}^4$$

$$\sigma = \frac{My}{I} = \frac{6200 \times 0.055}{5.502916667 \times 10^{-6}} = 61.97 \times 10^6 \text{ N}$$

$$R = \frac{IE}{M} = \frac{5.502916667 \times 10^{-6} \times 210 \times 10^9}{6200} = 186.39 \text{ m}$$

yay!