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NAME : BRADLEY BURTON
 STUDENT ID : 1803066
 DATE/TIME : 30TH APRIL 2020 11:00 HRS
 MODULE CODE : M4X02192
 MODULE DES : ENGINEERING SCIENCE

Q1 | 9 | 9
 Q2 | 11 | 11
 Q3 | 8 | 11
 Q4 | 17 | 17
 45 | 48

1) D = 5m
 L = 8m
 K = 1.7 W/mK
 h = 12 W/mK
 X = 200 mm = .2m

CONDUCTION
TEMPS

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

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

AREA OF A
 CYLINDER

$$A = \pi DL$$

$$(\pi)(5)(8) = 125.66\text{ m}^2$$

CONVECTION
TEMPS

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

$$T_2 = 341\text{K}$$

$$T_1 = 288\text{K}$$

CONDUCTION : $Q = \frac{-KA(T_2 - T_1)}{x}$ so $\frac{(-1.7)(125.66)(288 - 341)}{.2} = 56609.83\text{ W}$
 or 56.6 kW

CONVECTION : $Q = hA(T_2 - T_1)$ so $\frac{(12)(125.66)(341 - 288)}{1} = 79919.76\text{ W}$
 or 79.91 kW

$$56609.83 + 79919.76 = 136529.59\text{ W}$$

$$\text{HEAT TRANSFER (Q)} = 136.53\text{ kW}$$

✓ yay!

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2)

$$\begin{aligned}\text{BOLT DIAMETER} &= 12 \text{ mm} = 0.012 \text{ m} \quad \checkmark \\ \tau &= 304 \text{ MPa} = 304 \times 10^6 \text{ Pa} \quad \checkmark \\ F &= 165 \text{ kN} = 165 \times 10^3 \text{ N} \quad \checkmark\end{aligned}$$
$$\text{BOLT AREA (A)} = \frac{\pi D^2}{4}$$
$$\frac{(\pi)(0.012)^2}{4} = 1.13 \times 10^{-4} \text{ m}^2 \quad \checkmark$$

↑
A

$$\tau = \frac{F}{A} \quad \text{so} \quad A = \frac{F}{\tau} \quad \text{so} \quad \frac{(165 \times 10^3)}{(304 \times 10^6)} = 542.76 \times 10^{-6} \text{ m}^2 \quad \checkmark$$

$$\frac{(542.76 \times 10^{-6})}{(1.13 \times 10^{-4})} = 4.8 \leftarrow \text{THEREFOR, } \underline{5} \text{ BOLTS REQUIRED}$$

yay!

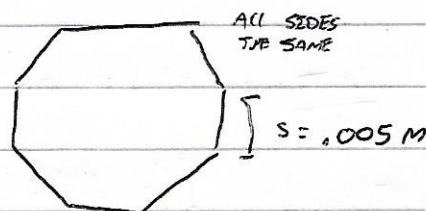
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3) $G = 78 \text{ GPa} = 78 \times 10^9 \text{ Pa}$ (1)

$L = 140 \text{ mm} = .14 \text{ m}$ (1)

$T = 10 \text{ Nm}$

$\theta = ?^\circ$



$s = 5 \text{ mm} \div 1000 = 5 \times 10^{-3} \text{ m}$

$J = \left(\frac{5\sqrt{3}}{8} \right) (5 \times 10^{-3})^4 = 6.77 \text{ m}^4$ Shame! $6.77 \times 10^{-16} \text{ m}^4$ (1)

$\frac{T'}{J} = \frac{T^*}{J^*} = \frac{G\theta}{L}$ so $\frac{T}{J} = \frac{G\theta}{L}$ so $\frac{TL}{JG} = \theta$ (2)

$\frac{(10)(.14)}{(6.77)(78 \times 10^9)} = 2.65 \times 10^{-12} \text{ RADS}$ (1)

$2.65 \times 10^{-12} \times \frac{360}{2\pi} = 1.52 \times 10^{-10}^\circ$ (1)

$\theta = 1.52 \times 10^{-10}^\circ \leftarrow \text{DEGREES}$

x Carried error.

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4) $B = 65 \text{ mm} \div 1000 = .065 \text{ m}$

$D = 110 \text{ mm} \div 1000 = .11 \text{ m}$

$b = 40 \text{ mm} = .04 \text{ m}$

$d = 80 \text{ mm} = .08 \text{ m}$

$M = 6200 \text{ Nm}$

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

$\sigma = ?$

$R = ?$

$I = 5.5 \times 10^{-6} \text{ m}^4$

$y = \frac{D}{2} \text{ so } \frac{.11}{2} = .055 \text{ m}$

$y = .055 \text{ m}$

$I = \frac{BD^3}{12} - \frac{bd^3}{12}$

$\left(\frac{(.065)(.11)^3}{12} \right) - \left(\frac{(.04)(.08)^3}{12} \right) =$

$I = 5.5 \times 10^{-6} \text{ m}^4$

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

STRESS (σ) $\frac{M}{I} = \frac{\sigma}{y} \text{ so } \frac{My}{I} = \sigma \text{ so } \frac{(6200)(.055)}{(5.5 \times 10^{-6})} = 62 \times 10^6 \text{ N/m}^2$

RADIUS OF CURVATURE (R) $\frac{M}{I} = \frac{E}{R} \text{ so } R = \frac{EI}{M} \text{ so } \frac{(210 \times 10^9)(5.5 \times 10^{-6})}{6200} = 186.29 \text{ m}$

yay!