

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

1) $D = 5\text{ m}$ CONDUCTION TEMP AREA OF A
 $L = 8\text{ m}$ CYLINDER
 $K = 1.7\text{ W/mK}$ $T_1 = 68^\circ\text{C} + 273 = 341\text{ K}$ $A = \pi DL$
 $h = 12\text{ W/mK}$ $T_2 = 15^\circ\text{C} + 273 = 288\text{ K}$ $(\pi)(5)(8) = 125.66$
 $X = 200\text{ mm} = .2\text{ m}$ m^2

CONVECTION
TEMP

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

$T_2 = 341\text{ K}$

$T_1 = 288\text{ K}$

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

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

HEAT TRANSFER (Q) = 136.53 kW

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2)

$$\text{BOLT DIAMETER} = 12 \text{ mm} = .012 \text{ m}$$

$$\text{BOLT AREA (A)} = \frac{\pi D^2}{4}$$

$$\gamma = 304 \text{ MPa} = 304 \times 10^6 \text{ Pa}$$

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

$$\frac{(\pi)(.012)^2}{4} = 1.13 \times 10^{-4} \text{ m}^2$$

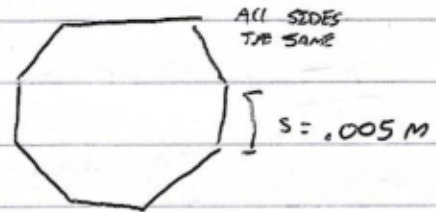
↑
A

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

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

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3) $G = 78 \text{ GPa} = 78 \times 10^9 \text{ Pa}$
 $L = 140 \text{ mm} = .14 \text{ m}$
 $T = 10 \text{ nm}$
 $\theta = ?^\circ$



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

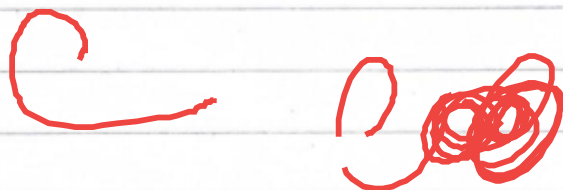
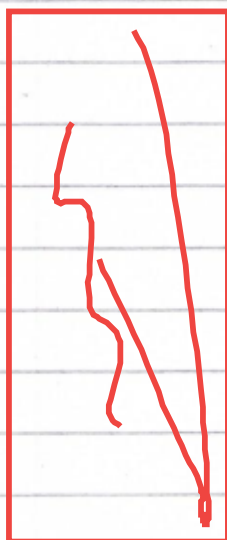
$$J = \left(\frac{5\sqrt{3}}{8} \right) (5 \times 10^{-3})^4 = 6.77 \text{ m}^4$$

$$\frac{T'}{J'} = \frac{T''}{J''} = \frac{G\theta}{L'} \quad \text{so} \quad \frac{T}{J} = \frac{G\theta}{L} \quad \text{so} \quad \frac{TL}{JG} = \theta$$

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

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

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



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