

Q1	3	9
Q2	11	11
Q3	9.5	11
Q4	4	17
	27.5	48

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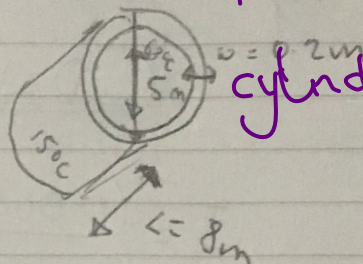
11:00 - 13:30

Engineering Science (M4X02192)

Oscar Pollett

$$A = \pi(2.5^2 - 2.4^2) = 1.54 \text{ m}^2$$

Surface area of a cylinder is πdh



$$d = 5 \text{ m} \rightarrow r = 2.5 \text{ m}$$

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

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

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

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

$$T_2 = 68 + 273$$

$$T_1 = 15 + 273$$

$$A = \pi(2.5^2 - 2.4^2) = 1.54 \text{ m}^2$$

$$Q = \frac{-kA(T_2 - T_1)}{x}$$

$$Q = \frac{-1.7(1.54)(341 - 288)}{0.2}$$

$$Q = hA(T_2 - T_1) = 12 \times 1.54 \times (341 - 288)$$

$$Q = -8843.328 \text{ W conduction}$$

$$Q = 12984.68 \text{ W convection}$$

$$Q = \frac{-kA(T_2 - T_1)}{x} = -693.77 \text{ W}$$

$$= \frac{1.7 \times 1.54 (341 - 288)}{0.2} \quad (1)$$

$$Q = hA(T_2 - T_1) = 979.44 \text{ W} \quad (12 \times 1.54 (341 - 288)) \quad (1)$$

$$12 \times 1.54 (341 - 288) \quad 979.44 - 693.77 = 285.67 \text{ W}$$

X .

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Engineering Science (M4X02192)

Oscar Pollitt 1900412

3) $G = 78 \text{ GPa} = 78 \times 10^9 \text{ N/m}^2$ ✓ ①

$l = 140 \text{ mm} = 0.14 \text{ m}$ ✓ ①

$s = 5 \text{ mm} = 5 \times 10^{-3} \text{ m}$ ✓ ①

$T = 10 \text{ Nm}$

$J = \frac{5\sqrt{3}}{8} \times \cancel{80 \times 10^{-3}} \times 5 \times 10^{-3} = 6.77 \times 10^{-10}$

2.5
units?

$\frac{\cancel{\theta}}{\cancel{J}} = \frac{\cancel{\theta}}{\cancel{J}} = \frac{G\theta}{l}$ ✓ ②

$$\frac{10}{6.77 \times 10^{-10}} = \frac{78 \times 10^9 \theta}{0.14}$$

$$\frac{10}{6.77 \times 10^{-10}} \times 0.14 = 78 \times 10^9 \theta$$

$$\frac{1.48 \times 10^{10}}{78 \times 10^9} =$$

$\theta = \cancel{0.02} = 0.026 \rightarrow$
 0.03 rads ✓

④

$\times \frac{360}{2\pi} = \text{Degrees.}$

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11:00 - 13:30

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Q4 continued

$y = \frac{110}{2} = 55$ ②
Base units!

if $D = 110 \text{ m}$

$$I = \frac{(0.065 \times 110)^3}{12} - \frac{(0.08 \times 0.04)^3}{12} \quad \text{①}$$

$$I = 30.46 \text{ m}^4 \quad \times$$

$$\frac{6200}{30.46} = 203.55$$

$\frac{BD^3}{12}$ only the
D is cubed.

$$203.55 = \frac{\sigma}{R} = \frac{2.1 \times 10^8 \text{ N}}{R}$$

~~$203.55 = \frac{\sigma}{R} = \frac{2.1 \times 10^8 \text{ N}}{R}$~~

~~$\sigma = 1120 \text{ N/m}^2$~~

No idea
what's going
on here!

①
 $203.55 \times 55 = 11195.25 = \sigma$

$$\frac{2.1 \times 10^8 \text{ N}}{203.55} = R = 10.32 \times 10^6 \text{ m}$$

$$R = 1.03 \times 10^9$$

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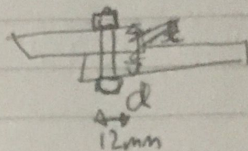
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2)

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

$$d = 12 \text{ mm} =$$

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



$$F = 165 \text{ kN} = 165000 \text{ N}$$

$$d = 0.012 \quad (0.012)^2 \times \pi \times 11.13 \times 10^{-4} = 1.13 \times 10^{-4} \text{ m}$$

$$\tau = \frac{F}{A} \rightarrow A = \frac{F}{\tau} = \frac{165000}{304 \times 10^6}$$

$$= 542.76 \times 10^{-6}$$

~~4 bolts~~ is needed

~~4 bolts~~

$$\left(\frac{542.76 \times 10^{-6}}{1.13 \times 10^{-4}} = 4.8 \right)$$

5 bolts needed

4.8

✓ Yay!

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4)

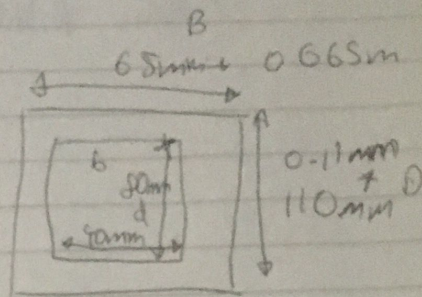
~~120mm~~

$d = 110 \text{ mm}$

$M = 6200 \text{ Nm}$

~~11~~

$E = 210 \text{ GPa} = 2.1 \times 10^{11} \text{ N/m}^2$



80mm $\rightarrow$ 0.08m

90mm $\rightarrow$ 0.09m

~~11~~

$$I = \frac{65(0.065 \times 0.11)^3}{12} - \frac{50(0.05 \times 0.09)^3}{12} = 2.77 \times 10^{-8} \text{ m}^4$$

$$y = \frac{D}{2} \rightarrow \frac{0.11}{2} = 0.055 \text{ m}$$

$$\frac{6200}{2.1 \times 10^9} = \frac{\sigma}{0.055} = 2.1 \times 10^9$$

$$2.95 \times 10^{12} = \frac{\sigma}{0.055} = \frac{2.1 \times 10^{11}}{R}$$

$$2.95 \times 10^{12} \times 0.055 = \sigma$$

$$\sigma = 1.62 \times 10^{11} \text{ N/m}^2$$

$$2.95 \times 10^{12} = \frac{2.1 \times 10^{11}}{R} = \frac{2.1 \times 10^{11}}{2.95 \times 10^{12}} = R$$

$$R = 71.17 \times 10^{-3} \text{ m}$$

$$R = 71.17 \times 10^{-3} \text{ m}$$