

11:00

30/04/2020

M4X02192 : Engineering Science
Connor McGuinness

Page 1 of 2

~~1803076~~ 1803076

Q1)

$$D = 5m$$

$$k = 1.7 W/mK$$

$$h = 12 W/m^2K$$

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

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

$$x = 200 \times 10^{-3} m$$

$$48Q = ?$$

Q1	4	9
Q2	5	11
Q3	11	11
Q4	17	17
	37	48

77%

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

$$= \frac{-1.7(1.54)(288 - 341)}{200 \times 10^{-3}}$$

$$Q = 643.77 \text{ kW}$$

$$Q = 0.7 \text{ kW}$$

① X

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

$$Q = 12(1.54)(288 - 341)$$

$$Q = 979.44 \text{ W}$$

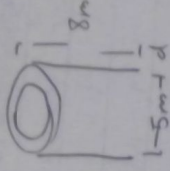
$$= 0.98 \text{ kW}$$

①

Surface area
of a cylinder
 πdh .

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

$$A = 1.54 \text{ m}^2 \times$$

200 mm
W 200x10³ mQ2) $\gamma = \frac{F}{A}$

$$\gamma = 304 \text{ MPa}$$

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

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

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

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

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

①

$$\frac{AF}{4A} = \frac{542.76 \times 10^{-6} \times 165 \times 10^3}{4 \times 165 \times 10^3}$$

$$A = \frac{\pi d^2}{4}$$

$$\sqrt{\frac{4A}{\pi}} = d$$

$$d = \sqrt{\frac{4(542.76 \times 10^{-6})}{\pi}} = d$$

$$d = 0.026$$

$$d = 26.29 \text{ mm} \times 10^{-3} \text{ m}$$

✓.

$$= 2.14$$

$$= 3 \text{ bolts}$$

$$\frac{26.29 \times 10^{-3}}{12 \times 10^{-3}}$$

 $d = 12 \text{ mm}$. Given in the question.

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Page 2 of 2

Q3)

$$G = 78 \times 10^9 \text{ Pa or } \text{Nm}^{-2}$$

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

$$\theta = ?$$

$$\frac{T}{J} = \frac{\tau}{r} = \frac{60}{r}$$

$$J = \frac{5\sqrt{3}}{8} (5^4)$$

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

$$S = 5 \times 10^{-3}$$

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

$$J = \frac{5\sqrt{3}}{8} ($$

$$\theta = \frac{T L}{\left(\frac{5\sqrt{3}}{8}\right) (5^4) (G)}$$

$$\theta = \frac{10(0.14)}{\left(\left(\frac{5\sqrt{3}}{8}\right) (5 \times 10^{-3})^4\right) (78 \times 10^9)}$$

~~0.03 rad~~

$$\theta = 0.027$$

$$\theta = 0.03 \text{ radians}$$

$$0.03 \left(\frac{360}{2\pi}\right)$$

$$= 1.719$$

$$= 1.72^\circ$$

yay!

Q4)

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

$$E = 210 \times 10^9 \text{ Nm}^{-2}$$

$$G = ?$$

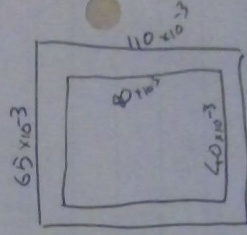
$$R = ?$$

$$y = \frac{110 \times 10^3}{2}$$

$$y = 0.055 \text{ m}$$

$$J = \frac{b D^3}{12} - \frac{b d^3}{12}$$

$$\frac{M}{J} = \frac{\sigma}{y} = \frac{E}{R}$$



$$J = \frac{65 \times 10^{-3} (110 \times 10^{-3})^3}{12} - \frac{40 \times 10^{-3} (40 \times 10^{-3})^3}{12}$$

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

~~$$\frac{M}{J} = \frac{\sigma}{y} = \frac{E}{R}$$~~

$$\frac{M}{J} = \frac{\sigma}{y}$$

$$\sigma = \frac{M y}{J}$$

$$\sigma = \frac{6200(0.055)}{5.5 \times 10^{-6}}$$

$$\sigma = 62 \times 10^6 \text{ Nm}^{-2}$$

$$\frac{M}{J} = \frac{E}{R}$$

$$R = \frac{E J}{M}$$

$$R = \frac{210 \times 10^9 (5.5 \times 10^{-6})}{6200}$$

~~$$R = 1.86 \text{ m}$$~~

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

yay!