

Q1	3	9
Q2	10	11
Q3	5	11
Q4	11	17
	29	48

60%

Q1

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

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

$$x = 200 \text{ mm} - 0.2 \text{ m} - 200 \times 10^{-3}$$

$$T_2 = 68^\circ\text{C} \quad (68 + 273) = 341 \text{ K}$$

$$T_1 = 15 \quad (15 + 273) = 288 \text{ K}$$

$$A = \frac{\pi}{4} (5^2 - 4^2) \text{ m}^2$$

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

$$u = \frac{k}{x} = \frac{1.7}{200 \times 10^{-3}}$$

$$8.5 \text{ W/mK}$$

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

$$12 \times (5 \times 8) \times (341 - 288) = 25.44 \text{ kW}$$

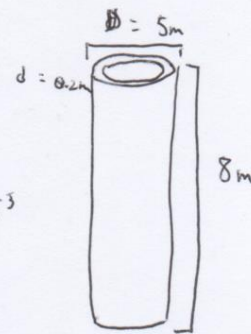
Carried error.

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

$$Q = \frac{1.7 (5 \times 8) \times (341 - 288)}{0.2} = 12.72 \text{ kW}$$

$$\text{Total heat transfer} = 38.16 \text{ kW}$$

Carried error.

Surface area of a chimney is πdh .

Q2

$$d = 12 = 0.012 \text{ m} \quad \checkmark \quad (1)$$

$$F = 165 \text{ kN} = 165 \times 10^3 \quad \checkmark \quad (1)$$

$$\tau = 304 \text{ MPa} = 304 \times 10^6 \text{ N/m}^2 \quad \checkmark \quad (1)$$

$$\text{area of bolt} \quad \frac{\pi d^2}{4} = \frac{\pi (0.012)^2}{4} =$$

$$1.13 \times 10^{-6} \text{ m}^2 \quad \checkmark \quad (3)$$

area needed for load

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

number of bolts

$$\frac{542.76 \times 10^{-6}}{1.13 \times 10^{-6}} = 480.32$$

$$= 481 \text{ bolts} \quad ?$$

(1)

How!?

4.8 ... 5 bolts.

Q3

$$J = ?$$

$$G = 78 \text{ GPa} = 78 \times 10^9 \text{ N/m}^2 \quad \checkmark \textcircled{1}$$

$$l = 140 \text{ mm} = 0.14 \text{ m} \quad \checkmark \textcircled{1}$$

$$Q = ?$$

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

$$0.005 \text{ m}$$

$$J = \frac{\sqrt{3}}{8} \times 0.005^4 = 9.73 \times 10^{-11} \quad \times \text{Shame!} \quad \textcircled{1}$$

$$\left(\frac{T}{J} \right) = \frac{\gamma}{r} = \left(\frac{G \theta}{l} \right) \quad \textcircled{1}$$

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

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

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

$$\theta = \frac{(78 \times 10^9 \times 9.73 \times 10^{-11})}{(0.14 \times 10)} = \underline{\underline{5.42^\circ \text{ radians}}} \quad \times \text{Shame!}$$

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

Q 4

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

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

$$Y = ?$$

$$R = ?$$

$$I = ?$$

$$\left(\frac{m}{I} \right) = \frac{6}{\gamma} = \left(\frac{E}{R} \right)$$

$$I = \frac{BD^3}{12} - \frac{bd^3}{12} = \frac{0.065 \times 0.11^3}{12} - \frac{0.040 \times 0.08^3}{12}$$

$$= \frac{329.17 \times 10^{-6}}{12} \text{ m}^4$$

$$= 5.50 \times 10^{-6} \text{ m}^4 \quad \checkmark \textcircled{7}$$

$$\frac{m}{I} \times \frac{E}{R}$$

$$R = \frac{EI}{m}$$

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

$$R = \frac{11.55 \times 10^3}{1}$$

$$186.29 \text{ m}$$

$$\checkmark \textcircled{4}$$

What about stress, σ ? Shame!