

Robert Morse 1806186 11:00AM 30/4/2020

M4x02192

Question 1

Q1	7	9	$D = 5m$
Q2	8	11	$H = 8m$
Q3	10.5	11	$k = 1.7 \text{ W/mK}$
Q4	17	17	$h = 12 \text{ W/m}^2\text{K}$
	42.5	48	$x = 0.2m$
			$A = \pi \times L \times D$

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

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

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

89%

Conduction

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

$$Q = \frac{(-1.7)(125.66)(341 - 288)}{0.2} =$$

$$Q = \frac{(-1.7)(125.66)(288 - 341)}{0.2} = 56609.8$$

56609.8

Convection

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

$$Q = (12)(125.66)(288 - 341) =$$

$$Q = (12)(125.66)(341 - 288) = 79919.76 \text{ W}$$

Combined Heat transfer = 85580.74 Watts

$$Q = 85.58 \text{ kW}$$

①

③
✓ yeah
boi!

✓ ① Shame!

②

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Question 2.

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

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

$$A = ?$$

$$\text{Bolt Area} = 0.012 \checkmark$$

(3)

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

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

$$\cancel{A = 238}$$

$$A = \frac{165 \times 10^3}{304 \times 10^6} = 5.43 \times 10^{-4} \text{ m}^2 \checkmark$$

(3)

$$\text{Area of 1 Bolt} = \frac{\pi \times 0.012^2}{4} = 3.55 \times 10^{-4} \text{ m}^2 \checkmark$$

(1)

No idea how this came at wrong. $\uparrow$

$$\text{Number of bolts} = \frac{5.43 \times 10^{-4}}{3.55 \times 10^{-4}} = 1.53$$

(1)

Number of bolts needed = 2 bolts.

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Question 3

$$G = 78 \text{ GPa} \rightarrow 78 \times 10^9 \text{ N/m}^2$$

$$l = 140 \text{ mm} \rightarrow 0.14 \text{ m}$$

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

$$J = 5 \text{ mm} \rightarrow 0.005 \text{ m}$$

$$J = \frac{5\sqrt{3}}{8} \times 5^4 \quad J = \frac{5\sqrt{3}}{8} \times 0.005^4$$

$$J = 6.77 \times 10^{-10} \quad \checkmark \text{ units?}$$

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

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

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

$$\theta = \frac{10 \times 0.14}{6.77 \times 10^{-10} \times 78 \times 10^9} = 0.03 \text{ rad.} \quad \checkmark$$

$$0.03 \times \frac{360}{2\pi} = 1.72 \text{ degrees.} \quad \checkmark$$

Angle of twist in degrees = 1.72 degrees

Yay!

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Question 4

$$B = 65 \text{ mm} \rightarrow 0.065 \text{ m}$$

$$b = 40 \text{ mm} \rightarrow 0.040 \text{ m}$$

$$D = 110 \text{ mm} \rightarrow 0.11 \text{ m}$$

$$d = 80 \text{ mm} \rightarrow 0.08 \text{ m}$$

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

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

$$G = ?$$

$$R = ?$$

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

$$I = \frac{BD^3}{12} - \frac{bd^3}{12} = \frac{(0.065 \times 0.11^3)}{12} - \frac{(0.04 \times 0.08^3)}{12}$$

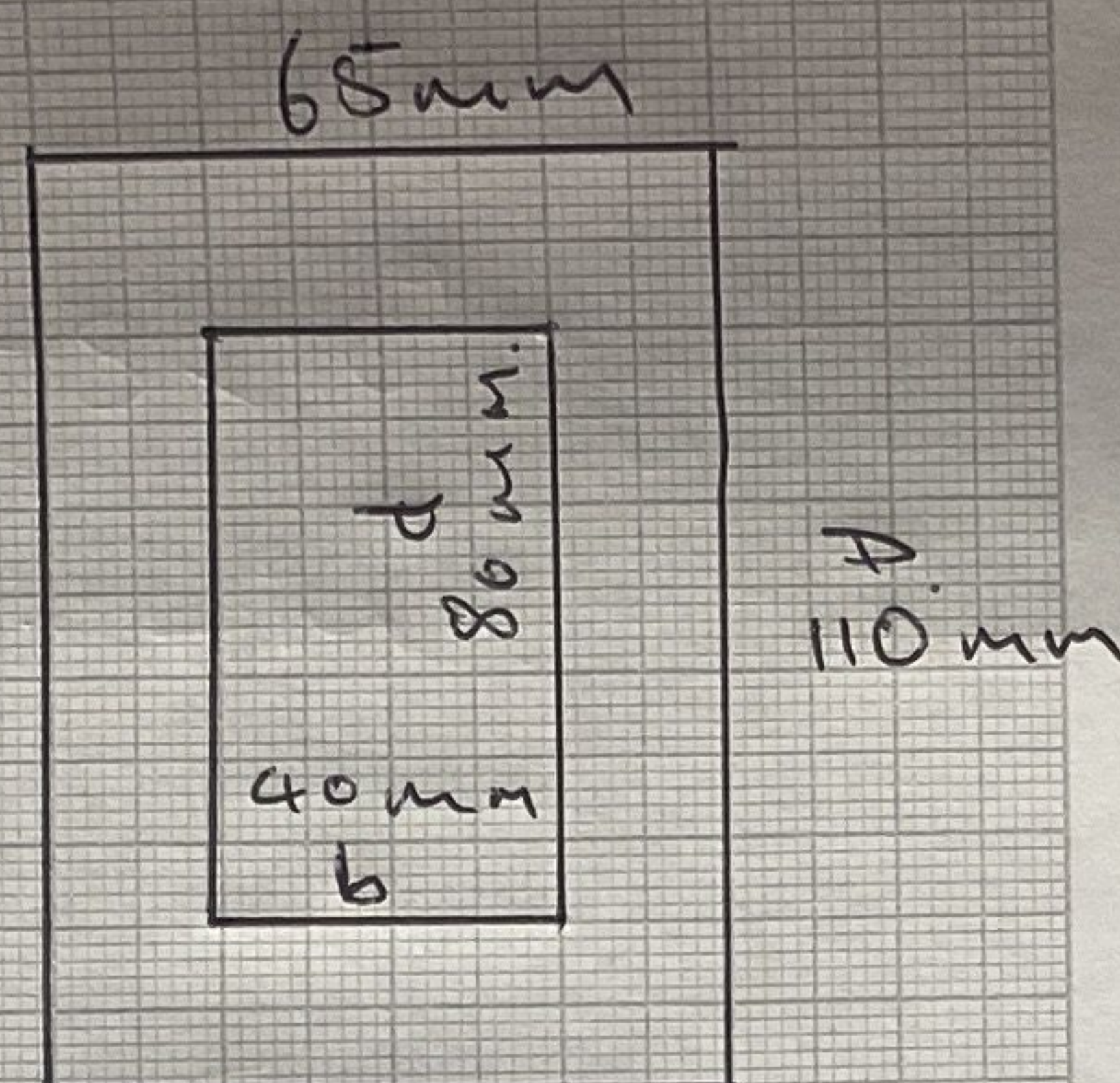
$$I = 5.50 \times 10^{-6}$$

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

$$\sigma = \frac{M \times y}{I} = \sigma = \frac{6200 \times 0.055}{5.50 \times 10^{-6}}$$

$$\sigma = 62000000 \text{ N/m}^2$$

Standard form?



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Question 4 - Part 2

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

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

$$R = \frac{E \times y}{\sigma}$$

$$R = \frac{210 \times 10^9 \times 0.055}{62000000}$$

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

Yay!