Tom Westcott WES03048767

71%

Prifysgol Cymru
Y Drindod Dewi Sant
University of Wales
Trinity Saint David

LOCATION: SWANSEA | **LLEOLIAD: ABERTAWE**

LEVEL 4 | **LEFEL 4**

EXAMINATION PERIOD | **CYFNOD ARHOLIADAU**
MAY 2020 | **MAI 2020**

MODULE CODE: M4X00385
ENGINEERING SCIENCE 1

TIME: 2 HOURS

ANSWER ALL QUESTIONS IN SECTION

Equipment or materials required – Scientific Calculator + Formula Booklet

Adnoddau neu ddefnyddiau sydd eu hangen -Scientific Calculator + Formula Booklet

Marks

Tom Westcott	Q1 [20]	Q2 [20]	Q3 [20]	Q4 [15]	Q5 [25]
	ai. 0	a.i0	20	a.5	a.i4
	ii. 5	ii.0		b.5	ii.5
	b.i.5	iii.0		c.5	iii.5
	ii.5	b.5			b.i2
					ii.0
					Total 71

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18/5/20

Question 1

b)

(i) $\sigma = \frac{F}{A}$

Cross section area $= \pi \times (70 \times 10^{-3})^2 - \pi \times (65 \times 10^{-3})^2$

$= 2.12 \times 10^{-3} \, m^2$

$\sigma = \frac{8 \times 10^3}{2.12 \times 10^{-3}} = 3.77 \times 10^6 \, Pa = 3.77 \, MPa$

(ii) $E = \frac{\sigma}{\varepsilon} = \frac{FL}{Ax}$

$\therefore x = \frac{FL}{AE} = \frac{(8 \times 10^3) \times (450 \times 10^{-3})}{(2.12 \times 10^{-3}) \times (96 \times 10^9)}$

$x = 1.769 \times 10^{-5} \, m$

$x = 0.018 \, mm$

Question 1

a) Area = Area outside − Area inside.

$= 1.5m \times b - (1.5 - 30\times10^{-3}) \times (b - 3\times10^{-3})$

$= 1.5b - 1.47b - 0.0441$

Area $= 0.036 - 0.0441$

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

$120\times10^{6} = \frac{90\times10^{3}}{0.036 - 0.0441}$

$120\times10^{6}(0.036 - 0.0441) = 90\times10^{3}$

$3.6\times10^{6}b - 5.292\times10^{6} = 90\times10^{3}$

$3.6\times10^{6}b = 5.382\times10^{6}$

$b = 1.495\ m$

(ii) $E = \frac{\sigma}{\varepsilon} = \frac{F\times L}{A\times x}$

$A = 0.036 - 0.441$

$A = 7.5\times10^{-4}\ m^{2}$

$E = \frac{(90\times10^{3}) \times (1.5)}{(7.5\times10^{-4}) \times (3.5\times10^{-3})}$

$E = 51.43\times10^{9}\ Pa$

$E = 51.43\ GPa$

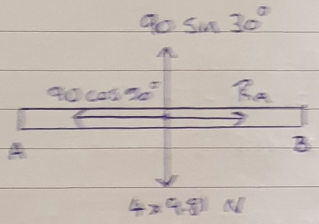
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Question 2

a)

(i)

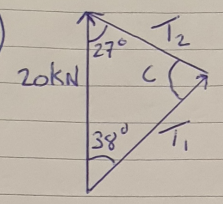


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Question 2

b)



$\hat{C} = 180 - 27 - 38$

$= 115°$

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$\frac{T_1}{\sin 27} = \frac{T_2}{\sin 38} = \frac{20 \times 10^3}{\sin 115}$$

$$\therefore T_1 = \frac{20 \times 10^3}{\sin 115} \times \sin 27$$

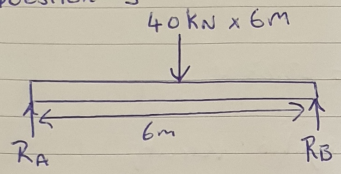
$T_1 = 10.02$ kN

$$T_2 = \frac{20 \times 10^3}{\sin 115} \times \sin 38$$

$T_2 = 13.59$ kN

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Question 3



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

$$I = \frac{bh^3}{12} - \frac{b_2h_2^3}{12}$$

$$I = \frac{0.1 \times 0.2^3}{12} - \frac{(0.1-0.06) \times (0.2-0.06)^3}{12}$$

$$I = 6.66 \times 10^{-5} - 9.14 \times 10^{-6}$$
$$I = 5.75 \times 10^{-5}$$

$$M = \left(\frac{wL}{2} \times \frac{L}{2}\right) - \left(\frac{wL}{2} \times \frac{L}{4}\right) = \left(\frac{40kN \times 6m}{2} \times 3\right) - \left(\frac{40 \times 6}{2} \times$$

$$M = 360 \times 10^3 - 180 \times 10^3 = 180 \text{ kNm}$$

$$\frac{M}{I} = \frac{\sigma}{y} \quad \text{where} \quad y = 0.1m$$

$$\sigma = \frac{180 \times 10^3}{5.75 \times 10^{-5}} \times 0.1 = 313.04 \times 10^6 \text{ Pa}$$
$$= 313 \text{ MPa}$$



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Question 3 (continued)

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

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

$$R = \frac{200 \times 10^9 \times 0.1}{313 \times 10^6} = 63.89\ M$$

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Question 4

1000 rev/min T = 23.87 N

a) Power = Torque × angular velocity

$\omega = 1000 \text{ revs/min} = \frac{1000 \times 2\pi}{60} = 104.72 \text{ rad s}^{-1}$

$P = T\omega = 23.87 \times 104.72 = 2499.6 \text{ W}$

b) $5 \text{ hP} = 5 \times 745.7 \text{ W} = 3728.5 \text{ W}$

$P = T\omega$

$\omega = \frac{P}{T} = \frac{3728.5}{14.5} = 257.14 \text{ rad s}^{-1}$

$\frac{257.14}{2\pi} \times 60 = 2455 \text{ revs/min}$

(c) $W = 10 \text{ MJ}$
$T = 4 \text{ kNm}$

$W = T\theta$

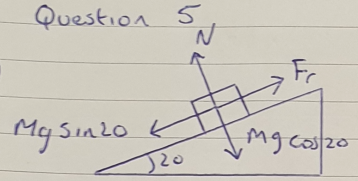
$\theta = \frac{W}{T} = \frac{10 \times 10^6}{4 \times 10^3} = 2500 \text{ radians}$

$\frac{2500}{2\pi} = 397.89 \text{ revs}$

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Question 5

(i)



$M = 30$ kg
$g = 9.81\ ms^{-2}$
$\mu = 0.3$

$Mg\sin 20 = 30 \times 9.81 \times \sin 20 = 100.66$ N

$Mg\cos 20 = 30 \times 9.81 \times \cos 20 = 276.55$ N

$N = Mg\cos 20 = 276.55$

$\mu = \frac{f_r}{N} \Rightarrow F_r = 0.3 \times Mg\cos 20 = 82.97$ N

(ii) $\vec{P} = Mg\sin 20 + F_r = 100.66 + 82.97 = 183.63$ N

(iii) Force exerted by the ~~body~~ Plane on the Body is the Normal Force

$N = Mg\cos 20 = 276.55$ N

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Question 5

b) $KE = \frac{1}{2} MV^2$

$60\ km/h = 60000\ m/h = \frac{60000}{3600}\ ms^{-1}$

$= 16.67\ ms^{-1}$

$25\ km/h = 6.94\ ms^{-1}$

$\Delta KE = \frac{1}{2} MV^2 - \frac{1}{2} Mu^2$

$= \frac{1}{2} 2 \times 10^3 \times (16.67)^2 - \frac{1}{2} \times 2 \times 10^3 \times (6.94)^2$

$\Delta KE = 277.89 \times 10^3 - 48.16 \times 10^3$

$\Delta KE = 229.73 \times 10^3\ J$

(ii) $W = \Delta KE$