Jonathan Davies **DAV1734427** **65%**

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

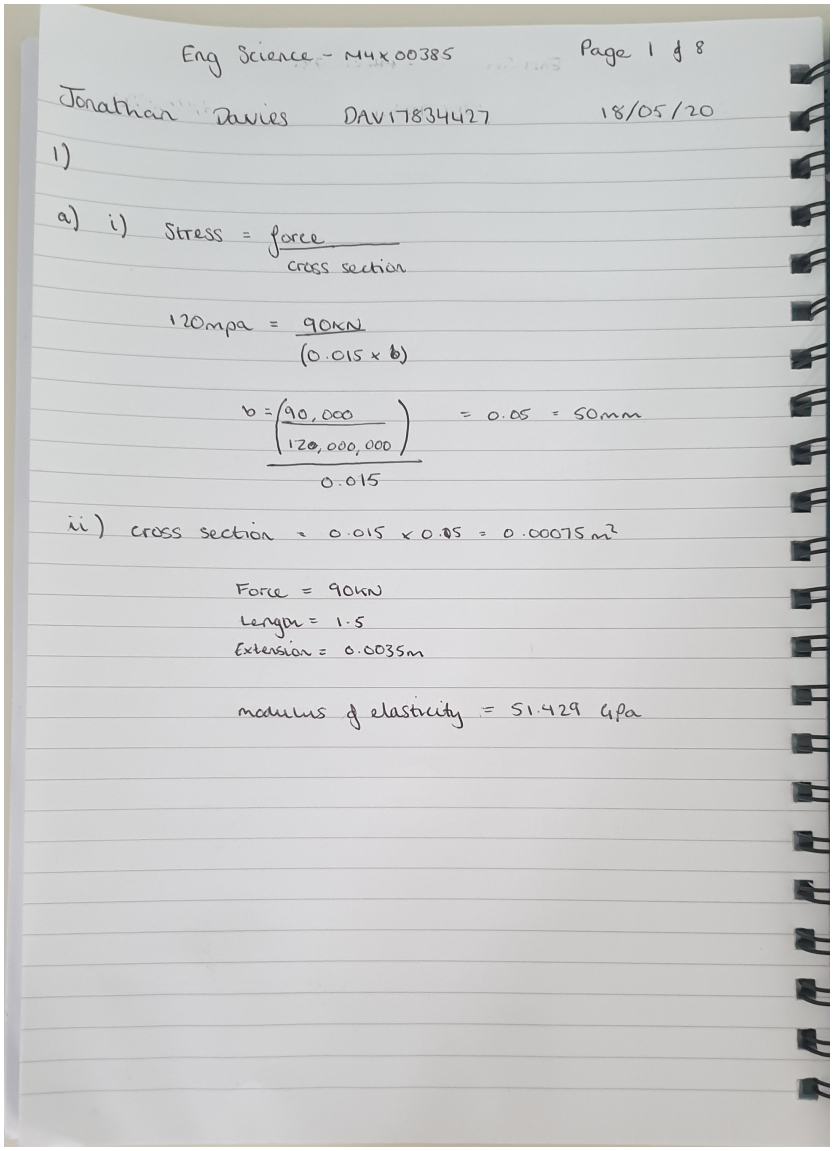
ANSWER ALL QUESTIONS IN SECTION

Equipment or materials required – Scientific Calculator + Formula Booklet

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

Marks

Jonathan Davies	Q1 [20]	Q2 [20]	Q3 [20]	Q4 [15]	Q5
	ai. 5	a.i 0	20	a.0	a.i 4
	ii. 5	ii. 0		b.5	ii. 2
	b.i. 5	iii.0		c.5	iii.5
	ii. 3	b. 4			b.i 2
					ii. 0
				Total 65	



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1)

a) i) Stress = $\frac{\text{force}}{\text{cross section}}$

$120\text{mpa} = \frac{90\text{kN}}{(0.015 \times b)}$

$b = \frac{\left(\frac{90,000}{120,000,000}\right)}{0.015} = 0.05 = 50\text{mm}$

ii) cross section = $0.015 \times 0.05 = 0.00075\ m^2$

Force = 90kN

Length = 1.5

Extension = 0.0035m

modulus of elasticity = 51.429 GPa

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b)

i) $A = \frac{\pi}{4}(140^2 - 130^2)$

$\frac{\pi}{4} = 0.785$

$140^2 - 130^2 = 2700$

$2700 \times 0.785 = 2119.5 \times 10^{-3} = 2.12$

$\text{Stress} = \frac{F}{A} = \frac{8 \times 10^3}{2.12} = 3.77\,\text{MPa}$

ii) $E = \frac{FL}{A\Delta L} = 96\,\text{GPa} = \frac{8 \times 10^3 \times 450 \times 10^{-3}}{2.1195 \times 10^{-3} \times \Delta L}$

$2.1195 \times 10^{-3} \times \Delta L = \frac{8 \times 10^3 \times 450 \times 10^{-3}}{96 \times 10^9}$

$\Delta L = \frac{8 \times 10^3 \times 450 \times 10^{-3}}{96 \times 10^9 \times 2.1195 \times 10^{-3}} = 17.084 \times 10^{-6}$

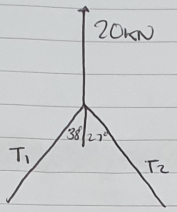
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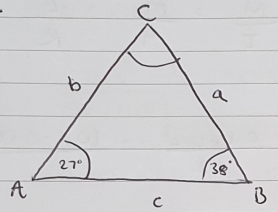
2)

a)

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b)





$C = 180 - (27 + 38)$

$= 115°$

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

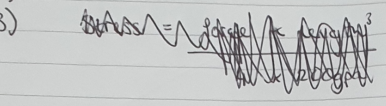
$$\frac{T_1}{\sin 27°} = \frac{T_2}{\sin 38°} = \frac{20kN}{\sin 115}$$

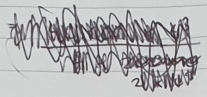
$$T_1 = \frac{20 \sin 27°}{\sin 115°} kN = 10kN$$

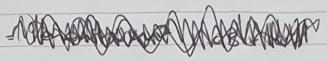
$$T_2 = \frac{20 \sin 38°}{\sin 115°} = 13.594kN$$

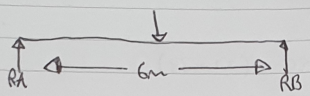
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3)









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

$$I = \frac{bh^3}{12} - \frac{b_2 \times b_2^3}{12} = \frac{0.1 \times 0.2^3}{12} - \frac{(0.1-0.06) \times (0.2-0.06)^3}{12}$$

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

$$M = \left(\frac{wL}{2} \times \frac{L}{2}\right) - \left(\frac{wL}{2} \times \frac{L}{4}\right) = \left(\frac{40 \times 6}{2} \times 3\right) - \left(\frac{40 \times 6}{2} \times 1.5\right)$$

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

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

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

$y = 0.1\text{m}$

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

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

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4)

a) $P = T \times S = 23.87 \times 1000 = 2.5kW$

b) $SHP = 5 \times 745.7$
$= 3728.5W$

$T = 14.5 N/m$

$N = \frac{3728.5}{2\pi(14.5)} = 40.92$ rev/s

$40.92 \times 60 = 2455$ rev/min

c) Work done $= 10MJ = 10 \times 10^6 J$
Torque $= 4kN = 4000N$

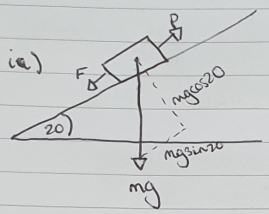
$\theta = \frac{10 \times 10^6}{4000} = 2500$ rad $\quad 2\pi$ rad = 1 revolution

$\frac{2500}{2\pi} = 397.09$ revolutions/min

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5)

a) i)



ii)

$F\uparrow = F\downarrow$

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

$F = \mu N$

$= 0.3 \times 276.55$

$= 82.965$

$F = P + mg\sin 20$

$P = F - mg\sin 20$

$P = 82.765 - (30 \times 9.81)\sin 20$

$P = -17.692$

b) i)

$F = mg\cos 20 = 30 \times 9.81 \times \cos 20 = 276.55\,N$

2 tonnes $= 2000 \times 9.81 = 19,620N$

$V_1 = 60km/h = \frac{(60 \times 1000)}{3600} = 16.6\,m/s$

$V_2 = 25km/h = \frac{(25 \times 1000)}{3600} = 6.94\,m/s$

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i) Kinetic energy = $(\frac{1}{2} \times 2000 \times 16.6^2) - (\frac{1}{2} \times 2000 \times 6.94^2)$

= $(277777.7) - (48225.31)$

= 229552.39 J

ii) Force = $\frac{W}{T}$

Acceleration = $2500 \times 19620 = 0.127$ m/s^2

$\frac{16.6 - 6.94}{0.127} = 76.55$ sec

Force required = $\frac{229552.39}{76.55}$

= 2998.725 N