Ethan Harris **60%**

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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

Ethan Harris	Q1 [20]	Q2 [20] part a not answered	Q3 [20]	Q4 [15]	Q5 [25]
	ai. 5	a.i 0	15	a. 0	a.i 4
	ii. 5	ii. 0	No FBD	b. 5	ii. 2
	b.i.5	iii. 0		c. 5	iii.5
	ii. 3 no units +inaccuracy	b. 4			b.i 2
					ii. 0
					Total 60

Ethan Harris
18/5/20

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1) Given INFO
Bar - length = 1.5m
thickness = 15mm
Load = 90kN

a i) Stress = Force ÷ cross section
= 90 ÷ (0.015x6)
B = 90,000 ÷ 12000000M ÷ 0.015 = 0.05m = 0.05 x 1000 = 50 mm

ii) cross section
0.015 x 0.05 = 0.00075 M^2
Length = 1.5M
Force = 90 kN
Extension = 0.35 ÷ 100 = 0.0035 m
Modulas OF elasticity = 51.429 GPA

bi) I/D - 130mm
O/D - 140 mm
Supports a load of 8kn
Tube O/L = 450mm long.

Determine Stress.

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

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

$140^2 - 130^2 = 2700\ mm.$

0.785×2700

$= 2119.5 \times 10^{-3}$

$= 2.12$

$Stress = \frac{F}{A} = \frac{8\ kN}{2.12} =$

Stress = 3.77 MPa

ii) Tube contraction

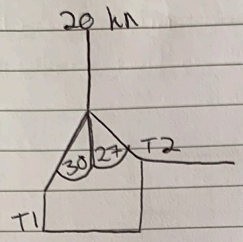
$E = \frac{contraction}{450\ mm.}$

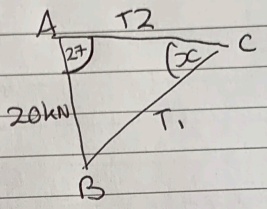
$\Delta L = \frac{8 \times 10^3 \times 450 \times 10^{-3}}{96}$

$E = \frac{FL}{A\Delta L}$ $\quad 96\ GPa = \frac{8 \times 10^3 \times 450 \times 10^{-3}}{2119.5 \times 10^{-3}\ \Delta L}$

$\Delta L = \frac{8 \times 10^3 \times 450 \times 10^{-3}}{96 \times 10^9 \times 2.1195 \times 10^{-3}} = 17.084 \times 10^{-4}$

Question 2 B





$x = 180 - 27 - 38$

$x = 115°$

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C} = \frac{T1}{\sin 27°} = \frac{T2}{\sin 38°} = \frac{20\ kN}{\sin 115°}$$

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

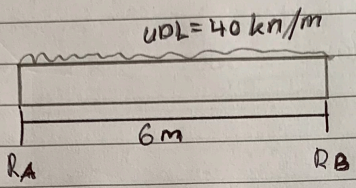
$$T_2 = \frac{20 \sin 38°}{\sin 115} = 13.59\ kN$$

Question 3.

Given data

UDL = 40 ~~kN/m~~ kN/m

6m long.



$$I = \frac{bh^3}{12} - b_2 h_2^3 \quad \ldots 1$$

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

$$I = 0.0666 \times 10^{-3} - 0.00914 \times 10^{-3}$$

$$I = 0.0575 \times 10^{-3}$$

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

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

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

$$\sigma = \frac{180 \times 10^3}{0.0575 \times 10^{-3}} \times 0.1 = 3130.435 \times 10^6 \text{ pa}$$

$$= 313 \text{ MPA}$$

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

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

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

Question 4

a) Given data
Spindle rotates @ 1000 rev/min
Torque produced = 23.87N
Power = Torque x Speed
P = 23.87 x 1000 = 2.5 kw.

B) 5 HP → watts
= 5 x 745.7 = 3728.5 watts.

Power = $2\pi NT$

Speed = $\frac{P}{2\pi T}$

Where power = 5hp = 5 x 745.7
= 3728.5 watts.

Torque = 14.5 N/M.

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

rotation Speed of motor = 40.92 x 60 = 2455.2revs/min

C) $\theta = \frac{\text{work done}}{\text{Torque.}}$

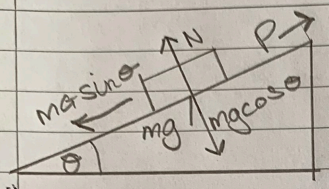
work done = 10 MJ = 10×10^6 J
Torque = 4kN/M = 4000 NM
Angular displacment.
$\theta = \frac{10 \times 10^6}{4000}$ = 2500 rad 2π rad = 1 rev

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

Question 5
MX400385

A

i



ii) $F = ma$

$Mg = 30kg \times 9.81 = 294.3N$

$P = Mg\sin 20 + F mg \sin 20$

$P = 294.3 + \sin 20 + 0.3 \times 294.3 \times \sin 20$

$P = 100.66 + 30.2 = 130.85N$

iii) $F = mg\cos 20 = 30 \times 9.81 \times \cos 20 = 276.55N.$

B) Given data.

Total mass = 2 Tonne

A reduction from 60 km/h to 25 km/h

35 km/h decrease.

A retarding force of 2.5 kn

2 tonne = 2000kg $\times$ 9.81 = 19,620.

V1 = 60 km/h = $(60 * 1000) \div 3600 = 16.6$ m/s.

V2 = 25 km/h = $(25 \times 1000) \div 3600 = 6.94$ m/s.

i) kinetic energy = $(0.5 \times 2000 \times 16.6^2) - (0.5 \times 2000 \times 6.94^2)$

= 227396.4 J

ii) Force = W ÷ T

Acceleration = 2500 ÷ 19620 = 0.127 m/s^2.

Time done = 16.6 - 6.94 ÷ 0.127 = 76.55 seconds.

Force needed = 227396.4 ÷ 76.55 = 3000 N

3000 ÷ 1000 = 3kN