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Examination Answer Books

12 Pages

Instructions to Candidates

Please give the information requested in the boxes below.

Enter your name in the space provided to the right, fold over and seal down (using the label provided) to hide your name.

The answers must be legibly written. The Examiners can either ignore illegible script or have it typed and the expense of typing charged to the candidate.

Write your answers in ink.

Begin each answer on a fresh page. Do all rough work in the answer book and cross it through.

No part of this book is to be torn out; it must be handed in complete.

If more books than one are used, fasten them together using the tags available from the invigilator(s).

Every book must be handed in. In no circumstances may answer books, used or unused, be taken out of the examination venue.

1	Student Number	1703189
2	Title of Examination Paper	Mech Principles
3	Module Code	M5X02201
4	Date and Time of Examination	17/01/19 09:00
5	Examination Venue	Vivian Hall
6	Seat Number	G025
7	Number of Answer Books handed in	1

[illegible]

OK

Mark agreed

23/01/19

$$i) \epsilon_x = 15 \times 10^{-6} \quad \epsilon_y = -18 \times 10^{-6}$$

$$\nu = 0.26$$

$$E = 169 \times 10^9$$

$$\sigma_x = \frac{E}{1-\nu^2} (\epsilon_x - \nu \epsilon_y)$$

$$= \frac{169 \times 10^9}{1-0.26^2} (15 \times 10^{-6} - (0.26 \times -18 \times 10^{-6}))$$

$$= -49.2 \times 10^6 \text{ Pa } N/m^2$$

$$\sigma_y = \frac{E}{1-\nu^2} (\epsilon_y - \nu \epsilon_x)$$

$$= \frac{169 \times 10^9}{1-0.26^2} (-18 \times 10^{-6} - (0.26 \times 15 \times 10^{-6}))$$

$$= 54.75 \times 10^6 \text{ N/m}^2$$

$\sigma_x = \text{compressive}$

$\sigma_y = \text{tensile}$

$$ii) \sigma_x = 65 \times 10^6 \text{ N/m}^2 \quad \sigma_y = 10 \times 10^6 \text{ N/m}^2$$

$$\epsilon_x = \frac{1}{E} (\sigma_x - \nu \sigma_y)$$

$$= \frac{1}{169 \times 10^9} (65 \times 10^6 - (0.26 \times 10 \times 10^6))$$

$$= 369.23 \times 10^{-6}$$

$$\epsilon_y = \frac{1}{E} (\sigma_y - \nu \sigma_x) = \frac{1}{169 \times 10^9} (10 \times 10^6 - (0.26 \times 65 \times 10^6))$$

$$= -40.83 \times 10^{-6}$$

2. i) $r = 25 \times 10^{-3}$ $P = 20 \text{ Bar} = 20 \times 10^5$

$E = 163.2 \times 10^9$ $\nu = 0.3$

$$G = \frac{E}{2(1-\nu)} = \frac{163.2 \times 10^9}{2(1-0.3)} = 116.6 \times 10^9$$

ii) $\epsilon_v = \frac{\sigma_x + \sigma_y + \sigma_z}{E} (1-2\nu)$

$$= \frac{20 \times 10^5 + 20 \times 10^5 + 20 \times 10^5}{163.2 \times 10^9} (1 - (2 \times 0.3))$$

$$= 1.47 \times 10^{-5}$$

iii) $V_{\text{sphere}} = \frac{4}{3} \pi r^3 = \frac{4}{3} \times \pi \times (25 \times 10^{-3})^3$

$$= 2.62 \times 10^{-3} \text{ m}^3$$

$$\epsilon_v = \frac{\Delta V}{V}$$

$$\Delta V = \epsilon_v \times V = 1.47 \times 10^{-5} \times 2.62 \times 10^{-3}$$

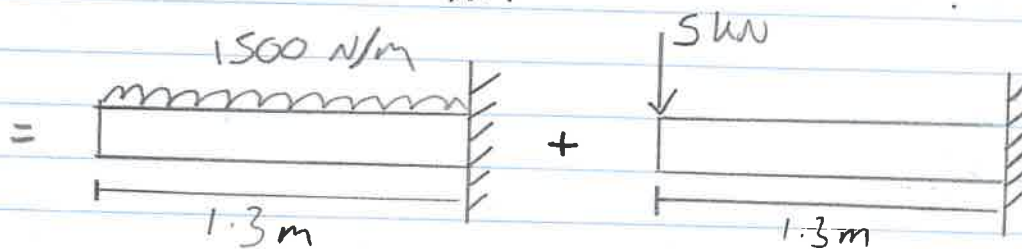
$$= 3.85 \times 10^{-8}$$

iv) ~~iii~~ An isotropic material is a material with the same characteristics in all directions.

A nonisotropic material would be Carbon Fibre or Glass.



$$EI = 2.2 \times 10^6 \text{ Nm}^2$$



i) $w = 1500 \text{ N/m}$ $L = 1.3 \text{ m}$

$$\delta y = \frac{wL^4}{8EI} = \frac{1500 \times 1.3^4}{8 \times 2.2 \times 10^6} = -2.43 \times 10^{-4}$$

ii) $F = 5 \times 10^3$ $L = 1.3 \text{ m}$

$$y = \frac{FL^3}{3EI} = \frac{5 \times 10^3 \times 1.3^3}{3 \times 2.2 \times 10^6} = -1.66 \times 10^{-3}$$

iii) $y_T = 2.43 \times 10^{-4} + -1.66 \times 10^{-3}$
 $= -1.42 \times 10^{-3}$

iv) $y = 3.5 \times 10^{-3} - 1.66 \times 10^{-3} = 1.84 \times 10^{-3}$

$$4. \quad \theta = 0.35 \text{ m} \quad L = 0.8 \text{ m} \quad t = ?$$

$$\eta_L = 0.85 \quad \eta_c = 0.95 \quad P = 20 \text{ Bar} = 20 \times 10^5$$

$$\sigma_{\max} = 110 \times 10^6$$

$$\sigma_c = \frac{PD}{2t\eta_L}$$

$$\sigma_c \times 2t\eta_L = PD$$

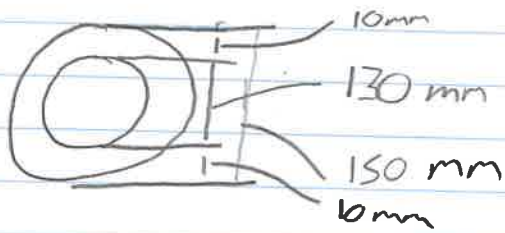
$$2t\eta_L = \frac{PD}{\sigma_c}$$

$$2t = \frac{PD}{\sigma_c \times \eta_L} = \frac{20 \times 10^5 \times 0.35}{110 \times 10^6 \times 0.85} = 7.5 \times 10^{-13}$$

$$\min t = \frac{7.5 \times 10^{-13}}{2} = 3.75 \times 10^{-13}$$

$$= 0.0000000000000375 \text{ m}$$

5. $e\phi = 150 \text{ mm}$ $i\phi = 130 \text{ mm}$



$r_i = 0.13 \text{ m}$

$r_o = 0.15 \text{ m}$

$P = 80 \times 10^5$

$t = 10 \text{ mm} = 0.01 \text{ m}$

X.

$\sigma_r =$ ~~scribbles~~

$\sigma_c =$ ~~scribbles~~

~~scribbles~~

Lame's Equation = ?

X

Question No.

Question No.

Question No.

Examiner C

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Question No.

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