



Complete, fold and seal
(see note 2 below)

FORENAME(S): SCOTT

12 Pages

1. Please give the information requested in the boxes below.
2. Enter your name in the space provided to the right, fold over and seal down (using the label provided) to hide your name.
3. 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.
4. Write your answers in ink.
5. Begin each answer on a fresh page. Do all rough work in the answer book and cross it through.
6. No part of this book is to be torn out; it must be handed in complete.
7. If more books than one are used, fasten them together using the tags available from the invigilator(s).
8. **Every book must be handed in. In no circumstances may answer books, used or unused, be taken out of the examination venue.**

[illegible]

(Gweler yr ochr arall am y fersiwn Cymraeg)

Mark agreed
23/01/19.

$$\epsilon_x = \frac{\sigma_x}{E} \quad \epsilon_y = \frac{\sigma_y}{E}$$

ϵ

1) ~~Ex~~
i)

$$\epsilon_x = 15 \times 10^{-6}$$

$$\epsilon_y = -18 \times 10^{-6}$$

$$\nu = 0.26$$

$$E = 169 \times 10^9 \text{ N/m}^2$$

✓ correct eqn.

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

(Tensile) = $\sigma_x = \cancel{1.82 \times 10^6 \text{ Nm}^2} \quad \cancel{3.27 \times 10^6 \text{ Nm}^2} \quad 1.87 \times 10^6 \text{ Nm}^2$

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

$$\sigma_y = -2.56 \times 10^6 \text{ Nm}^2 \quad (\text{compressive})$$

ii)

$$\sigma_x = 65 \text{ MPa} / 65 \times 10^6 \text{ Nm}^2$$

$$\sigma_y = 10 \text{ MPa} / 10 \times 10^6 \text{ Nm}^2$$

$$E = 169 \times 10^9 \text{ N/m}^2$$

$$\nu = 0.26$$

Correct eqn. ✓

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

$$\epsilon_x = 400 \times 10^{-6}$$

X

Same!

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

✓

$$\epsilon_y = 159.17 \times 10^{-6}$$

X

2) $D = 0.005 \text{ m}$
 $R = 0.0025 \text{ m}$
 i) $E = 163.2 \times 10^9 \text{ N/m}^2$
 $\nu = 0.3$
 $K = ?$
 $-P = 20 \text{ bar} = 20 \times 10^5 \text{ N/m}^2$

i) $K = \frac{E}{3(1-2\nu)} = \frac{163.2 \times 10^9}{3(1-2(0.3))} = 136 \times 10^9 \text{ N/m}^2$

ii) $\epsilon_V = \frac{-P}{K} = \frac{-20 \times 10^5}{136.2 \times 10^9} = -14.68 \times 10^{-6}$

iii) $\Delta V = V \epsilon_V$
 $\Delta V = 65.44 \times 10^{-9} \times -14.68 \times 10^{-6}$
 $\Delta V = -9.606592 \times 10^{-13} \text{ m}^3$

$$V = \frac{4}{3} \pi r^3$$

$$V = \frac{4}{3} \pi \times (0.0025)^3$$

$$= 65.44 \times 10^{-9}$$

$$\Delta V = (65.44 \times 10^{-9}) (-14.68 \times 10^{-6})$$

$$= -9.606592 \times 10^{-13} \text{ m}^3$$

iv) isotropic = Stress + Strains in 2 dimensions/directions
 non isotropic = " in 3 dimensions/directions

3) $L = 1.3\text{m}$
 $w = 1500\text{N/m}$
 $F = 5000\text{N}$
 $EI = 2.2 \times 10^6\text{Nm}^2$
 $F_y = ?$
 $w_y = ?$
 $y = ?$

3ii) $F_y = \frac{FL^3}{3EI}$ ✓

$F_y = \frac{-5000 \times 1.3^3}{3(2.2 \times 10^6)}$ ✓ $F_y = -1.66 \times 10^{-3}\text{m}$ ✓

3i) $w_y = \frac{wL^4}{8EI} = \frac{-1500 \times 1.3^4}{8(2.2 \times 10^6)} = -2.43 \times 10^{-4}$
 $= -243.4 \times 10^{-6}\text{m}$

3iii) $y = -1.66 \times 10^{-3} + -243.4 \times 10^{-6} = -1.903 \times 10^{-3}\text{m}$ ✓

$y = 3.5\text{mm} / 3.5 \times 10^{-3}\text{m}$ $y - w_y = F_y$

$3.5 \times 10^{-3} - 2.43 \times 10^{-4} = 3.257 \times 10^{-3}$ ✓

$F_y = \frac{FL^3}{3EI} \rightarrow F = \frac{3EIF_y}{L^3}$ ✓

iv) $F = \frac{3(2.2 \times 10^6)(3.257 \times 10^{-3})}{(1.3)^3}$

max point load
with 3.5mm
deflection

$F = 9784.34\text{N}$

$\Delta F = ?$

! Shame

$$4) D = 0.35 \text{ m}$$

$$L = 0.8 \text{ m}$$

$$\eta_L = 0.85$$

$$\eta_c = 0.95$$

$$t = ?$$

$$P = 20 \text{ bar} / 20 \times 10^5 \text{ N/m}^2$$

$$\sigma_{\max} = 110 \text{ MPa} / 110 \times 10^6 \text{ N/m}^2$$

$$\sigma_c = \frac{PD}{2t\eta_L} \quad \frac{(20 \times 10^5)(0.35)}{2(\cancel{t})0.85}$$

$$t = \frac{2(\sigma_c)}{(20 \times 10^5)(0.35)} \quad \cancel{t} = 2(\sigma_c)$$

being a thin walled vessel, the wall thickness will be below 17.5mm thick ($1/20^{\text{th}}$)

5) $D_o = 150 \text{ mm} / 150 \times 10^{-3} \text{ m}$
 $D_i = 130 \text{ mm} / 130 \times 10^{-3} \text{ m}$
 $P = 80 \text{ bar} / 80 \times 10^5 \text{ N/m}^2$
 $\sigma_r = ?$
 $\sigma_c = ?$

$$r = \frac{D}{2}$$

$$r_o = 75 \times 10^{-3} \text{ m}$$

$$r_i = 65 \times 10^{-3} \text{ m}$$

$$\sigma_r = a - \frac{b}{r^2}$$

$$\sigma_c = a + \frac{b}{r^2}$$

$$\sigma_r = a - \frac{b}{75 \times 10^{-3}}^2$$

$$\ln \sigma_r = a - \frac{b}{65 \times 10^{-3}}$$

$$\sigma_c = a + \frac{b}{75 \times 10^{-3}}$$

$$\ln \sigma_c = a + \frac{b}{65 \times 10^{-3}}$$

Question No.

Examiner

Arholwr yn unig

Qwestiwn

Question No.

Examiner C

Arholwr yn unig

y Cwestiwn

Question No.

Examiner

Arholwr yn unig

y Cwestiwn

Question No.

Examiner

Arholwr yn unig

/ Cwestiwn



Cyfarwyddiadau i Ymgeiswyr

1. Rhwch yr holl wybodaeth y gofynnir amdani yn y blychau isod.
2. Rhwch eich enw yn y lle a ddarparwyd ar y dde, pigwch et a'i selio i lawr (gan ddefnyddio'r label a ddarparwyd) i guddio'ch enw.

3. Rhaid i'r atebion fod mewn llawysgriften ddarllenadwy. Gall yr Arholwyr naill ai anwybyddu sgrifft annarllenadwy, neu drefnu iddi gael ei threipio a chael yr ymgeisydd i dalu.

4. Ysgriptennwch eich atebion mewn inc.

5. Dechreuwch bob ateb ar dudalen newydd. Gwnewch unrhyw fras nodiadau yn y llyfr atebion a thynnu llinell drwyddynt.

6. Ni ddylid rhwygo unrhyw ran o'r llyfr hwn; rhaid ei gyflwyno yn gyfan.

7. Os defnyddir mwy nag un lliftr, rhwymwch hwy gyda'i gilydd gan ddefnyddio'r tagiau sydd ar gael oddi wrth y gwylwyr/gwylwyr.

8. Rhaid dychwelyd pob llyfr. Ni chanafeir mynd â llyfrau atebion, wedi eu defnyddio neu heb eu defnyddio, allan o'r lleoliad arholi o dan unrhyw amgylchiadau.

7	Nifer y Llyfrau Atebion a gyflwynwyd	
6	Rhif Sedd	
5	Lleoliad yr Arholiad	
4	Dyddiad ac Amser yr Archoliad	
3	Cod y Modwl	
2	Teitl y Papur Arholiad	
1	Rhif Myfyrwr	

[illegible]

(See the other side for English version)

Llenwch, plygwch a seliwch
(gweler nodyn 2 isod)

CYFENW:

ENW(AU) CYNTAF:

ENW(AU) CYNTAF: