



**Complete, fold and seal**  
(see note 2 below)

SURNAME: Coughlin

FORENAME(S): Leighton Joseph

## 12 Pages

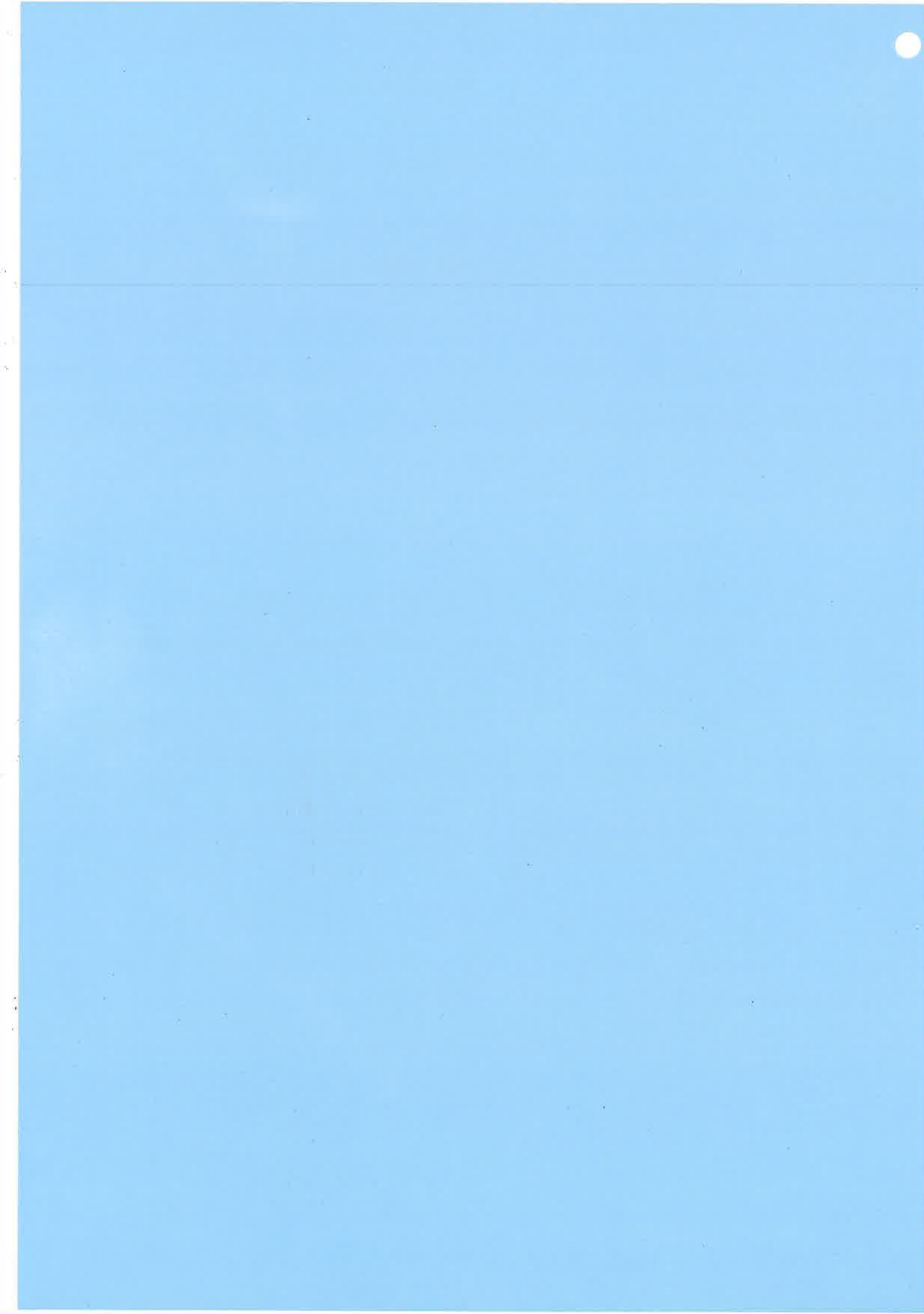
1. Please give the information requested in the boxes below.
2. Enter your name in the space provided to the right, fold over and seal down (using the label provided) to hide your name.
3. The answers must be legibly written. The Examiners can either ignore illegible script or have it typed and the expense 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.**

|   |                                  |                     |
|---|----------------------------------|---------------------|
| 1 | Student Number                   | 1802971             |
| 2 | Title of Examination Paper       | Engineering Science |
| 3 | Module Code                      | M4X02192            |
| 4 | Date and Time of Examination     | 03/05/2019          |
| 5 | Examination Venue                | 1Q106               |
| 6 | Seat Number                      |                     |
| 7 | Number of Answer Books handed in |                     |

| List the numbers of the questions you have attempted | Office Use |                 |
|------------------------------------------------------|------------|-----------------|
| 1                                                    | 8          | 8               |
| 2                                                    | 11         | <del>8</del> 11 |
| 3                                                    | 10         | 10              |
| 4                                                    | 10         | 10              |
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|                                                      |            |                 |
|                                                      |            |                 |
| Total                                                | 139        | 39              |

I'd Tim Tudor  
~~Dean~~  
Excellent Job!

100 %  
Gay :



$$1) A = 0.6\text{m} \times 0.465\text{m} = 0.279\text{m}^2 \quad (2)$$

$$h = 1100\text{W/m}^2\text{K} \quad (1)$$

$$Q = 55\text{kw or } 55 \times 10^3\text{W} \quad (1)$$

$$Q = h \cdot A (T_2 - T_1)$$

$$\frac{Q}{h \cdot A} = (T_2 - T_1) \quad (1)$$

$$(T_2 - T_1) = \frac{55 \times 10^3}{1100 \times 0.279} \quad (1)$$

$$(T_2 - T_1) = \underline{\underline{179.2^\circ\text{C}}} \quad \checkmark$$

8/8

$$2) F = 250\text{N}$$

$$x = 2\text{mm or } 2 \times 10^{-3}\text{m} \quad (1)$$

$$A = 400\text{mm} \text{ or } 0.4\text{m} \times 25\text{mm or } 0.025\text{m} = 0.01\text{m}^2 \quad (1)$$

$$L = 100\text{mm or } 0.1\text{m} \quad (1)$$

$$a) \tau = \frac{F}{A} \quad \checkmark$$

$$\tau = \frac{250}{0.01} \quad (1)$$

$$\tau = \underline{\underline{25000}} \text{ N/m}^2 \quad (1) \quad \checkmark$$

$$b) \gamma = \frac{x}{L}$$

$$\gamma = \frac{2 \times 10^{-3}}{0.1} \quad (1)$$

$$\gamma = \underline{\underline{0.02}} \text{ (no units)} \quad \checkmark \quad (1)$$

$$c) G = \frac{\tau}{\gamma}$$

$$G = \frac{25000}{0.02} \quad \checkmark \quad (1)$$

$$G = \underline{\underline{1.25 \times 10^6}} \text{ N/m}^2 \quad (1)$$

11/11

3)  $L = 0.75 \text{ m}$   
 $T = 1200 \text{ Nm}$   
 $\theta = 0.0005 \text{ radians}$   
 $G = 210 \text{ GN/m}^2 \text{ or } 210 \times 10^9 \text{ N/m}^2$  ①  
 $D = ?$

$$\frac{T}{J} = \frac{\tau}{r} = \frac{G\theta}{L}$$

$$\frac{G\theta}{L} = \frac{T}{J}$$

$$\frac{G\theta J}{L} = T$$

$$G\theta J = T \times L$$

$$J = \frac{T \times L}{G\theta}$$

$$J = \frac{1200 \times 0.75}{210 \times 10^9 \times 0.0005}$$

$$J = 8.5714 \times 10^{-6} \text{ (4dp)}$$

$$J = \frac{\pi D^4}{32}$$

$$\frac{J}{\pi} = \frac{D^4}{32}$$

$$\sqrt[4]{\frac{32J}{\pi}} = D$$

$$D = \sqrt[4]{\frac{32 \times 8.5714 \times 10^{-6}}{\pi}} = 0.097 \text{ m (3dp)}$$

10/10

$$\begin{aligned}
 4) \quad F &= 273 \text{ N} \\
 x &= 0.0035 \text{ mm or } 3.5 \times 10^{-6} \text{ m} \\
 L &= 0.25 \text{ m} \\
 D &= 15 \text{ mm or } 0.015 \text{ m}
 \end{aligned}$$

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

$$A = \pi r^2$$

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

~~$$\sigma = \frac{F}{\pi \times \left(\frac{d}{2}\right)^2}$$~~

$$\sigma = \frac{F}{\pi \times \left(\frac{d}{2}\right)^2}$$

$$\sigma = \frac{273}{\pi \times \frac{0.015^2}{2}}$$

$$\sigma = 1.544864 \times 10^6 \text{ N/m}^2 \text{ (6dp)} \quad \checkmark$$

$$E = \frac{x}{L}$$

$$E = \frac{3.5 \times 10^{-6}}{0.25}$$

$$E = 1.4 \times 10^{-5} \text{ (no units)}$$

$$E = \frac{1.544864 \times 10^6}{1.4 \times 10^{-5}} = \frac{\sigma}{E}$$

$$E = 1.103474286 \times 10^{11} \text{ N/m}^2 \quad \checkmark$$

10/10

Question No.

Examiner O

Arholwr yn unig

y Cwestiwn



Question No.

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Question No.

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Question No.

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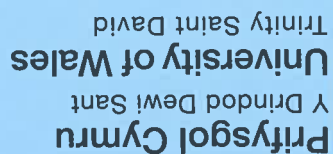
Question No.

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## 12 Tüdalen

1. Rhwch yr holl wybodaeth y gofynnir armdani yn y blychau isod.
2. Rhwch eich enw yn y lle a ddarparwyd ar y dde, plygwch ef a'i seilio i lawr (gan ddefnyddio'r label a ddarparwyd) i guddio'ch enw.

**CYFENW:**

Llenwch, plygwch a selwch  
(gweler nodyn 2 isod)

1. Rhaid i'r atebion fod mewn llawysgriften ddarllenadwy. Gall yr Arholwyr naill ai anwybyddu sgript annarllenadwy, neu drefnu iddi gael ei theipio a chael yr ymgesydd i dalu.
2. Ysgrifennwch eich atebion mewn inc.
3. Dechreuwch bob ateb ar dudalen newydd. Gwnewch unrhyw fras nodiadau yn y llyfr atebion a thynnu llinell drwyddynt.
4. Ni ddylid rhwygo unrhyw ran o'r llyfr hwn; rhaid ei gyflwyno yn gyfan.
5. Os defnyddir mwy nag un llyfr, rhwymwch hwy gyda'i gilydd gan ddefnyddio'r tagiau sydd ar gael oddi wrth y gwyllwr/gwylwyr.
6. Rhaid dychwelyd pob llyfr. Ni chaniateir mynd â llyfrau atebion, wedi eu defnyddio neu heb eu defnyddio, allan o'r lleoliad arholi o dan unrhyw amgylchiad nadu.

|   |                                         |           |
|---|-----------------------------------------|-----------|
| 1 | Rhif Myfyriwr                           |           |
| 2 | Teitl y Papur                           | Arholiad  |
| 3 | Cod y Modwl                             |           |
| 4 | Dyddiad ac Amser yr                     | Archoliad |
| 5 | Lleoliad yr Arholiad                    |           |
| 6 | Rhif Sedd                               |           |
| 7 | Nifer y Llyfrau Atebion<br>a gyflwynwyd |           |

[illegible]

(See the other side for English version)