



Complete, fold and seal
(see note 2 below)

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Instructions to Candidates

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	2117073
2	Title of Examination Paper	Eng. Maths
3	Module Code	SG-EE 4002
4	Date and Time of Examination	13/22 2.30
5	Examination Venue	
6	Seat Number	
7	Number of Answer Books handed in	

[illegible]

(Gweler yr ochr arall am y fersiwn Cymraeg)

Section A

i) ~~15~~
 $15(3x+2) - 8(2-4x) = 125$

$$45x + 30 - 16 + 32x = 125$$

$$77x + 14 = 125$$

$$77x = 111$$

$$x = \frac{111}{77}$$

$$x = 1.44$$

5

ii) 4A - 3B

$$\begin{pmatrix} 12 & -4 \\ 20 & 4 \end{pmatrix} - \begin{pmatrix} 6 & -9 \\ 6 & 3 \end{pmatrix} = \begin{pmatrix} 6 & 5 \\ 14 & 1 \end{pmatrix}$$

2

iii) BC

$$\begin{pmatrix} 2 & -3 \\ 2 & 1 \end{pmatrix} \begin{pmatrix} 4 & -3 & 2 \\ 2 & 3 & 4 \end{pmatrix} = \begin{pmatrix} 2 & -15 & -8 \\ 10 & -3 & 8 \end{pmatrix}$$

4

$$D_{11} = (2 \times 4) + (-3 \times 2) = 2$$

$$D_{12} = (2 \times -3) + (-3 \times 3) = -15$$

$$D_{13} = (2 \times 2) + (-3 \times 4) = -8$$

$$D_{21} = (2 \times 4) + (1 \times 2) = 10$$

$$D_{22} = (2 \times -3) + (1 \times 3) = -3$$

$$D_{23} = (2 \times 2) + (1 \times 4) = 8$$

iii) A^{-1} , $\det A = (3 \times 1) - (5 \times -1) = 8$

$$A^{-1} = \frac{1}{8} \begin{pmatrix} 1 & 1 \\ -5 & 3 \end{pmatrix} = \begin{pmatrix} 1/8 & 1/8 \\ -5/8 & 3/8 \end{pmatrix}$$

5

$$3) y = 5x^3 - \frac{3}{x^4} + 4\sqrt{x}$$

$$y' = 15x^2 - 12x^{3/4} + \frac{1}{4}x^{-3/4}$$

1

$$4) Z_1 = 5 - j4$$

$$r = \sqrt{5^2 + 4^2} = 6.4$$

$$\theta = \tan^{-1} \frac{4}{5} = 38.66^\circ \therefore Z_1 = 6.4 \angle -38.66^\circ$$

$$Z_2 = 3 + j5$$

$$r = \sqrt{3^2 + 5^2} = 5.83$$

$$\theta = \tan^{-1} \frac{5}{3} = 59.036^\circ \therefore Z_2 = 5.83 \angle 59.036^\circ$$

$$i) Z_1 Z_2$$

$$6.4 \times 5.83 (-38.66 + 59.036)$$

$$= 37.312 \angle 20.376^\circ$$

$$ii) \frac{Z_1}{Z_2}$$

$$\frac{6.4}{5.83} (-38.66 - 59.036)$$

$$= 1.09 \angle -97.696^\circ$$

10

$$5) \int_0^{\pi/2} (4 \cos 2x - 6 \sin 3x) dx$$

$$= \left[8 \sin 2x + 3 \cos 3x \right]_0^{\pi/2} \quad \times$$

$$= \left[8 \sin(2 \times \pi/2) + 3 \cos(3 \times \pi/2) \right] -$$

$$\left[8 \sin(2 \times 0) + 3 \cos(3 \times 0) \right]$$

$$= \left[2.55 + 3 \right] = 5.55 \quad \times$$

0.

27
40

Section B

Prove:

$$\begin{aligned} i) & 7I_1 + 8(I_1 + I_2) = 12 \\ ii) & 14I_1 + 8(I_2 + I_1) = 8 \end{aligned}$$

$$\begin{aligned} 7I_1 + 8I_1 + 8I_2 &= 12 \\ 14I_1 + 8I_2 + 8I_1 &= 8 \end{aligned}$$

$$\begin{aligned} 15I_1 + 8I_2 &= 12 \\ 22I_1 + 8I_2 &= 8 \end{aligned}$$

$$\begin{aligned} 12 &= 15I_1 + 8I_2 \\ 8 &= 8I_1 + 22I_2 \end{aligned}$$

Cramer's Rule:

$$I_1 = \frac{\begin{vmatrix} 12 & 8 \\ 15 & 8 \end{vmatrix}}{\begin{vmatrix} 15 & 8 \\ 8 & 22 \end{vmatrix}} = \frac{(12 \times 8) - (15 \times 8)}{-24}$$

$$\frac{\begin{vmatrix} 8 & 22 \\ 12 & 8 \end{vmatrix}}{\begin{vmatrix} 15 & 8 \\ 8 & 22 \end{vmatrix}} = \frac{(8 \times 8) - (12 \times 22)}{-200}$$

$$= \frac{-24}{-200} = 0.12$$

$$I_2 = \frac{\begin{vmatrix} 15 & 8 \\ 8 & 22 \end{vmatrix}}{\begin{vmatrix} 15 & 8 \\ 8 & 22 \end{vmatrix}} = \frac{(15 \times 22) - (8 \times 8)}{-200}$$

$$= \frac{266}{-200} = -1.33$$

4

$$\text{ii) } \begin{array}{r} 15 I_1 + 8 I_2 = 12 \\ 22 I_2 + 8 I_1 = 8 \end{array} \quad \times$$

$$-7 I_1 = 4$$

$$I_1 = \frac{4}{-7}$$

$$I_1 = -0.571428$$

$$= -0.571 \quad \times$$

sub into $\rightarrow$

~~$$22(-0.571) + 8 I_2 = 8$$~~

$$15(-0.571) + 8 I_2 = 12$$

$$-8.565 + 8 I_2 = 12$$

$$8 I_2 = 20.565$$

$$I_2 = 2.570625 \quad \times$$

$$\frac{4}{20}$$

3)

x	f	xf	$f(x - \bar{x})^2$
5	24	120	11197.44
15	42	630	5651.52
25	58	1450	148.48
35	42	1470	2963.52
45	22	990	7448.32
55	12	660	9678.72
Σf	Σxf	$\Sigma = 37,088$	
$= 200$	5320		

$$\bar{x} = \frac{\Sigma fx}{\Sigma f} = \frac{5320}{200} = 26.6$$

$$\sigma = \sqrt{\frac{\Sigma f(x - \bar{x})^2}{\Sigma f}} = \sqrt{\frac{37,088}{200}} = \sqrt{185.44}$$

ii)

$$a) P(A) \times P(B) = 0.45 \times 0.85 = 0.3825$$

$$b) P(\text{neither}) = 0.55 \times 0.15 = 0.0825$$

$$P(\text{correct}) = 1 - 0.0825 = 0.9175$$

18
20

4)
a) $y = \frac{2e^{6x}}{\sin 3x}$

let $u = 2e^{6x}$ ~~$\frac{du}{dx} = \sin 3x$~~

$\frac{dy}{dx} = 3\cos 3x$

~~$12e^{5x}$~~

~~$\frac{dy}{dx}$~~

$\frac{dy}{dx} = \frac{(2e^{6x})(3\cos 3x) - (12e^{5x})(\sin 3x)}{(3\cos 3x)^2}$

$\frac{dy}{dx} = \frac{6e^{6x}\cos 3x - 12e^{5x}\sin 3x}{(3\cos 3x)^2}$

2

b) $y = 6\cos(3x - 5)$

let $u = 3x - 5$ $\frac{du}{dx} = 3$

$\frac{dy}{dx} = 3$

1

$\frac{dy}{dx} = 18\cos u(3x - 5)$

ii) $y = 3x^3 + 4x^2 - 2x - 5$

$$y' = 9x^2 + 8x - 2$$

where $\frac{dy}{dx} = 0$

$$9x^2 + 8x - 2 = 0$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$x = \frac{-8 \pm \sqrt{(8)^2 - 4(9)(-2)}}{2(9)}$$

$$x = \frac{-8 \pm \sqrt{64 - 72}}{18} \quad x = \frac{-8 \pm \sqrt{-8}}{18}$$

$$x = 0.2034390994$$

$$= 0.203$$

or

$$x = -1.092327988$$

$$= -1.092$$

~~0.203~~ $0.203 > 0$ so ~~min~~ point $\times$

$-1.092 < 0$ so max point $\times$

8/20