



Examination Answer Books

12 Pages

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.

Complete, fold and seal
(see note 2 below)

SURNAME: Smith

FORENAME(S): John

1	Student Number	Sm16836261
2	Title of Examination Paper	MATHEMATICS
3	Module Code	GOEN4001
4	Date and Time of Examination	15th of May 2023 9.30
5	Examination Venue	Tycoch
6	Seat Number	B2
7	Number of Answer Books handed in	

List the numbers of the questions you have attempted	Office Use
1	
2	
3	
Q1 a	13
b	0
c	1
Q2 a	14
b	7
c	0
Q3 a	14
b	2
c	0
Total	51/100

51%
51%

ML

Q1)

Q1aa) i) $Z_1 + Z_2$ 13/18

$$2+4j+5+3j = 7+7j \quad \checkmark \quad \underline{\underline{1}}$$

ii) $3Z_1 + 2Z_3$ $\checkmark$

$$3(2+4j) + 2(3+2j) \quad \checkmark$$

$$6+12j+6+4j = 12+16j \quad \checkmark \quad \underline{\underline{2}}$$

iii) $Z_1 Z_2$

$$(2+4j)(5+3j) \quad \checkmark$$

$$10+6j+20j+12j^2 \quad \checkmark$$

$$= -2+26j \quad \checkmark \quad \underline{\underline{3}}$$

iv) $Z_1 + Z_3^2$

$$2+4j+(3+2j)(3+2j) \quad \checkmark$$

$$= 2+4j+9+6j+6j+4j^2 \quad \checkmark$$

$$= 11+16j+4j^2 \quad \checkmark$$

$$= -2+16j \quad \checkmark \quad \underline{\underline{3}}$$

v) $Z_1 Z_2 Z_3$

$$(2+4j)(5+3j)(3+2j) \quad \checkmark$$

$$10+6j+20j+12j^2(3+2j) \quad \checkmark$$

$$-2+26j(3+2j) \quad \checkmark$$

$$= -6-4j+78j+52j^2 \quad \checkmark$$

$$= -58+74j \quad \checkmark$$

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

$$\frac{2+6j}{s+3j} \times \frac{s+3j}{s+3j}$$

$$\frac{(2+6j)(s+3j)}{(s+3j)(s+3j)} = \frac{10+6j+20j+12j^2}{2s+13j+15j^2+9j^2}$$

$$= \frac{10+26j+12j^2}{2s+30j+16j^2}$$

$$\frac{16j^2-2}{30j+16}$$

$$= \frac{-2}{16} + \frac{26j}{30j}$$

$$b) (4+s^2)^3$$

$$= 4^3 + 3(4)(s^2) = 64 + 12s^2 = 4^3 (\cos^2 1s^2 + \sin^2 1s^2)$$

$$c) 2x^2 - 8x + 26 = 0$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} = \frac{+8 \pm \sqrt{8^2 - 4(2)(26)}}{2(2)}$$

$$x = -2.1$$

or

$$x = 6.1$$

Q160/7Q1C1/9

Q2

a) i) Determinant of A

$$0 \ 30 \ 8 = 38$$

$$\begin{bmatrix} 3 & 2 & 3 \\ 1 & 0 & 2 \\ 3 & 5 & 4 \end{bmatrix}$$

$$0 \ 12 \ 15 = 27$$

$$27 - 38 = -11$$

ii) can't be calculated

iii) Determinant of D

$$\begin{bmatrix} 4 & 5 \\ 4 & 5 \end{bmatrix}$$

$$20 - 5 = 15$$

iv) AB

$$\begin{bmatrix} 3 & 2 & 3 \\ 1 & 0 & 2 \\ 3 & 5 & 4 \end{bmatrix} \times \begin{bmatrix} 1 & 2 & 2 \\ 3 & 0 & 5 \\ 1 & 1 & 3 \end{bmatrix} = \begin{bmatrix} 12 & 9 & 25 \\ 3 & 7 & 8 \\ 22 & 10 & 43 \end{bmatrix}$$

v) AC $(3 \times 3)(3 \times 2)$

$$\begin{bmatrix} 3 & 2 & 3 \\ 1 & 0 & 2 \\ 3 & 5 & 4 \end{bmatrix} \times \begin{bmatrix} 4 & 5 \\ 2 & -2 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 16 & 15 \\ 4 & 7 \\ 22 & 9 \end{bmatrix}$$

vi) DC $(2 \times 2)(3 \times 2)$

can't be calculated

Q2a14/16

vi) A+B

$$\begin{bmatrix} 3 & 2 & 3 \\ 1 & 0 & 2 \\ 2 & 3 & 4 \end{bmatrix} + \begin{bmatrix} 1 & 2 & 2 \\ 3 & 0 & 5 \\ 1 & 1 & 3 \end{bmatrix} = \begin{bmatrix} 4 & 4 & 5 \\ 4 & 0 & 7 \\ 3 & 4 & 7 \end{bmatrix}$$

b)

$$\begin{aligned} 3x + 2y + 4z &= -5 \\ 2x + 3y + 3z &= 2 \\ 5x + 2y + 5z &= 3 \end{aligned}$$

$$\begin{bmatrix} 3 & 2 & 4 \\ 2 & 3 & 3 \\ 5 & 2 & 5 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} -5 \\ 2 \\ 3 \end{bmatrix}$$

$60 \quad 18 \quad 20 = 98$

$$D = \begin{bmatrix} 3 & 2 & 4 \\ 2 & 3 & 3 \\ 5 & 2 & 5 \end{bmatrix} \begin{bmatrix} 3 & 2 \\ 2 & 3 \\ 5 & 2 \end{bmatrix}$$

$45 \quad 30 \quad 16 = 91$

$$Dx = \begin{bmatrix} -5 & 2 & 4 \\ 2 & 3 & 3 \\ 3 & 2 & 5 \end{bmatrix} \begin{bmatrix} -5 & 2 \\ 2 & 3 \\ 3 & 2 \end{bmatrix}$$

$-75 \quad 188 \quad 16$

$91 - 98 = -7$

$$Dy = \begin{bmatrix} 3 & -5 & 4 \\ 2 & 2 & 3 \\ 5 & 3 & 5 \end{bmatrix} \begin{bmatrix} 3 & -5 \\ 2 & 2 \\ 5 & 3 \end{bmatrix}$$

$35 \quad -75 \quad 24 = -16$

$$-16 - 17 = -33$$

Q2b

F/E

$$-75 \ 12 \ 12 \div -51$$

$$D_2 \begin{bmatrix} 3 & 2 & -5 & 3 & 2 \\ 2 & 3 & 2 & 2 & 3 \\ 5 & 2 & 3 & 5 & 2 \end{bmatrix}$$

$$27 \ 20 \ -20 \ 27 \checkmark$$

$$27 \div -51 = 78 \checkmark$$

$$x = \frac{-67}{-7} \quad y = \frac{-33}{-7} \quad z = \frac{78}{-7} \checkmark$$

c) inverse

$$0 \ 12 \ -36 \div -24$$

$$A \begin{bmatrix} 2 & 3 & 0 \\ 4 & 1 & 3 \\ 2 & 4 & 3 \end{bmatrix} = \begin{bmatrix} 1 & -4 & 0 \\ -3 & 2 & 3 \\ -2 & 4 & -3 \end{bmatrix} \begin{bmatrix} 1 & -4 \\ -3 & 2 \\ -2 & 4 \end{bmatrix}$$

$$-6 + 24 = 18 \times$$

$$18 \div -24 = 42$$

$$\frac{1}{42} \begin{bmatrix} 1 & -4 & 0 \\ -3 & 2 & 3 \\ -2 & 4 & -3 \end{bmatrix}$$

Q2c

0/10

Q3 a)

$$i) \int (2x^4 + x^3 - 3x^2 + 5x) dx$$

$$= \frac{2x^5}{5} + \frac{x^4}{4} - \frac{3x^3}{3} + \frac{5x^2}{2} + C \quad \underline{\underline{4}}$$

$$ii) \int (\sin 3x + \cos 5x) dx$$

$$= -\frac{1}{3} \cos 3x + \frac{1}{5} \sin 5x + C \quad \underline{\underline{2}}$$

$$iii) \int (1+3t)t^2 dt$$

$$\int t^2 + 3t^3 dt$$

$$\frac{t^3}{3} + \frac{3t^4}{4} + C \quad \underline{\underline{L}}$$

$$iv) \int (2e^x + \frac{1}{x} + \ln 2) dx$$

$$\frac{2e^x}{1} + \ln(x) + \ln 2 + C \quad \underline{\underline{L}}$$

$$v) \int_0^2 (5x^3 + 2x^2 + 5x - 6) dx$$

$$\left[\frac{5x^4}{4} + \frac{2x^3}{3} + \frac{5x^2}{2} - 6x \right]_0^2 \quad \underline{\underline{4}}$$

$$\left[\frac{5(2)^4}{4} + \frac{2(2)^3}{3} + \frac{5(2)^2}{2} - 6(2) \right] - [0]$$

$$= 23 \cdot 3$$

$$vi) \int_1^3 (Se^{2x} + 2x^2) dx$$

$$\left(\frac{1}{2}e^{2x} + \frac{2x^3}{3} \right) - \left(\frac{1}{2}e^{2x} + \frac{2x^3}{3} \right)$$

$$\left(\frac{1}{2}e^{2(3)} + \frac{2(3)^3}{3} \right) - \left(\frac{1}{2}e^{2(1)} + \frac{2(1)^3}{3} \right) = 3626.5$$

↑
correct
method

↑
error carried
forward

$$b) \int x^2 (2x^3 + 1)^5 dx$$

$$u = 2x^3 + 1$$

$$\frac{du}{dx} = 6x^2$$

Q3b2/6

$$\int x^2 (u)^5 \cdot \frac{dx}{6x^2}$$

$$6^5 (u)^5 = \frac{dx}{6x^2}$$

$$6(u)^5 = \frac{dx}{6x^2}$$

$$6(2x^3 + 1)^5$$

$$\int (12x^3 + 1)^5 = dx$$

$$\left(\frac{12x^4}{4} + 1x \right)^5 = dx$$

$$\frac{60x^{20}}{20} + 5x = dx$$

$$3 + 5x$$

$$c) \int \sin x \cos x$$

Q3c0/8

$$u = \sin x \quad du = \cos x$$

$$v = -\frac{1}{x} \cos x$$

$$= \sin x - \frac{1}{x} \cos x - \int -\frac{1}{x} \cos x \left(\frac{\sin x}{2} \right) dx$$

$$\int u \frac{du}{dx} dx = uv - \int v \frac{du}{dx} dx$$