



Prifysgol Cymru
Y Drindod Dewi Sant
University of Wales
Trinity Saint David

OME

Complete, fold and seal
(see note 2 below)

SURNAME: Sherlock

FORENAME(S): Arun Joseph

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 of the label and seal down (using the label provided) to hide your name.
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1	Student Number	2318644
2	Title of Examination Paper	Mathematics Paper 1
3	Module Code	ACDA4008
4	Date and Time of Examination	09/01/2024
5	Examination Venue	IQ 310
6	Seat Number	027
7	Number of Answer Books handed in	1

List the numbers of the questions you have attempted	Office Use
1	25
2	13
3	10
4	10
5	1
6	3
Total	62

62%

Q1

$$i) 6x + 2y - 5z - 3x - 9y + 3z + 2x - 5y + 8z$$

$$\Rightarrow 6x - 3x + 2x = 5x$$

$$\Rightarrow 2y - 9y - 5y = -12y$$

$$\Rightarrow -5z + 3z + 8z = 6z$$

$$= 5x - 12y + 6z$$

5

$$ii) x(x+3) - x(x-4)$$

$$\Rightarrow x^2 + 3x - x^2 + 4x$$

$$= 7x$$

5

$$iii) 2p^2qr \times 4pq^3 \times 6qr^2$$

$$\Rightarrow 2 \times 4 \times 6 = 48$$

$$\Rightarrow p^2 \times p = p^3$$

$$\Rightarrow q \times q^3 \times q = q^5$$

$$\Rightarrow r \times r^2 = r^3$$

$$= 48 p^3 q^5 r^3$$

5

$$iv) \frac{12 p^5 q r}{4 p^3 q^3 r^{-2}}$$

$$\Rightarrow 12 \div 4 = 3$$

$$\Rightarrow p^5 \div p^3 = p^2$$

$$\Rightarrow q \div q^3 = q^{-2}$$

$$\Rightarrow r \div r^{-2} = r^3$$

$$= 3 p^2 q^{-2} r^3$$

5

Q1-v)

$$\frac{5g}{16h} \times \frac{8gh^2}{4fh} \times \frac{32fh^3}{12f^3}$$

$$\Rightarrow 5g \times 8gh^2 \times 32fh^3 = 256 f^2 g^2 h^5$$

$$\Rightarrow 16h \times 4fh \times 12f^3 = 768 h^2 f^4$$

$$= \frac{1}{3} f^{-2} g^2 h^3$$

5

Q2

$$i) 5(x+3) = 2(x-8)$$

$$\Rightarrow 5x + 15 = 2x - 16$$

$$\Rightarrow 3x + 15 = -16$$

$$\Rightarrow 3x = -31$$

$$= x = -\frac{31}{3}$$

8

$$ii) \frac{(x-3)}{4} = x + \frac{(3x+4)}{8}$$

$$\Rightarrow 8(x-3) = 8x + 4(3x+4) \times 8$$

$$\Rightarrow 8x - 24 = 8x + 12x + 16$$

$$\Rightarrow 8x = 13x + 40$$

$$\Rightarrow 8x = 13x + 40$$

$$\Rightarrow -5x = 40$$

$$\Rightarrow 5x = -40$$

$$= x = -8$$

Idea Correct ✓

error in

Simplifying

5

Q3 $\textcircled{A} 2x + 4y = 6$
 $\textcircled{B} 3x - 5y = -2$ $\text{lcm} = 6$ for x

$\textcircled{A} \times 3 = 6 \Rightarrow \cancel{4x} + 12y = 18$
 $\textcircled{B} \times 2 = 6 \Rightarrow 6x - 10y = -4$

$\textcircled{A} -6x + 12y = 18$
 $\Rightarrow 12y = 18$
 $y = \frac{3}{2}$

~~$6x - 10y = -4$~~

~~$4x$~~

$6x + 12y = 18$

$\Rightarrow 18y = 18$

$y = 1$

x from A:

$2x + 4\textcircled{1} = 6$

$\Rightarrow 2x = 2$

$x = 1$

There fore, $x = 1$ and $y = 1$

Question No.

Q4

Notes

$$\begin{vmatrix} 1 & 2 & 3 \\ 2 & -1 & 2 \\ 3 & 2 & 1 \end{vmatrix} \begin{vmatrix} 1 & 2 \\ 2 & -1 \\ 3 & 2 \end{vmatrix}$$

to find diss.

$$- - - + + +$$

Q4)

$$A = \begin{vmatrix} 1 & 2 & 3 \\ 2 & -1 & 2 \\ 3 & 2 & 1 \end{vmatrix} \begin{vmatrix} 1 & 2 \\ 2 & -1 \\ 3 & 2 \end{vmatrix}$$

$$9 - 4 - 4 + 1 + 12 + 12 \Rightarrow 24$$

$$\text{Determinant} = 24$$

Find A^{-1}

$$\begin{bmatrix} \begin{vmatrix} -1 & 2 \\ 2 & 1 \end{vmatrix} & \begin{vmatrix} 2 & 2 \\ 3 & 1 \end{vmatrix} & \begin{vmatrix} 2 & -1 \\ 3 & 2 \end{vmatrix} \\ \begin{vmatrix} 2 & 3 \\ 2 & 1 \end{vmatrix} & \begin{vmatrix} 1 & 3 \\ 3 & 1 \end{vmatrix} & \begin{vmatrix} 1 & 2 \\ 3 & 2 \end{vmatrix} \\ \begin{vmatrix} 2 & 3 \\ -1 & 2 \end{vmatrix} & \begin{vmatrix} 1 & 3 \\ 2 & 2 \end{vmatrix} & \begin{vmatrix} 1 & 2 \\ 2 & -1 \end{vmatrix} \end{bmatrix}$$

Need inverse

for determinants.

$$\begin{aligned} a & \begin{vmatrix} -1 & 2 \\ 2 & 1 \end{vmatrix} = (-1 \times 1) - (2 \times 2) = -3 \\ & \begin{vmatrix} 2 & 2 \\ 3 & 1 \end{vmatrix} = (2 \times 1) - (3 \times 2) = -4 \\ & \begin{vmatrix} 2 & -1 \\ 3 & 2 \end{vmatrix} = (2 \times 2) - (3 \times -1) = 1 \end{aligned}$$

$$\begin{aligned} b & \begin{vmatrix} 2 & 2 \\ 3 & 1 \end{vmatrix} = (2 \times 1) - (3 \times 2) = -4 \\ & \begin{vmatrix} 1 & 3 \\ 3 & 1 \end{vmatrix} = (1 \times 1) - (3 \times 3) = -8 \\ & \begin{vmatrix} 1 & 2 \\ 3 & 2 \end{vmatrix} = (1 \times 2) - (3 \times 2) = -4 \end{aligned}$$

$$\begin{aligned} c & \begin{vmatrix} 2 & -1 \\ 3 & 2 \end{vmatrix} = (2 \times 2) - (3 \times -1) = 12 \\ & \begin{vmatrix} 1 & 2 \\ 2 & 2 \end{vmatrix} = (1 \times 2) - (2 \times 3) = -4 \\ & \begin{vmatrix} 1 & 2 \\ 2 & -1 \end{vmatrix} = (1 \times -1) - (2 \times 2) = -5 \end{aligned}$$

$$\begin{bmatrix} + & - & + \\ - & + & - \\ + & - & + \end{bmatrix}$$

$$A^{-1} = \frac{1}{|A|} C^T$$

$$A^{-1} = \frac{1}{24} \begin{bmatrix} -3 & -4 & 12 \\ +4 & -8 & -4 \\ 1 & -4 & -5 \end{bmatrix}$$

$$A^{-1} = \begin{bmatrix} -3 & -4 & 12 \\ -4 & -8 & -4 \\ 1 & -4 & -5 \end{bmatrix} \cdot \frac{1}{24}$$

Q5)

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

write as

$$AX = b$$

Find determinant D :

$$\Rightarrow A^{-1}AX = A^{-1}b$$

Simplify Matrix -

$$\Rightarrow \underline{X} = \underline{A^{-1}b}$$

$$\Rightarrow \begin{vmatrix} 1 & 2 & 3 & | & 1 & 2 \\ 2 & -1 & 2 & | & 2 & -1 \\ 3 & 2 & 1 & | & 3 & 2 \end{vmatrix}$$

- - - + + +

-9 4 4 -1 12 12

$$\Rightarrow -1 + 12 + 12 - (-9) - 4 - 4 = 24$$

$$D = 24$$

Find D_x , $x = 2$

Cramer's Rule?

$$\begin{vmatrix} 2 & 2 & 3 & | & 2 & 2 \\ 4 & -1 & 2 & | & 4 & -1 \\ 6 & 2 & 1 & | & 6 & 2 \end{vmatrix}$$

- - - + + +

-18 8 8 -2 24 24

$$\Rightarrow -2 + 24 + 24 - (-18) - 8 - 8 = 48$$

$$D_x = 48$$

$$x = \frac{D}{D_x} = \frac{24}{48} = \frac{1}{2}$$

$$\begin{matrix} x & y & z \\ \begin{matrix} x \\ y \\ z \end{matrix} & \begin{bmatrix} 1 & 2 & 3 \\ 2 & -1 & 2 \\ 3 & 2 & 1 \end{bmatrix} & \begin{matrix} 2 \\ 5 \\ 2 \end{matrix} \end{matrix}$$

Find D_y :

$$\begin{vmatrix} 1 & 10 & 3 \\ 2 & -5 & 2 \\ 3 & 10 & 1 \end{vmatrix} \begin{vmatrix} 1 & 10 \\ 2 & -5 \\ 3 & 10 \end{vmatrix}$$

-45 20 20 -5 60 60

$$\Rightarrow -5 + 60 + 60 - (-45) - 20 - 20 = 120$$

$$D_y = 120$$

$$y = \frac{D}{D_y} = \frac{24}{120} = \frac{1}{5}$$

Find D_z :

$$\begin{vmatrix} 1 & 2 & 6 \\ 2 & -1 & 4 \\ 3 & 2 & 2 \end{vmatrix} \begin{vmatrix} 1 & 2 \\ 2 & -1 \\ 3 & 2 \end{vmatrix}$$

-18 6 6 -2 24 24

$$\Rightarrow -2 + 24 + 24 - (-18) - 6 - 6 = 48$$

$$D_z = 48$$

$$z = \frac{D}{D_z} = \frac{24}{48} = \frac{1}{2}$$

$$\text{So, } x = \frac{1}{2}, y = \frac{1}{5}, z = \frac{1}{2}$$

Q6) $f(x) = \frac{x+2}{x^2+2x-3}$

$(x-1)(x-2)$ should be

$$\Rightarrow \frac{A}{(x-1)} + \frac{B}{(x-2)}$$

$$= \frac{x}{(x-1)} + \frac{2}{x-2}$$

$$\Rightarrow 2(x-1) \quad x(x-2)$$

$$\frac{A}{x-1} + \frac{B}{x-2}$$

$$(x-1)(x+3)$$

↓ method
Correct.

3



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3	Module Code	ACDA 4008
4	Date and Time of Examination	11/01/2024 3:00 PM
5	Examination Venue	IQ 310
6	Seat Number	020
7	Number of Answer Books handed in	

List the numbers of the questions you have attempted	Office Use
1	26
2	11
3	5
4	6
Total	48

48/0

Q1a)

(MSAD)

$$i) y = 8x^3 + 3$$

$$\frac{dy}{dx} = 3 \cdot 8x^2$$

$$\frac{dy}{dx} \Rightarrow 24x^2$$

(2)

$$ii) y = 4x^3 + 10x^{\frac{1}{2}}$$

$$\frac{dy}{dx} = 3 \cdot 4x^2 + \frac{1}{2} \cdot 10x^{-\frac{1}{2}}$$

$$\frac{dy}{dx} = 12x^2 + 5x^{-\frac{1}{2}}$$

(3)

$$iii) y = \frac{2}{x^5} + x^3$$

$$y \Rightarrow 2x^{-5} + x^3$$

$$\frac{dy}{dx} = -5 \cdot 2x^{-6} + 3x^2$$

$$\frac{dy}{dx} = -10x^{-6} + 3x^2$$

$$\frac{dy}{dx} = \frac{-10}{x^6} + 3x^2$$

(3)

$$iv) y = \sin(5x)$$

$$\frac{dy}{dx} = 5 \cos(5x)$$

(2)

Question No.

v) $y = x^2 \cos(x)$ $\rightarrow$ use product rule

$$\frac{dy}{dx} = u \cdot \frac{dv}{dx} + \cancel{v \cdot \frac{du}{dx}} \quad v \cdot \frac{du}{dx} \quad u = x^2 \quad \frac{dv}{dx} = -\sin(x)$$

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

$$\frac{dy}{dx} = x^2 \cdot -\sin(x) + \cos(x) \cdot 2x$$

$$\frac{dy}{dx} = -x^2 \sin(x) + 2x \cos(x)$$

vii) $y = (9x + 3)^{10}$ $\rightarrow$ ~~chain rule~~ chain rule?

$$y = 9x^{10} + 3^{10} \quad \text{No!}$$

$$\frac{dy}{dx} = 10 \cdot 9x^9$$

$$\frac{dy}{dx} = 90x^9 \quad \times$$

Chain rule
needed

viii) $y = (x + 3 \tan(x))$

$$\frac{dy}{dx} = 1 + 1 \cdot 3 \sec^2(x)$$

$$\frac{dy}{dx} = 1 + 3 \sec^2(x)$$

b) $y = \frac{1}{x} + \cos(3x)$, find $\frac{d^4y}{dx^4}$

$$y \Rightarrow x^{-1} + \cos(3x)$$

$$\frac{dy}{dx} = -x^{-2} - 3\sin(3x)$$

$$\frac{d^2y}{dx^2} = +2x^{-3} + 9\cos(3x)$$

$$\frac{d^3y}{dx^3} = -6x^{-4} - 27\sin(3x)$$

$$\frac{d^4y}{dx^4} = +24x^{-5} + 81\cos(3x)$$

(3)

c) $y = \frac{(2x+1)}{(3+x^2)}$

Quotient.
then find $\frac{dy}{dx}$ when $x=0$

Formula: $\frac{dy}{dx} = \frac{v \cdot \frac{du}{dx} - u \cdot \frac{dv}{dx}}{v^2}$

$$u = 2x+1 \quad v = 3+x^2$$

$$\frac{du}{dx} = 2$$

$$\frac{dv}{dx} = 2x$$

Substitute in:

$$= \frac{(3+x^2) \cdot 2 - (2x+1) \cdot 2x}{(3+x^2)^2}$$

$$\Rightarrow \frac{6 + 2x^2 - 4x - 2x}{3^2 + x^4}$$

$$\Rightarrow \frac{2x^2 - 2x + 6}{3^2 + x^4}$$

$$\frac{2x^2 - 2x + 6}{3^2 + x^4} \quad \text{when } x = 0$$

$$\Rightarrow \frac{2(0)^2 - 2(0) + 6}{3^2 + (0)^4}$$

$$\Rightarrow \frac{6}{3^2}$$

$$\Rightarrow \frac{6}{9}$$

$$\Rightarrow \frac{2}{3}$$

6

Q2a) i) $\int (10x + x^3) dx$ M SAD

$$y = \frac{10x^2}{2} + \frac{x^4}{4}$$

$$y = 5x^2 + \frac{x^4}{4} + C$$

ii) $\int (2x + 3e^x) dx$

$$y = \frac{2x^2}{2} + 3e^x + C$$

$$y = x^2 + 3e^x + C$$

iii) ~~$\int (2x + 4) dx$~~ $\int (\frac{2}{x} + 4) dx$

$$\Rightarrow \int (2x^{-1} + 4) dx$$

$$y = 2x^0$$

$$y = 2x$$

iv) $\int (x-1)(3x+4) dx$

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

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

$$y = \frac{3x^3}{3} + \frac{x^2}{2}$$

$$y = x^3 + \frac{x^2}{2} + C$$

V) $\int_3^6 (3x^2 - 2x) dx$

~~920788~~

$$y = \frac{3x^3}{3} - \frac{2x^2}{2}$$

$$y = x^3 - x^2 \checkmark$$

$$\left[x^3 - x^2 \right]_{3(b)}^{6(a)}$$

$$a - b = \dots$$

$$((6)^3 - (6)^2) - ((3)^3 - (3)^2) = 162.$$

3

B)

Canceled have $\int_0^1 \frac{e^x}{(e^x + 1)} dx$

Integration by Parts

↑ use Substitution

Formula: $u \cdot v - \int v \cdot \frac{du}{dx}$

$$u = e^x + 1$$

$$u = (e^x + 1) \checkmark \quad v = e^x$$

$$\frac{du}{dx} = e^x \quad \frac{dv}{dx} = e^x$$

Substitute in:

$$(e^x + 1) \cdot e^x - \int e^x \cdot e^x$$

$$\Rightarrow y = \cancel{e^x + 1} \cdot e^x - \int e^{2x}$$

$$y = 2e^x + 1 - e^x$$

$$y = e^x + 1$$

1

$$[e^{ax} + 1]_0^1 \quad (a)$$

$$a - b =$$

Substitute in:

$$(e^1 + 1) - (e^0 + 1) = 1.718 \text{ to 3.d.p}$$

c)

i) $\int x \cos(x) dx$

Parts formula:

$$u \cdot v - \int v \cdot \frac{du}{dx}$$

Substitute in:

$$x \cdot \cos(x) - \int \cos(x) \cdot \frac{x^2}{2}$$

$$\Rightarrow x \cdot \cos(x) + \frac{\sin(x) \cdot x^2}{2}$$

$$y = x \cdot \cos(x) + \frac{\sin(x) \cdot x^2}{2}$$

$$u = \cos(x) \quad v = x$$

$$\frac{du}{dx} = \frac{\sin(x)}{x}$$

$$v = x \quad u = \cos(x)$$

$$\frac{du}{dx} = \frac{\sin(x)}{x}$$

$$u = x \quad v = \cos(x)$$

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

ii) $\int_1^e \ln(x) dx$

$$y = \frac{\ln(x)}{x}$$

$$\left[\frac{\ln(x)}{x} \right]_1^e$$

$$(a) - (b) =$$

Substitute in

$$\left(\frac{\ln(e)}{e} \right) - \left(\frac{\ln(1)}{1} \right) = 0.368 \text{ to 3.d.p}$$

Q3a)

i) $(3+2i)(1-i)$

Formula:

$$\Rightarrow (3 \cdot 1)(2i+i)$$

$$z_1 + z_2 = r_1 r_2 e^{i(\theta_1 + \theta_2)}$$

$$\Rightarrow \cancel{3} + \cancel{3i} \quad 5-i$$

ii) $\frac{3}{(2-i)}$

Formula:

$$\frac{z_1}{z_2} = \frac{r_1}{r_2} e^{i(\theta_1 - \theta_2)}$$

$$\Rightarrow \frac{3i}{2}$$

iii) $\frac{1}{is}$

Formula:

$$\frac{z_1}{z_2} = \frac{r_1}{r_2} e^{i(\theta_1 - \theta_2)}$$

B) $z_1 = \frac{2-i}{2+i} \quad z_2 = \frac{3+i}{1-2i}$ in Rectangular $(a+bi)$

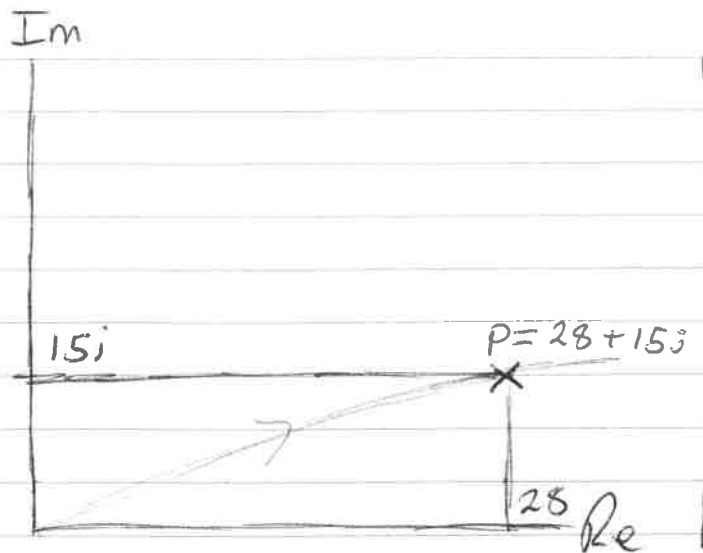
$$\text{Ans } \frac{2-i}{2+i} \cdot \frac{2-i}{2-i}$$

$$z_1 = \frac{2-i}{2+i} \cdot \frac{2-i}{2-i}$$

$$\Rightarrow 4 - 2i + 2i - i^2 + 4 + 2i + 2i + i^2$$

$$\Rightarrow 2i^2 + 4i + 8$$

$$\Rightarrow 8i + 8 = (8+8i)$$

3C)
i)

$$P = Z_1 + 2Z_2$$

$$(6j+8) + 2(7j+10)$$

$$\Rightarrow (28 + 15j)$$

3B)
continued

$$\frac{3+j}{1-2j} \times \frac{1-2j}{3+j}$$

$$\Rightarrow 1 - 2j - 2j + 4j^2 + 9 + 3j + 3j + j^2$$

$$\Rightarrow -3j^2 + 2j + 10$$

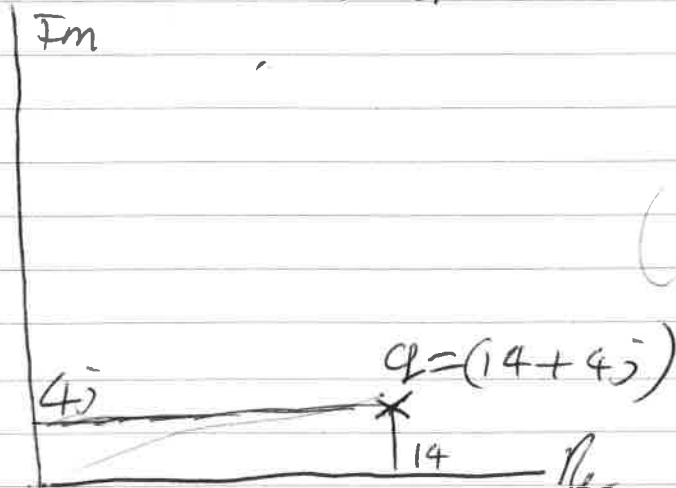
$$\Rightarrow -7j + 10$$

3Cii) $q = 3Z_1 - Z_2$ ✓ ✓ ✓

$$\Rightarrow 3(8j+8) - (7j+10)$$

$$\Rightarrow Re = (3 \cdot 8) - 10 = 14$$

$$Im = (3j+8) - 7j = 4j \Rightarrow (14 + 4j)$$



Q4)

i)

$$4^x = 3^{x+1}$$

$$\Rightarrow \log 4^x = \log 3^{x+1}$$

$$\Rightarrow 2x \log 4 = (x+1) \log 3 \quad \text{Cancels both}$$

$$\Rightarrow x \log 4 = 1 \log 3$$

$$\Rightarrow x = 1 - \log 1$$

$$2 \ln x = \ln(4x - 4)$$

$$x = 1$$

$$ii) 2 \ln(x) = \ln(4x - 4)$$

$$\Rightarrow 2 \ln(x) = \frac{\ln(4x)}{\ln(-4)}$$

$$\Rightarrow 2 \ln(x) = \ln(-4) = \ln(4x)$$

$$\Rightarrow 2 \ln x = \ln(-4)$$

B)

i)

$$\log(x^4 y z)$$

$$4 \log x + \log y + \log z$$

$$\Rightarrow \log x^4 + \log y + \log z$$

$$\Rightarrow 4 \log x + \log y + \log z$$

$$\text{ii)} \quad \ln \left(\frac{x^4 y}{z} \right)$$

$$\Rightarrow \ln(x^4 y) - \ln(z)$$

$$\Rightarrow \ln(x^4) + \ln(y) - \ln(z)$$

$$= 4 \ln(x) + \ln(y) - \ln(z)$$

(2)