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SWANSEA - ABERTAWE

71/0

Examination Answer Books

Complete, fold and seal
(see note 1 below)

SURNAME: McNICHOLAS

FORENAME(S): JOSEPH, DAVID

Candidate's Exam Number: _____

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Examination Paper Ref No.: _____ **Desk Letter/Number:** _____

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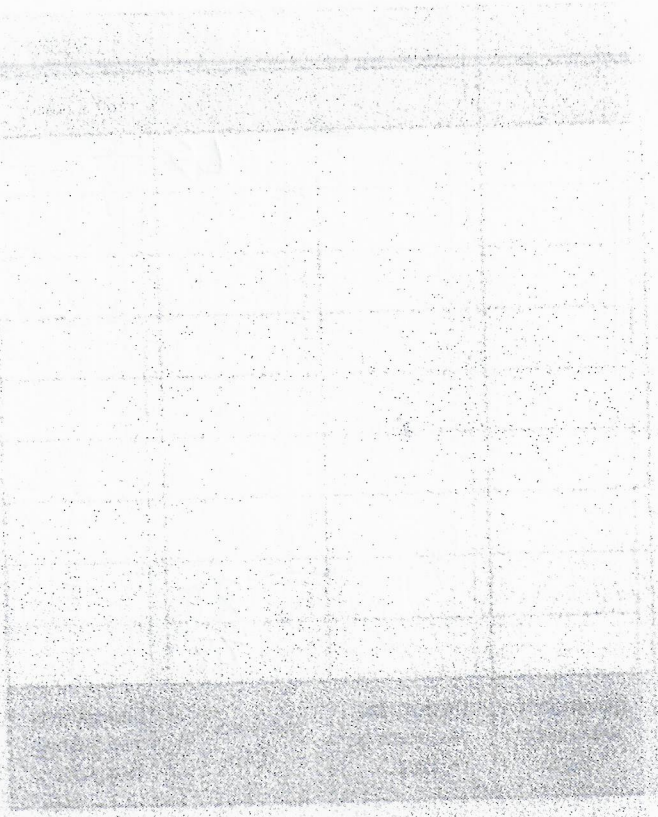
Instructions to Candidates:

1. Please give the information requested above and enter your name in the space provided at the top right of this page. If your answers are to be marked under a scheme whereby the examiners will not know your identity, fold over and seal down the top right-hand corner of the page (using the gummed label provided) in order to conceal your name.
2. Commence each answer on a fresh page.
3. Do all rough work in the answer book and cross through it.
4. No part of this booklet is to be torn out.
5. Supplementary answer books if used must:-
   (a) bear the candidate's name (concealed, where appropriate), reference number and paper title;
   (b) be numbered consecutively;
   (c) be fastened together by the tags available from the invigilator.
6. Every book must be handed in. In no circumstances may answer books, used or unused, be taken out of the exam room.
7. Your anwers must be legibly written **IN INK**. The Examiners can either ignore illegible script or have it typed and the expense of typing charged to the candidate.

Summary of Marks

Question Numbers Answered	1st Examiner	2nd Examiner (optional)	3rd Examiner (optional)
1	32		
2	25		
	57		
TOTAL			
RESULT			



Question No.

Examiner Only

1ai) $x^2 - 12x + 37 = 0$ $\quad x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ ✓ 1

$a = 1$
$b = -12$
$c = 37$

$x = \frac{+12 \pm \sqrt{(-12)^2 - 4(1 \times 37)}}{2(-12)}$

$x = \frac{12 \pm \sqrt{144 - 4(37)}}{-24}$ 1

$x = \frac{12 \pm \sqrt{144 - 148}}{-24} \rightarrow \frac{12 \pm \sqrt{-4}}{-24}$

$\frac{12 \pm \sqrt{4j}}{-24} \rightarrow \frac{12 \pm 2j}{-24} \rightarrow x = \frac{12 - 2j}{-24}$ or $\frac{12 + 2j}{-24}$ 1

simplified as $\frac{-6 - j}{12}$ or $\frac{-6 + j}{12}$

1aii) $4 - 5j$ the other root will be $4 + 5j$ ✓ 1

1b) $p = -4 + 8j \quad q = 2 + 6j \quad r = -1 - 3j$

1bi) $\frac{-4 + 8j}{2} + \frac{2 + 6j}{2} = -2 + 4j + 1 + 3j = -1 + 7j$ ✓ 2

1bii) $(p + r)(p - r) \quad (-4 + 8j + -1 - 3j)(-4 + 8j - -1 - 3j)$

$(-5 + 5j)(-3 + 11j)$

$+15 - 55j - 15j + 55j^2$

$= 15 - 70j + 55j^2$

$15 - 70j + 55(-1)$

$15 - 70j - 55$

$= -40 - 70j$ ✓ 4

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1b iii) $p^2+q^2+r^2$ $(-4+8j)(-4+8j)+(2+6j)(2+6j)+(-1-3j)(-1-3j)$

$[16-32j-32j+64j^2]+[4+12j+12j+36j^2]+[1+3j+3j+9j^2]$

$[16-64j+64(-1)]+[4+24j+36(-1)]+[1+6j+9(-1)]$

$[16-64j-64]+[4+24j-36]+[1+6j-9]$

$-48-64j+-32+24j+-8+6j$

$=-88-34j$ ✓ 5

1b iv) $q=2+6j$ $r=-1-3j$

$\frac{q}{r}=\frac{2+6j}{-1-3j}$

$\frac{(2+6j)}{(-1-3j)}\times\frac{(-1+3j)}{(-1+3j)}=\frac{-2+6j-6j+18j^2}{+1-3j+3j-9j^2}$

$\frac{-2+18(-1)}{1-(-9)}=\frac{-2-18}{10}=-2$ ✓ 3

1b v) $\frac{2p-3r}{4q+p}$ $p=-4+8j$ $q=2+6j$ $r=-1-3j$

$\frac{2(-4+8j)-3(-1-3j)}{4(2+6j)+(-4+8j)}$

$=\frac{(-8+16j)-(+3+9j)}{(8+24j)+(-4+8j)}=\frac{-11+7j}{4+32j}$ ✓ 1

$\frac{(-11+7j)}{(4+32j)}\times\frac{(4-32j)}{(4-32j)}=\frac{(-44+352j+28j-224j^2)}{16-128j+128j-1024j^2}=\frac{-44+380j-224(-1)}{16-1024(-1)}$ 1 1

$=\frac{-44+224+380j}{16+1024}=\frac{180+380j}{1040}$ ✓ 1

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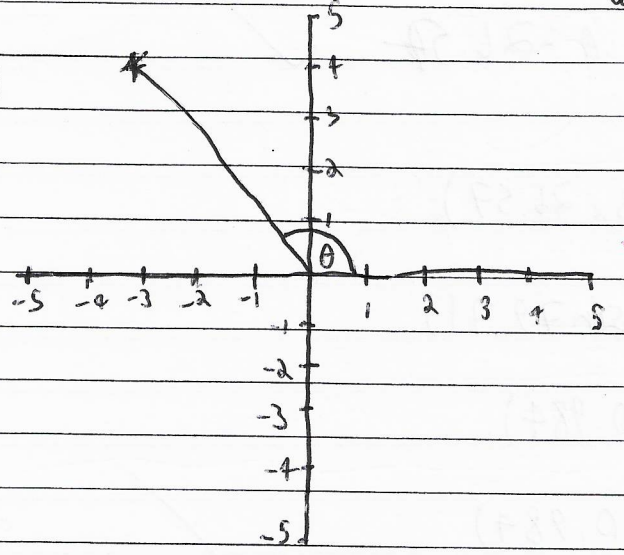
1ci) $r(\cos\theta + j\sin\theta)$ — length

r = modulus = line from centre to point on argand diagram

θ = argument = angle from positive x axis to the modulus line — anticlockwise

1cii)



$r = 5$ so $r^2 = 25$

real axis

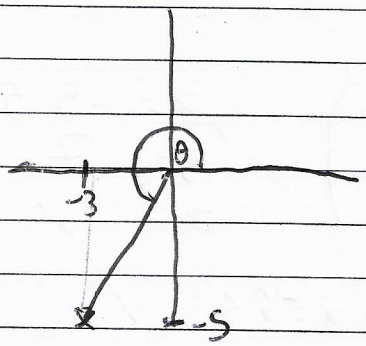
$r^2 = 25$

$r^2 = a^2 + b^2$

$r^2 = 4^2 + 3^2$

1

1ciii)



$-3 - 5j$ in polar form

$r^2 = a^2 + b^2$

$r^2 = -3^2 + -5^2$

$r^2 = 9 + 25$

$r = \sqrt{9+25}$

$r = 5.83$

$\tan\theta = \frac{5}{3} = 59.03$

$59.03° + 180°$

$= 239.03°$

Polar form: $5.83\angle 239.03°$

or

$5.83(\cos 239.03 + j\sin 239.03)$

3

1d) $(2+j^3)^3$

$(2+j)(2+j)(2+j) \rightarrow (4+2j+2j+j^2)$

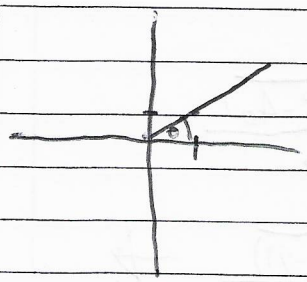
$(4+4j+-1)$

or $(3+4j)(2+j)$

$= 6+3j+8j+4j^2$

$= 6+11j+4(-1)$

$= 2+11j$



$r^2 = 2^2 + 1^2$

$r^2 = 4+1$

$r^2 = 5$

$r = \sqrt{5}$

$r = 2.236$

2

→ P.T.O

Question No. Examiner On

$r = 2.236$ $\tan^{-1}$ or $\tan\theta = \frac{1}{2}$

$\theta = 26.57$ ✓

de moivres theorem

$2.236^3(\cos 3\times 26.57 + j\sin 3\times 26.57)$

$2.236(\cos 79.71 + j\sin 79.71)$

$2.236^3(0.178 + j0.984)$

$11.17(0.178 + j0.984)$ ✓

$= 1.988 + j10.99$

algebraic answer $= 2 + 11j$ 5

2a) $\begin{pmatrix} 3 & 2x+4 & 2 \\ y^2 & 0 & 1 \\ \frac{2z-1}{5} & 5 & 3 \end{pmatrix} = \begin{pmatrix} 3 & -7 & 2 \\ 49 & 0 & 1 \\ \frac{z}{3} & 5 & 3 \end{pmatrix}$ $x = -5.5$, $y = 7$, $z =$

$x =$ $2x+4 = -7 \rightarrow 2x = -11 \rightarrow x = 5.5$ ✓ 2

$y =$ $y^2 = 49$ $y = \sqrt{49}$ $y = 7$ ± 1

$z = \frac{2z-1}{5} = \frac{z}{3}$ $\frac{6z-1}{15} = \frac{5z}{15}$ $6z-1 = 5z$, $-1 = -z$, $z = 1$ ✗ 1

2b) $\begin{vmatrix} x & 3 & -2 \\ 5 & x & -4 \\ 3 & -2 & 5 \end{vmatrix} = 0$ $5x^2 - 2x - 91 = 0$ $\frac{-b \pm \sqrt{b^2-4ac}}{2a}$ 1

$a = 5$ ✓

$b = -2$ ✓

$c = -91$ ✓ $\frac{+2 \pm \sqrt{-2^2 - 4(5\times -91)}}{2(5)}$ → see final page

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2c) $P = \begin{pmatrix} -1 \\ -3 \\ -5 \end{pmatrix}$ $Q = \begin{pmatrix} 3 & -2 \\ 5 & -4 \end{pmatrix}$ $R = \begin{pmatrix} 2 & -1 & 6 \\ 0 & 3 & 0 \\ 5 & -1 & -3 \end{pmatrix}$

2c i) $PQ = \begin{pmatrix} -1 \\ -3 \\ -5 \end{pmatrix}\begin{pmatrix} 3 & -2 \\ 5 & -4 \end{pmatrix}$ NOT POSSIBLE ✓ 1

C R

R C

3×1 2×2

2c ii) $\begin{pmatrix} -1 \\ -3 \\ -5 \end{pmatrix}\begin{pmatrix} -1 \\ -3 \\ -5 \end{pmatrix}$ NOT POSSIBLE ✓ 1

1 3

3 C R 1

R C

2c iii) $\begin{pmatrix} 3 & -2 \\ 5 & -4 \end{pmatrix}\begin{pmatrix} 3 & -2 \\ 5 & -4 \end{pmatrix}$

R C R C

2×2 2×2

$\begin{pmatrix} 9-10 & -6+8 \\ -1 & 2 \\ 15-20 & -10+16 \\ -5 & 16 \end{pmatrix}$ 1

$\begin{pmatrix} -1 & 2 \\ -5 & 16 \end{pmatrix}$

2c iv) R^2 $\begin{pmatrix} 2 & -1 & 6 \\ 0 & 3 & 0 \\ 5 & -1 & -3 \end{pmatrix}\begin{pmatrix} 2 & -1 & 6 \\ 0 & 3 & 0 \\ 5 & -1 & -3 \end{pmatrix}$

R C R C

3 3 3 3

$\begin{pmatrix} 4+0+30 & -2-3+6 & 12-0-18 \\ 34 & 1 & -6 \\ 0 & 0+9+0 & 0+0+0 \\ 0 & 9 & 0 \\ 10+1-18 & -5-3+3 & 30+0 \\ -7 & -5 & 39 \end{pmatrix}$

$\begin{pmatrix} 34 & 1 & -6 \\ 0 & 9 & 0 \\ -7 & -5 & 39 \end{pmatrix}$ 1

2cv) $PR \begin{pmatrix} -1 \\ -3 \\ -5 \end{pmatrix} \begin{pmatrix} 2 & -1 & 6 \\ 0 & 3 & 0 \\ 5 & -1 & -3 \end{pmatrix}$

NOT POSSIBLE ✓ 1

R C R C

3×1 3 × 3

2cvi) $RP \begin{pmatrix} 2 & -1 & 6 \\ 0 & 3 & 0 \\ 5 & -1 & -3 \end{pmatrix} \begin{pmatrix} -1 \\ -3 \\ -5 \end{pmatrix}$

$\begin{pmatrix} -2+3-30 \\ -29 \\ 0-9-0 \\ 9 \\ -5+3+15 \\ 13 \end{pmatrix} = \begin{pmatrix} -29 \\ -9 \\ 13 \end{pmatrix}$ 1

R C R C

3 × 3 3 × 1

2cvii) P^T $P = \begin{pmatrix} -1 \\ -3 \\ -5 \end{pmatrix}$ $P^T = \begin{pmatrix} -1 & -3 & -5 \end{pmatrix}$ ✓ 1

2cviii) Q^T $Q = \begin{pmatrix} 3 & -2 \\ 5 & -4 \end{pmatrix}$ $Q^T = \begin{pmatrix} 3 & 5 \\ -2 & -4 \end{pmatrix}$ ✓ 1

2c ix) $P^T R^T$ $P^T = \begin{pmatrix} -1 & -3 & -5 \end{pmatrix}$ $R = \begin{pmatrix} 2 & -1 & 6 \\ 0 & 3 & 0 \\ 5 & -1 & -3 \end{pmatrix}$

$R^T = \begin{pmatrix} 2 & 0 & 5 \\ -1 & 3 & -1 \\ 6 & 0 & -3 \end{pmatrix}$ ✓ 1

$P_T \begin{pmatrix} -1 & -3 & -5 \end{pmatrix} \begin{pmatrix} 2 & 0 & 5 \\ -1 & 3 & -1 \\ 6 & 0 & -3 \end{pmatrix}$

$\left(\begin{array}{c|c|c} -2+3-30 & 0+9+0 & -25+5+15 \\ -29 & -9 & -5 \end{array}\right)$

C R

R C

1 × 3 3 × 3

$\left(\begin{array}{c|c|c} -29 & -9 & -5 \end{array}\right)$ ✓ 1

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21) $x + 2y + 3z = -5$
$3x + y - 3z = 4$
$-3x + 4y + 7z = -7$

$$\begin{pmatrix} 1 & 2 & 3 \\ 3 & 1 & -3 \\ -3 & 4 & 7 \end{pmatrix} \begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} -5 \\ 4 \\ -7 \end{pmatrix}$$

$|A| = 1(7 - -12) - 2(21 + 9) + 3(12 - -3)$
$1(-5) - 2(30) + 3(15)$
$-5 - 60 + 45$
$|A| = 20$

$|A_1| = \begin{pmatrix} -5 & 2 & 3 \\ 4 & 1 & -3 \\ -7 & 4 & 7 \end{pmatrix}$ $-5(7 - -12)$

$|A| = 1(7 - -12) - 2(21 - 9) + 3(12 - -3)$
$1(19) - 2(12) + 3(15)$
$19 - 24 + 45$
$|A| = 40$

$|A_1| = \begin{pmatrix} -5 & 2 & 3 \\ 4 & 1 & -3 \\ -7 & 4 & 7 \end{pmatrix}$ $-5(7 - -12) - 2(28 - 21) + 3(16 - -7)$
$-5(19) - 2(7) + 3(23)$
$-95 - 14 + 69$
$= -40$ $\frac{|A_1|}{|A|} = \frac{-40}{40} = -1$

$|A_2|$ $\begin{pmatrix} 1 & -5 & 3 \\ 3 & 4 & -3 \\ -3 & -7 & 7 \end{pmatrix}$ $1(28 - 21) - -5(21 - 9) + 3(-21 - -12)$
$1(7) + 5(12) + 3(-9)$
$7 + 60 - 27$
$= 40$ $\frac{|A_2|}{|A|} = \frac{40}{40} = 1$

$|A_3|$ $\begin{pmatrix} 1 & 2 & -5 \\ 3 & 1 & 4 \\ -3 & 4 & -7 \end{pmatrix}$ $1(-7 - 16) - 2(-21 - -12) + -5(12 - -3)$
$1(-23) - 2(-9) - 5(15)$
$-23 + 18 - 75$
-80 $\frac{|A_3|}{|A|} = \frac{-80}{40} = -2$

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22) $|A| = 40$ $A_1 = -1$

$|A_1| = -40$ $A_2 = 1$

$|A_2| = 40$ $A_3 = -2$

$|A_3| = -80$

$x + 2y + 3z = -5$

$3x + y - 3z = 4$

$-3x + 4y + 7z = -7$

$x = -1$

$y = 1$

$z = -2$ ✓

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2b) $$\frac{+2 \pm \sqrt{(-2)^2 - 4(5x-91)}}{2(5)}$$

$$\frac{+2 \pm \sqrt{4 - 4(-455)}}{10} \rightarrow \frac{2 \pm \sqrt{4\,59}}{10} \div \frac{2 \pm 21.4}{10}$$

$$\frac{2+21.4}{10} \quad \frac{2-21.4}{10}$$

$$\frac{23.4}{10} \quad \frac{-19.4}{10}$$

$x = 2.3$ ✗ or $x = -1.9$ ✗

~~$-6x^2 + 2x + 30$.~~

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