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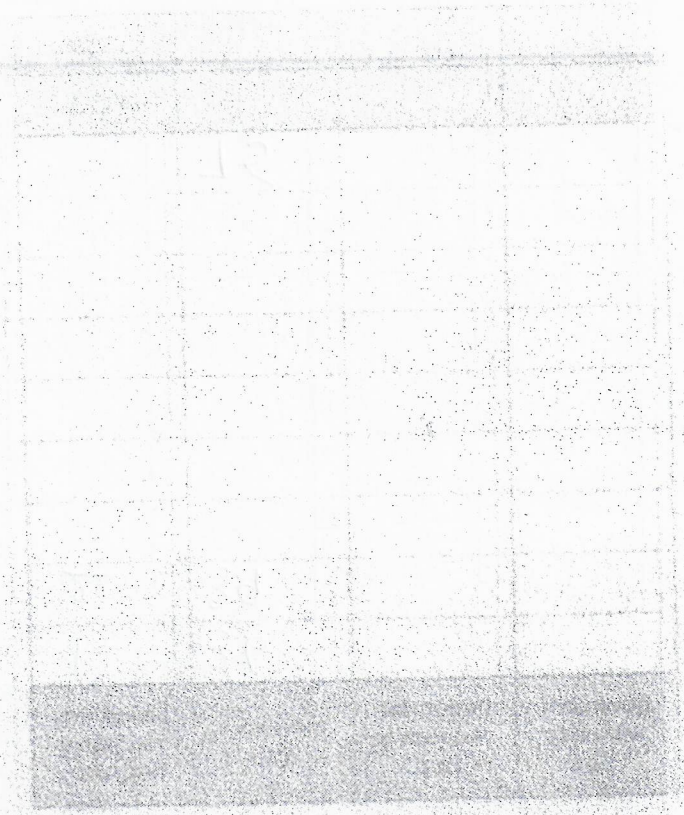
Summary of Marks

Question Numbers Answered	1st Examiner	2nd Examiner (optional)	3rd Examiner (optional)
1	36		
2	39		
	75		
TOTAL			
RESULT			



Question No.

Examiner Only

(1) a) i $x^2 - 12x + 37 = 0$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} = \frac{12 \pm \sqrt{(-12)^2 - 4.1.37}}{2}$$

$$= \frac{12 \pm \sqrt{144 - 148}}{2} = \frac{12 \pm \sqrt{-4}}{2}$$

$$= \frac{12 \pm \sqrt{4}\ \sqrt{-1}}{2} = \frac{12 \pm 2j}{2}$$

$= 6 \pm j$ Answers $6+j$ and $6-j$ ✓ 6

ii) $4 + 5j$

b) i) $\frac{p}{2} + \frac{q}{2}$ $\frac{-4+8j}{2} + \frac{2+6j}{2}$

$= (-2 + 4j) + (1 + 3j) = -1 + 7j$ ✓ 2

ii) $(p+r)(p-r)$

$(-4+8j - -1-3j)(-4+8j + 1+3j)$

$(-5+5j)(-3+11j) = 15 - 55j - 15j + 55j^2$

$= 15 - 70j - 55 = -40 - 70j$ ✓ 4

iii) $p^2 + q^2 + r^2$

$p^2 = (-4+8j)(-4+8j) = 16 - 32j - 32j + 64j^2$

$= 16 - 64j - 64$

$= -48 - 64j$

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$q^2 = (2+6j)(2+6j) = 4 + 12j + 12j + 36j^2$

$= 4 + 24j - 36$

$= -32 + 24j$ ✓

$r^2 = (-1-3j)(-1-3j) = 1 + 3j + 3j + 9j^2$

$= 1 + 6j - 9$

$= -8 + 6j$

$p^2 + q^2 + r^2 = (-48 - 64j) + (-32 + 24j) + (-8 + 6j)$ 5

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

$= -88 - 34j$ ✓

iv) $\frac{q}{R} \quad \frac{(2+6j)}{(-1-3j)}$ 1

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

$= \frac{-2-18}{10-6j} = \frac{-20}{10} \quad \frac{-20}{6j}$ 1

$= -2 - \frac{10}{3j}$

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

$= \frac{-8+16j + 3 + 9j}{8+24j - 4 + 8j} = \frac{-5+25j}{4+32j}$ ✓

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$$\frac{(-5+25j)}{(4+32j)} \times \frac{(4-32j)}{(4-32j)}$$

$$= \frac{-20 + 160j + 100j - 800j^2}{16 - 128j + 128j - 1024j^2}$$

$$= \frac{780 + 260j}{1040} \qquad \frac{6}{8} + 2j$$

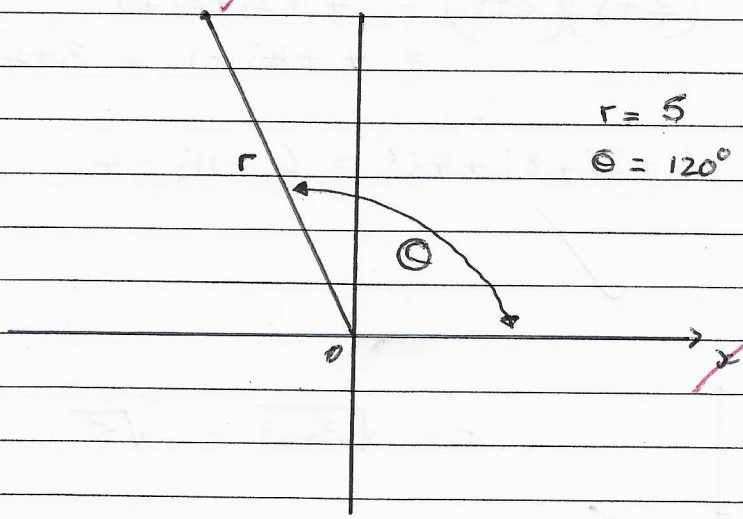
6

$$= \frac{3}{4} + j$$

0

c) i) r = modulus θ = Argument

ii)



r = 5

θ = 120°

Real

1

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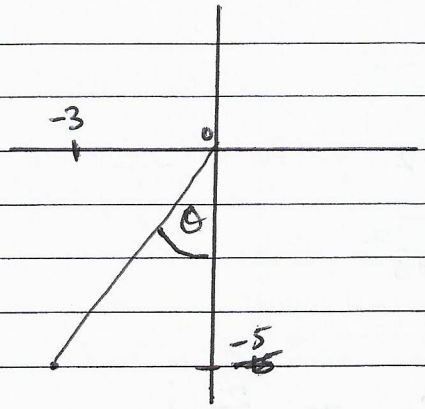
iii) $-3-5j$ in polar form



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

$= \sqrt{34}$ or 5.83

$\theta = \tan^{-1}\frac{O}{A} = \frac{3}{5} = 30.9637^\circ$

$90 - 30.9637 + 180 = 239.04^\circ$

$(-3-5j)$ in polar form $= 5.83\left(\cos 239.04^\circ + j\sin 239.04^\circ\right)$

or $\sqrt{34} \angle 239.04^\circ$

3

d) $(2+j)^3$

$(2+j)(2+j) = 4+2j+2j+j^2$

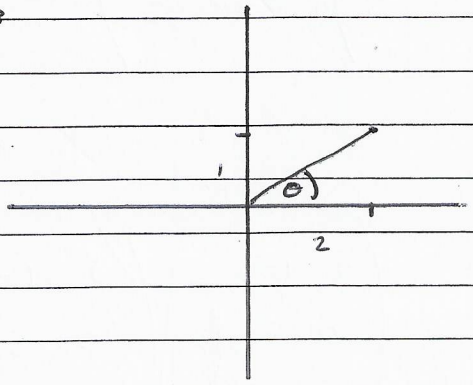
$= 4+4j-1 = 3+4j$

$(3+4j)(2+j) = 6+3j+8j+4j^2 = 6+11j-4$

$= 2+11j$

2

$(2+j)^3$



$r = \sqrt{1^2+2^2} = \sqrt{5}$

$\theta = \tan^{-1}\frac{1}{2} = 26.565^\circ$

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$\therefore (2+j)^3 = \left(2.236 \angle 26.565^\circ\right)^3$

$= 2.236^3 \left(\text{Cos}.3.26.565 + j\,\text{Sin}.3.26.565\right)$

$= 2.236^3 \left(\text{Cos}\,79.695 + j\,\text{Sin}\,79.695\right)$

$= 11.1793 \left(0.17888 + j\,0.9836\right)$

$= 1.9997 + j\,10.9989 = \underline{\underline{2 + 11j}}$ ✓ 5

(2) a) $2x + 4 = -7 \qquad y^2 = 49$ 36

$\frac{2z-1}{5} = \frac{z}{3}$

$y = \sqrt{49} = \underline{\underline{7}}$ ±

$2x = -7 - 4 = -11 \quad \therefore \quad x = \frac{-11}{2} = \underline{\underline{-5.5}}$ ✓

$\frac{2z-1}{5} = \frac{z}{3} \quad (\times 15) = 15\left(\frac{2z-1}{5}\right) = 15\left(\frac{z}{3}\right)$

$= 3(2z-1) = 5z$

$6z - 3 = 5z \qquad 6z = 5z + 3 \qquad \underline{\underline{z = 3}}$ ✓ 5

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b) $x(5x - 8) - 3(25 + 12) + -2(-10 - 3x) = 0$

$= 5x^2 - 8x - 111 + 20 + 6x = 0$

$= 5x^2 - 2x - 91 = 0$

$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} = \frac{2 \pm \sqrt{(-2)^2 - 4.5.(-91)}}{10}$

$= \frac{2 \pm \sqrt{4 + 1820}}{10} = \frac{2 \pm 42.71}{10}$

$= \frac{2 + 42.71}{10} = \frac{44.47}{} \rightarrow 4.5$ (to 1 dp)

$= \frac{2 - 42.71}{10} = -4.07 \rightarrow -4.1$ (to 1 dp)

9

c) i) PQ – Not possible

1

ii) P^2 – Not possible

1

iii) Q^2 $\begin{pmatrix} 3 & -2 \\ 5 & -4 \end{pmatrix}\begin{pmatrix} 3 & -2 \\ 5 & -4 \end{pmatrix} = \begin{pmatrix} -1 & 2 \\ -5 & 6 \end{pmatrix}$

2

iv) R^2

$\begin{pmatrix} 2 & -1 & 6 \\ 0 & 3 & 0 \\ 5 & -1 & -3 \end{pmatrix}\begin{pmatrix} 2 & -1 & 6 \\ 0 & 3 & 0 \\ 5 & -1 & -3 \end{pmatrix} = \begin{pmatrix} 34 & -11 & -6 \\ 0 & 9 & 0 \\ -5 & -5 & 39 \end{pmatrix}$

3

P 3×1
Q 2×2
R 3×3

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v) PR — Not possible ✓ 1

vi) RP

$$\begin{pmatrix} 2 & -1 & 6 \\ 0 & 3 & 0 \\ 5 & -1 & -3 \end{pmatrix}\begin{pmatrix} -1 \\ -3 \\ -5 \end{pmatrix} = \begin{pmatrix} -29 \\ -9 \\ 13 \end{pmatrix}$$

3×3 $\quad$ 3×1 ✓ 2

vii) $P^T \begin{pmatrix} -1 \\ -3 \\ -5 \end{pmatrix} \Rightarrow P^T \begin{pmatrix} -1 & -3 & -5 \end{pmatrix}$ ✓ 1

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

1

ix) $P^T R^T$

$$\begin{pmatrix} -1 & -3 & -5 \end{pmatrix}\begin{pmatrix} 2 & 0 & 5 \\ -1 & 3 & -1 \\ 6 & 0 & -3 \end{pmatrix} = \begin{pmatrix} -29 & -9 & 13 \end{pmatrix}$$

1×3 $\quad$ 3×3 ✓ ✓ 2

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

$|A| = 1(7+12) - 2(21-9) + 3(12+3)$

$= 1(19) - 2(12) + 3(15)$

$= 19 - 24 + 45 = 40$

$A_1 = \begin{pmatrix} -5 & 2 & 3 \\ 4 & 1 & -3 \\ -7 & 4 & 7 \end{pmatrix}$ $|A_1| = -5(7+12) - 2(28-21) + 3(16+7)$

$= -5(19) - 2(7) + 3(23)$

$= -95 - 14 + 69 = -40$

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

$= 1(7) + 5(12) + 3(-9)$

$= 7 + 60 - 27 = 40$

$A_3 = \begin{pmatrix} 1 & 2 & -5 \\ 3 & 1 & 4 \\ -3 & 4 & -7 \end{pmatrix}$ $|A_3| = 1(-7-16) - 2(-21+12) + -5(12+3)$

$= 1(-23) - 2(-9) - 5(15)$

$= -23 + 18 - 75 = -80$

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$$x = \frac{A_1}{A} = \frac{-40}{40} = \underline{\underline{-1}}$$

$$y = \frac{A_2}{A} = \frac{40}{40} = \underline{\underline{1}}$$

$$z = \frac{A_3}{A} = \frac{-80}{40} = \underline{\underline{-2}}$$

(check into equation (1) $(-1) + 2(1) + 3(-2) = -5$

$-1 + 2 - 6 = -5$

$-7 + 2 = -5$ ✓)

10

(39)

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Examiner On