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Examination Answer Books

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1	1

Complete, fold and seal
(see note 1 below)

76/80

SURNAME: Dand.

FORENAME(S): Alexander Martin

Programme Title: OME

Year/Level/Stage: Level 4

Examination Paper Title: Mathematics

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

Date: ___ / ___ / 20___ **Time:** _____ **am/pm** **Room Name or No.:** _____

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.
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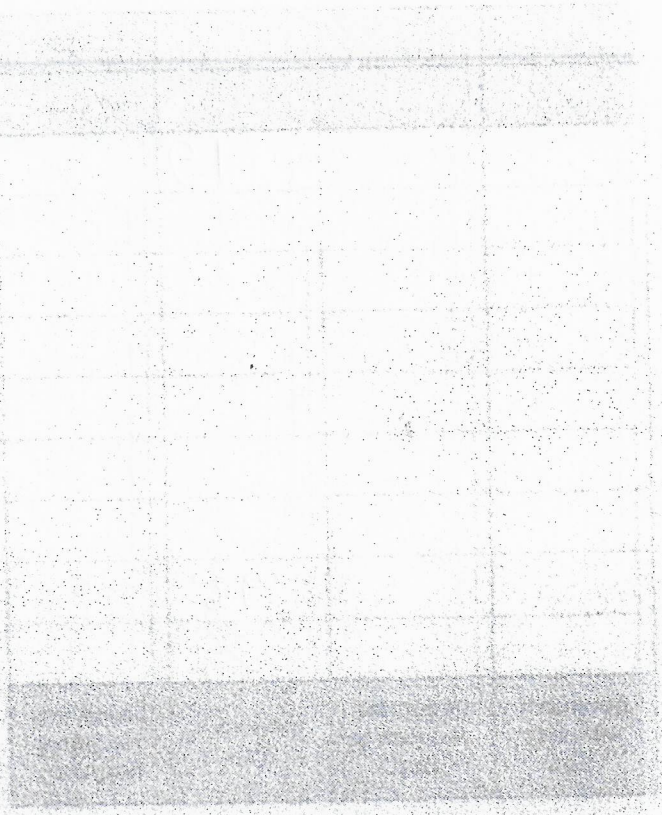
   (a) bear the candidate's name (concealed, where appropriate), reference number and paper title;
   (b) be numbered consecutively;
   (c) be fastened together by the tags available from the invigilator.
6. Every book must be handed in. In no circumstances may answer books, used or unused, be taken out 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	35		
3	26		
	61		
TOTAL			
RESULT			



Question No.

Examiner Only

(1)

a) Solve $x^2 - 12x + 37 = 0$ $a = 1$ $b = -12$ $c = 37$ ✓ 1

~~$(x \quad)(x \quad) = 0$~~ $(x - \quad)(x \quad) = 0$

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

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

ii) If a quadratic equation has a root of $(4 - 5j)$, the other root is $(4 + 5j)$ ✓ 1

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Question No. Examiner Only

(1)

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

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

$= -2+4j + 1+3j$

$= \underline{-1+7j}$ ✓ 2

ii) $(p+r)(p-r) = (-4+8j-1-3j)(-4+8j+1+3j)$

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

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

$= 15 - 70j - 55$

$= \underline{-40 - 70j}$ ✓ 4

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

$p^2 = (16 - 32j - 32j + 64j^2)$
$= 16 - 64j - 64$
$= (-48 - 64j)$

$q^2 = (4 + 12j + 12j + 36j^2)$
$= (4 + 24j - 36)$
$= (-32 + 24j)$

$r^2 = (1 + 3j + 3j + 9j^2)$
$= 1 + 6j - 9$
$= (-8 + 6j)$

$(-48 - 64j) + (-32 + 24j) + (-8 + 6j)$
$= \underline{-88 - 34j}$ ✓ 5

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(1)

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

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

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

$= \frac{-2-18}{1+9}$

$= \frac{-20}{10}$

$= (-2+0j)$

3

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

$= \frac{-8+16j+3+9j}{8+24j-4+8j}$

$= \frac{-5+25j}{4+32j}$

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

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

$= \frac{-20+260j+800}{16+1024}$

$= \frac{780+260j}{1040}$

$= \frac{780}{1040} + \frac{260j}{1040}$

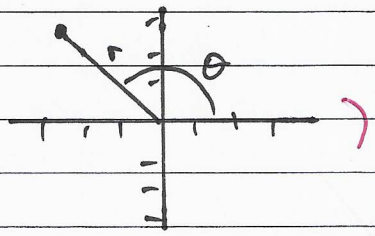
$= \frac{3}{4} + \frac{j}{4}$

6

Question No. | Examiner On

① c)

i) $r(\cos\theta + j\sin\theta)$ is the polar form of a complex number. r is the modulus of the line on an Argand diagram (or length of the line). θ is the Argument, or angle the line sits at in relation to the positive x axis, moving in an Anti clockwise direction 2



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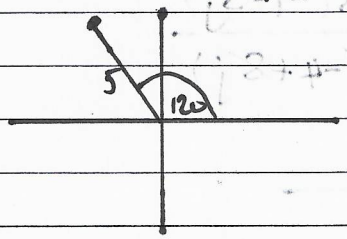
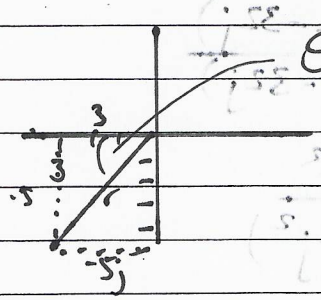
ii) $r = 5 \quad \theta = 120$



labelling

iii) $-3-5j$ in polar form $= \sqrt{34} \angle 239.0$ (1dp) 3



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

$r = \sqrt{9+25}$

$= \sqrt{34}$

$\tan(\theta - 180) = \frac{5}{3}$

$\theta - 180 = \tan^{-1}\frac{5}{3}$

$\theta - 180 = 59.0362$

$\theta = 239.0362$

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Question No.

Examiner Only

① d)

$$(2+j)^3 = (2+j)(2+j)(2+j)$$

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

$$= (4+4j-1)(2+j)$$

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

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

$$= 6+11j-4$$

$$= (2+11j)$$

✓ 2

De moivres theorem

$(2+j)$ in polar form. $= \sqrt{5} \angle 26.5651$

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

$r = \sqrt{5}$

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

$= 26.5651$

$$[\sqrt{5} \angle 26.5651]^3 = (\sqrt{5})^3 (\cos(3 \times 26.5651) + j\sin(3 \times 26.5651))$$

$$= 5\sqrt{5} (\cos 79.6952 + j\sin(79.6952))$$

$$= 5\sqrt{5} (0.1789 + 0.9839j)$$

$$= 2.0001 + 11.0003j$$

$$= \underline{2.0 + 11j} \quad (1dp)$$

✓ 5

3 marks

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Question No. | Examiner Only

Q2

Q3 a

(3) i) $\int_0^2 (4x^3 - 6x^2 + 8x - 1)\,dx$

$$\left[\frac{4x^4}{4} - \frac{6x^3}{3} + \frac{8x^2}{2} - x\right]_0^2$$

$$\left[2^4 - 2(2^3) + 4(2^2) - 2\right] - \left[0\right]$$

$$16 - 16 + 16 - 2 = 14$$

5

ii) $\int_0^1 (e^{2x} - e^x + 3)\,dx$

$$\left[\frac{1}{2}e^{2x} - e^x + 3x\right]_0$$

$$\left[\frac{1}{2}e^2 - e + 3\right] - \left[\frac{1}{2}e^0 - e^0\right]$$

$$\left[3.6945 - 2.7183 + 3\right] - \left[\frac{1}{2} - 1\right]$$

$$3.9762 + \frac{1}{2} = 4.4762 \quad (4\,dp)$$

4

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Question No.

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(3) a) iii)

$$\int (4\sin 2x - 3\cos 4x)\, dx$$

$$\left[4\left(-\tfrac{1}{2}\cos 2x\right) - 3\left(\tfrac{1}{4}\sin 4x\right)\right]$$

$$-2\cos 2x - \frac{3\sin 4x}{4} + C. \qquad 2$$

b)

$$\int (x)(\sin 4x)\, dx$$

Let $u = x$ ✓ Let $\frac{dv}{dx} = \sin 4x$ ✓

$\frac{du}{dx} = 1$ $v = 4\cos 4x$ ✗ 3

So:

$$\int x\sin 4x\, dx = (x)(4\cos 4x) - \int 4\cos 4x \times 1\, dx$$

$$= 4x\cos 4x - \int \frac{4}{4}\sin 4x$$

$$= 4x\cos 4x - \sin 4x + C \qquad 1$$

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Question No.

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(3) c) Let $u = 5x^2 - 4$

$$\int_1^2 \frac{10x}{5x^2 - 4}\, dx$$

$$\frac{du}{dx} = \frac{5}{2}x$$

$$du = \frac{5x}{2}\, dx$$

$$\frac{du}{\frac{5x}{2}} = dx$$

$$\frac{2du}{5x} = dx$$

$$\int_1^2 \frac{2\cancel{0}x}{5x^2 - 4} \times \frac{2du}{\cancel{5}}$$

$$\int_1^2 \frac{4x}{u}\, du = \int_1^2 4x\left(\frac{1}{u}\right) du$$

$$= 4 \ln u$$

$$= 4 \ln (5x^2 - 4)$$

$$\left[4\ln((5\times 4)) - 4)\right] - \left[4\ln(5-4)\right]$$

$$= 4\ln 16 - 4\ln 1$$

$$= \ln 16$$

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(3) d) $\int_5^6 \frac{5x-5}{(x+1)(x-4)}\,dx$

Express as

$$\frac{A}{x+1} + \frac{B}{x-4} = \frac{5x-5}{(x+1)(x-4)}$$

$$\frac{A(x+1)(x-4)}{x+1} + \frac{B(x+1)(x-4)}{x-4} = 5x-5$$

$$A(x-4) + B(x+1) = 5x-5$$

Sub $x = 4$

$$5B = 20 - 5$$
$$B = 3$$

Sub $x = -1$

$$-5A = -5 - 5$$
$$A = 2$$

$$\frac{2}{x+1} + \frac{3}{x-4} = \frac{5x-5}{(x-1)(x-4)}$$

$$\int_5^6 \frac{2}{x+1} + \frac{3}{x-4}\,dx$$

$$\int_5^6 2(x+1)^{-1} + 3(x-4)^{-1}\,dx$$

$$\left[2\ln(x+1) + 3\ln(x-4)\right]_5^6$$

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(3) d) cont.

$$\left[2\ln 7 + 3\ln 2\right] - \left[2\ln 6 + 3\ln 1\right]$$

$$= 5.9713 - 3.5835$$

$$= \underline{2.39} \quad (2\text{dp})$$

8

(4) e)

$$\int \frac{x^2+1}{x^3+3x}\,dx$$

$$\int (x^2+1)(x^3+3x)^{-1}\,dx$$

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

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

$$= \frac{x^5}{5} + \cancel{\frac{3x^3}{3}} + \cancel{\frac{x^3}{3}} + 3x + c$$

$$= \frac{x^5}{5} + \frac{4x^3}{3} + 3x + c$$

1

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