

Complete, fold and seal
(see note 1 below)

75%

SURNAME:

JAMES

FORENAME(S):

STEVEN

Candidate's Exam Number:

Book No.

1. *Journal of the American Medical Association*, 277: 1033-1036, 1997.

**Total Books
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Programme Title:

OME Degree Maths

Year/Level/Stage:

Examination Paper Title:

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Date: ____ / ____ / 20__

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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 answers 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	30		
3	30		
	60		
TOTAL			
RESULT			

① a. (i) $x^2 - 12x + 37 = 0$

$$a = 1$$

$$b = 12$$

$$c = 37$$

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

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

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

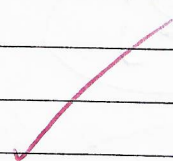
$$\frac{12 \pm 2j}{2} = \frac{6 \pm j}{6 \mp j}$$

$$* = 6 + j \quad \text{and} \quad 6 - j$$



6

① a. (ii) $4 + 5j$



b

(1)

$$P = -4 + 8j, \quad Q = 2 + 6j, \quad r = -1 - 3j$$

$$(i) \quad \frac{P}{2} + \frac{Q}{2} = \frac{-4 + 8j}{2} + \frac{2 + 6j}{2}$$

$$\therefore -2 + 4j + 1 + 3j = -1 + 7j$$

✓

2

(ii)

$$(P+r)(P-r)$$

$$P+r = (-4 + 8j) - (1 - 3j) = -5 + 11j \quad \times$$

$$P-r = (-4 + 8j) + (1 - 3j) = -3 + 5j \quad \times$$

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

$$15 - 25j - 33j + 55$$

$$-40 - 58j$$

1

$$(iii) \quad (-4 + 8j)(-4 + 8j) = 16 - 32j - 32j - 64 = -48 - 64j$$

$$(2 + 6j)(2 + 6j) = 4 + 12j + 12j - 36 = -32 + 24j$$

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

+

$$-48 - 32 + 8 = -88$$

$$-64 + 24 + 6 = -34$$

$$-88 - 34j$$

✓

5

(1)

b

iv

9/r

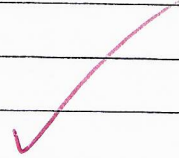
$$\frac{2+6j}{-1-3j}$$

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

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

=

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



3

(1)

b

(v)

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

$$\therefore \frac{-8+16j-3-9j}{8+24j+2+6j} = \frac{(-11-7j)(10-30j)}{(10+30j)(10-30j)}$$

1

$$\frac{-110+330j-70j+210}{100-300j+300j-900}$$

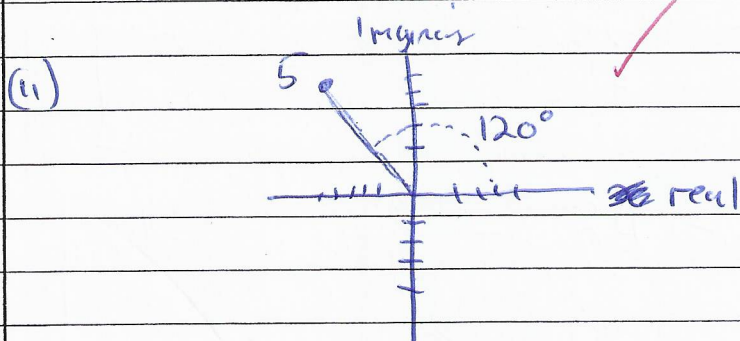
$$\frac{320-400j}{-800}$$

$$= \frac{100-400j}{-800}$$

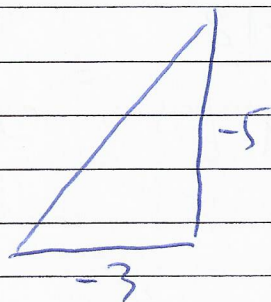
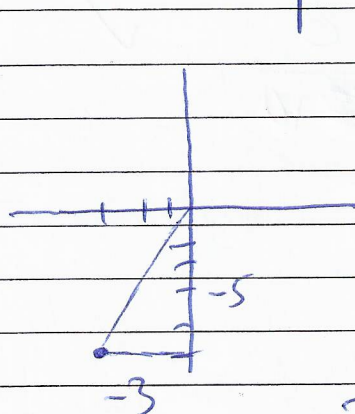
X

1 < (1) r is the modulus, akin to the "real" part of the number

ϕ is the argument, the angle at the modulus in a clockwise direction from the 0° axis of the modulus



(iii)



$$\sqrt{3^2 + 5^2} = 5.831$$

$$\tan^{-1} \frac{-3}{-5} = 30.9637$$

$$270 - 30.9637$$

$$= 239.036^\circ$$

$$\therefore 5.83 / 239.04^\circ$$

① $(2+j)(2+j)(2+j)$

$$4 + 2j + 2j - 1$$

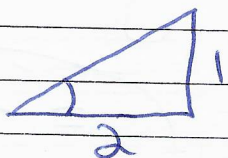
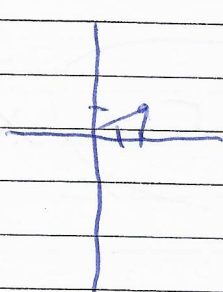
$$\therefore (3+4j)(2+j)$$

$$6 + 3j + 8j - 4$$

$$(2 + 11j) \leftarrow \text{Algebraic}$$

De Moivre

$$2+j =$$



$$\sqrt{1^2 + 2^2} = 2.2361$$

$$\angle 26.5651^\circ$$

$$2.2361^3 (\cos(3)(26.5651) + j \sin(3)(26.5651))$$

$$0.17888 + 0.9839j$$

$$11.180339 (0.17888 + 0.9839j)$$

$$2 + 11j$$

$$2.0000 + 11.0000j$$

$$= 2 + 11j$$

5

30

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

$$\frac{4x^4}{4} - \frac{6x^3}{3} - \frac{8x^2}{2} - 1x \quad \checkmark$$

4

$$\left[\frac{4(2)^4}{4} - \frac{6(2)^3}{3} - \frac{8(2)^2}{2} - (2) \right]$$

$$[16 - 48 - 24 - 2] = -55$$

$$0 [0 - 0 - 0 - 0] = -55 - 0$$

$$= -55 \quad \times$$

b(11) $\int_0^1 (e^{2x} - e^x + 3) \, dx$

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

3

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

$$3.6945 - 2.71828 + 3$$

$$3.976246221$$

$$\left[\frac{1}{2} e^0 - e^0 \right]_{2.5}$$

$$3.976246 - 2.5$$

$$= 1.476 \quad \times$$

3 a (14) $\int (4 \sin 2x - 3 \cos 4x) dx$

$-\frac{1}{2} \cos 2x$ $\frac{1}{4} \sin 4x$

$-2 \cos 2x - \frac{3}{4} \sin 4x + c$

$-2 \cos 2x - 0.75 \sin 4x + c$

3

Question No.

(3)

$$b \int x \sin 4x$$

$$\text{let } u = x$$

$$\frac{dv}{dx} = \sin 4x$$

$$\frac{du}{dx} = 1$$

$$v = -\frac{1}{4} \cos 4x$$

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

$$x \sin 4x = \left(x - \frac{1}{4} \cos 4x\right) - \int \frac{1}{4} \frac{1}{4} \sin 4x \sin 4x$$

$$= x - \frac{1}{4} \cos 4x - \frac{1}{16} \sin 4x \sin 4x + C$$

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

$$U = (5x^2-4)$$

$$\frac{du}{dx} = 10x$$

$$\frac{10x}{U} dx$$

$$\frac{du}{10x} = dx$$

$$\frac{10x}{U} \frac{du}{10x}$$

$$\int \frac{du}{U}$$

$$du \int \frac{1}{U}$$

$$\therefore \int \frac{1}{U} = \ln(U) + C$$

$$\therefore \ln(5x^2-4) \text{ for } 2 = \ln(5(2)^2-4)$$

$$= \ln(16)$$

10

$$= \ln(5(1)^2-4)$$

$$\ln(1)$$

$$20 \times \ln(16)$$

$$10x$$

$$- 10 \times \ln(1)$$

$$- 10 \times (\ln 2)$$

Partial

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

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

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

$$x=4$$

$$0A + (4+1)B = 5(4)-5$$

$$5B = 15 \quad \therefore$$

$$B = 3$$

$$x=-1$$

$$(-1-4)A + 0B = 5(-1)-5$$

$$-5A = -10$$

$$A = 2$$

$$A = 2$$

$$B = 3$$

$$\int \frac{2}{x+1} + \int \frac{3}{x-4}$$

$$2 \ln(x+1) + 3 \ln(x-4)$$

$$2 \ln(6+1) + 3 \ln(6-4) = 5.87126$$

$$2 \ln(5+1) + 3 \ln(5-4) = 3.5835$$

$$2.38774$$

$$2.39$$