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SWANSEA - ABERTAWE

Examination Answer Books

Candidate's Exam Number: _____

Book No.

1

Total Books
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1

Complete, fold and seal
(see note 1 below)

73/0

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Instructions to Candidates:

- 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.
- Commence each answer on a fresh page.
- Do all rough work in the answer book and cross through it.
- No part of this booklet is to be torn out.
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 - bear the candidate's name (concealed, where appropriate), reference number and paper title;
 - be numbered consecutively;
 - be fastened together by the tags available from the invigilator.
- Every book must be handed in. In no circumstances may answer books, used or unused, be taken out of the exam room.
- 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	25		
3	33.5		
	58.5		
TOTAL			
RESULT			

1

a
i

Solve $x^2 - 12x + 37 = 0$

$a = x^2$

$b = -12x$

$c = 37$

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

$\frac{+12x \pm \sqrt{24x - 4(148)}}{2x^2}$

$12 \pm \sqrt{-568} = -23.8327$
 x^2

$\frac{12 \pm (-23.8327)}{2}$

$12 \pm 11.9164 = x = 23.9164$
 $x = -0.0836$

ii

complex Conjugate = $4 + 5j$

b $P = -4 + 8j$ $Q = 2 + 6j$ $R = -1 - 3j$

i $\frac{-4 + 8j}{2} + \frac{2 + 6j}{2} = \frac{-2 + 14j}{2}$

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

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

$8 - 32j - 4 + 12j - 32j + 64j^2 + 8j - 24j^2$
 ~~$- (-14)$~~
 $+ 4 - 8j - 1 + 3j + 12j - 24j^2$

$7 - 18j + 22j^2$
 (-22)
 $-3j + 6j^2$

$$7 - 40j - 22$$

$$-15 - 40j$$

$$\text{iii} \quad \underbrace{-4 + 8j}_P + \underbrace{2 + 6j}_Q + \underbrace{(-1 - 3j)}_R$$

expand PQR

$$P \quad (-4 + 8j)(-4 + 8j) \rightarrow 8 - 32j - 32j + 64j^2 \\ = -56 - 64j$$

$$Q \quad (2 + 6j)(2 + 6j) \rightarrow 4 + 12j + 12j + 36j^2 \\ = -36 + 24j$$

$$R \quad (-1 - 3j)(-1 - 3j) \rightarrow 1 + 3j + 3j + 9j^2 \\ = -8 + 6j$$

$$= -100 - 34j$$

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

$$\frac{-20}{10} = -2$$

$$\text{v} \quad \underline{2(-4 + 8j) - 3(-1 - 3j)}$$

$$4(2 + 6j) + (-4 + 8j)$$

Numerator

$$2(\cancel{-4 + 8j}) \rightarrow -8 + 16j + 1 + 9j$$

Denom

$$8 + 24j - 4 + 8j$$

$$\frac{7 + 25j}{4 + 32j} \times \frac{4 - 32j}{4 - 32j} \rightarrow \frac{28 - 224j + 100j - 800j^2}{16 - 128j + 128j - 1024j^2}$$

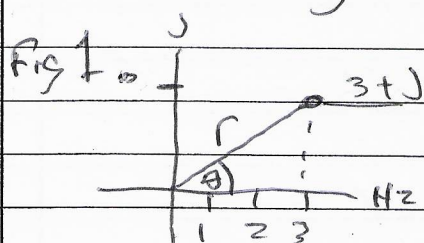
$$\frac{828 + 124j}{1040}$$

$$1040$$

C.

i

r is the modulus and is represented by pythag. formula Best demonstrated in image below



r is signified by length of Hypotenuse in Fig 1

θ is the argument + can be calculated with $\tan^{-1} \frac{\text{Opp}}{\text{Adj}}$ + is the angle between Hz axis in Fig 1 and the modulus

ii

to sketch an Argand Diagram must be Rectangular form and so

$$5(\cos(120^\circ) + j \sin(120^\circ))$$

$$-2.5 + 4.33j$$

shown in fig 2 Below

Fig 2.

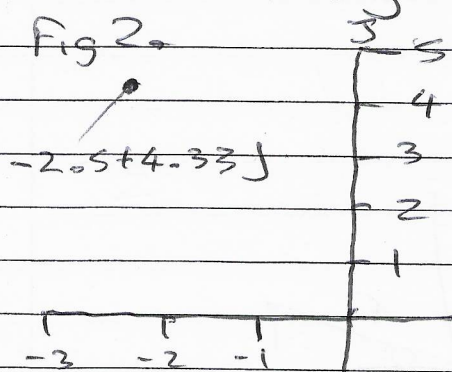
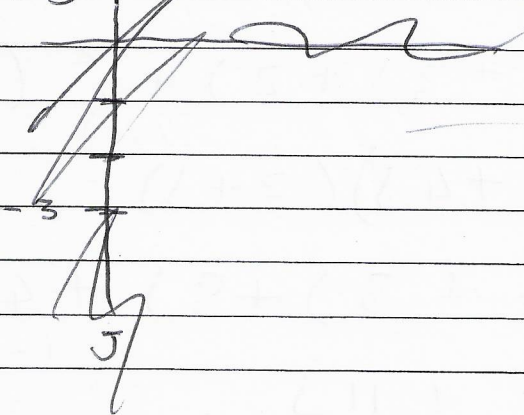


Fig 2



Real
Imaginary

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

$$r^2 = 3^2 + 5^2 \quad (\text{Pythag})$$

$$r = \sqrt{9 + 25}$$

$$r = \sqrt{34}$$

$$\theta_0 = \tan^{-1} \frac{5}{3} = 59.0362^\circ$$

$$\theta = \theta_0 + 180^\circ = 239.0362$$

$\therefore -3 - 5j$ in Polar form

$$= \sqrt{34} (\cos(239.0362) + j \sin(239.0362))$$

$$= \sqrt{34} / 239.0362$$

d) $(2 + j)^3$

Alg $(2 + j)(2 + j)(2 + j)$

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

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

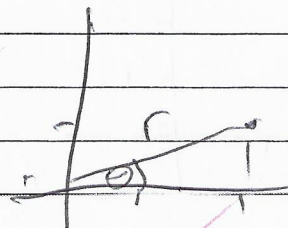
$$6 + 3j + 8j + 4j^2$$

$$2 + 11j$$

De Moivre's $(2 + j)^3$ in Polar

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

$$\theta = \tan^{-1} \frac{1}{2} = 26.5651$$



Polar =

$$\sqrt{5} (\cos(26.5651) + j \sin(26.5651))$$

Apply theorem $r^n (\cos n\theta + j \sin n\theta)$

$$\sqrt{5}^3 (\cos(79.6953) + j \sin(79.6953))$$

in Cartesian form

$$1.9999 + 11.0000j \quad \checkmark$$

$$2 + 11j$$

5

(25)

3
ai Find $\int_0^2 4x^3 - 6x^2 + 8x - 1 \, dx$

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

$$\left[x^4 - 2x^3 + 4x^2 - x \right]_0^2$$

$$[16 - 64 + 64 - 2] - [0] = 14 \quad \checkmark$$

5

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

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

3

$$\left[\frac{1}{2}e^2 - e + 3 \right] - [0] = 3.9762 \quad \checkmark$$

$$\text{iii} \quad \int 4 \sin 2x - 3 \cos 4x \, dx$$

$$\left[-2 \cos 2x - \frac{3}{4} \sin 4x \right] + C$$

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

2½

b by 'Parts'

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

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

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

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

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

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

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

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

8

c Using Substitution let $u = 5x^2 - 4$ to show

$$\int_1^2 \frac{10x}{5x^2 - 4} \, dx = \ln 16$$

$$\text{If } u = 5x^2 - 4$$

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

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

$$\text{So } \int_1^2 \frac{10x}{u} \frac{du}{10x} = \int_1^2 \frac{1}{u} du$$

$$\left[\ln(u) \right]_1^2$$

with respect to x

$$\left[\ln(5x^2 - 4) \right]_1^2$$

$$\left[\ln(20 - 4) \right] - \left[\ln(5 - 4) \right]$$

$$\left[\ln(16) \right] - \left[0 \right]$$

d use Partial Fractions to find

$$\int_3^6 \frac{5x - 5}{(x+1)(x-4)} dx$$

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

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

cancel B: $x = -1$

$$\cancel{A(x-4)} = -5$$

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

$$= -10$$

$$A = \frac{-10}{-5} = 2$$

Question No.

To cancel A $\therefore$ ~~A = x+4~~ $x = +4$

$$BS = 20 - 5$$

$$= 15$$

$$\therefore B = 3$$

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

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

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

$$\left[2 \ln(7) + 3 \ln(10) \right] - \left[2 \ln(6) + 3 \ln(9) \right]$$

$$10.7996 - 10.1752$$

$$= 0.6244$$

e find $\int \frac{x^2 + 1}{x^3 + 3x}$

$$\int x^2 + 1 + x^{-3} + 3x^{-1}$$

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

$$\frac{x^3}{3} + 1x + x^{-2} + 3\ln(x) + C$$

x

33½

Question No.

Examiner On