



Complete, fold and seal  
(see note 2 below)

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## Examination Answer Books

12 Pages

### Instructions to Candidates

1. Please give the information requested in the boxes below.
2. Enter your name in the space provided to the right, fold over and seal down (using the label provided) to hide your name.
3. The answers must be legibly written. The Examiners can either ignore illegible script or have it typed and the expense of typing charged to the candidate.
4. Write your answers in ink.
5. Begin each answer on a fresh page. Do all rough work in the answer book and cross it through.
6. No part of this book is to be torn out; it must be handed in complete.
7. If more books than one are used, fasten them together using the tags available from the invigilator(s).
8. Every book must be handed in. In no circumstances may answer books, used or unused, be taken out of the examination venue.

|   |                                  |                       |
|---|----------------------------------|-----------------------|
| 1 | Student Number                   | 1810813/1             |
| 2 | Title of Examination Paper       | MATHS TEST 2          |
| 3 | Module Code                      | M4X00391              |
| 4 | Date and Time of Examination     | 10/5/2019<br>13:30/PM |
| 5 | Examination Venue                | HALL                  |
| 6 | Seat Number                      | 21                    |
| 7 | Number of Answer Books handed in |                       |

| List the numbers of the questions you have attempted | Office Use |
|------------------------------------------------------|------------|
| Q 2                                                  |            |
| a                                                    | 4          |
| b                                                    | 2          |
| c                                                    | 4          |
| d                                                    | 1          |
| e                                                    | 0          |
| Q 3                                                  |            |
| a                                                    | 3          |
| b                                                    | 1          |
| c                                                    | 0          |
| d                                                    | 1          |
| Total                                                | 16/80      |

20%

## Question Two Complex Numbers.

$$+ + = +$$

$$- + = -$$

$$+ - = -$$

a)  $z_1 = 2+3j$ ,  $z_2 = 5-2j$  &  $z_3 = 4+j$

i)  $z_1 + z_2$

$$(2+3j) + (5-2j)$$

$$(2+5) + (3j-2j)$$

$$7 + j$$

ii)  $z_1 - z_3$

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

$$(2-4) - (j-j)$$

$$-2 - 2j$$

iii)  $\frac{z_1}{z_2} = \frac{(2+3j)}{(5-2j)} \times \frac{(5+2j)}{(5+2j)}$

$$\frac{10+6j}{25-4j}$$

$$\frac{10}{25}$$

$$\frac{6}{25}$$

iv)  $\overline{z_1} + \overline{z_3} = z_1 - z_3 = 2+3j - 4+j$

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

$$(2-4) - (j-j)$$

$$-2 - 2j$$

(v)  $(2j)^2 + z_2 + z_3$   
 $(2+3j) \times (2+3j) + (5-2j) + (4+j)$  ✓ ①  
 $(4+6j) + (5-2j) + (4+j)$  ✗  
 $4+5+4+6j-2j+j$  ✗  
 $9+5j$  ✗

|   |   |
|---|---|
| S | A |
| T | C |

b)  $14x^2 = -3x - 9$   
 $\rightarrow 14x^2 + 3x + 9 = 0$  ✓ ①  
 $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$x = \frac{-3 \pm \sqrt{3^2 - 4(14)(9)}}{2(14)}$  ✓ ①

$x = \frac{-3 \pm \sqrt{3^2 - 4(14)(-9)}}{2(14)}$  ✗

$x = \frac{-3 \pm \sqrt{495}}{2(14)}$  ✗

$\sqrt{495} = 22.248$

$x = 0.90$  ✗

$x = -0.69$  ✗

|   |   |
|---|---|
| S | A |
| T | C |

$r = |z| \sqrt{(0.90)^2 + (-0.69)^2}$

$= 0.57$

$0.57 \angle 37.47^\circ$

$\tan^{-1} \frac{b}{a} = 37.47^\circ$  ✗

$\theta = 322.53^\circ$

$0.57 (\cos 322.53 + j \sin 322.53)$

$0.57 (0.791 - 0.61j)$

$= 0.10$  ✗

c)  $(6+5j)^5$

i)  $r = |z| = \sqrt{6^2 + 5^2}$  ✓

$r = \sqrt{61} = 7.81$  ✓  $7.8 \angle 39.8^\circ$

$r = 7.8$  ✓ ①

$\theta = \tan^{-1} \frac{5}{6} = 39.8^\circ$  ✓ ①

$$\left( \begin{array}{l} 7.8^5 (\cos 5 \times 39.8 + j \sin 5 \times 39.8) \\ (-0.945 + -0.325j) \\ 28871.74 (-27283.7963 + -9383.3155j) \\ 28871.74 (-36667.1098 - 1058643261j) \end{array} \right)$$
 ✓ ①

3

ii)  $(-2+3j)^7$

$r = |z| = \sqrt{2^2 + 3^2}$

$r = \sqrt{13} = 3.61$  ✓  $3.61 \angle -56.31^\circ$

$\theta = \tan^{-1} \frac{3}{-2} = -56.31^\circ$  ✓

$3.61^7 (\cos 7 \times -56.31 + j \sin 7 \times -56.31)$

① for correct method

$282.97 (0.827 + -0.562j)$

$234.8651 + -158.4632j$

$76.4019$

2

$$13(\cos 22.6 + j\sin 22.6)$$

$$13(0.92 + 0.38j)$$

$$11.96 + 4.94j$$

$$D = 16.9$$

$$13(\cos 337.4 + j\sin 337.4)$$

$$13(0.92 - 0.38j)$$

$$11.96 - 4.94j$$

$$D = 7.02$$

d) Conjugate of  $1+8j$   
 $= 1-8j$  ✓ ①

e)  $z_1 = 6+j$   $z_2 = 2-5j$   $z_3 = 1-j$

Calculate  $z_1 z_2 z_3$

Express in polar form

$(z_1 \times z_2) \times z_3$

$(6+j)(2-5j)$  ✓

$(12-5j) \times (1-j)$  ✓

$12+5j$

$r = |z| = \sqrt{12^2 + 5^2}$

$r = 13$  ✓

$13 \angle 22.6^\circ$

$\theta = \tan^{-1} \frac{5}{12} = 22.6^\circ$

$13 (\cos 22.6 + j \sin 22.6)$

$13 (0.92 + 0.38j)$

$11.96 + 4.94j$

$16.9$

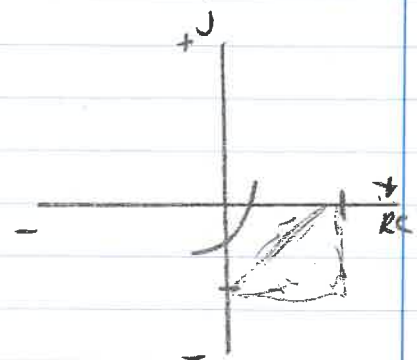
$\theta = 337.4$

$13 (\cos 337.4 + j \sin 337.4)$

$13 (0.92 + -0.38j)$

$11.96 + -4.94j$

$7.02$



0

✓

$$-1 \ 30 \ 0 \ 50 = 73$$

$$\begin{array}{cccc|cccc} 5 & -1 & 6 & -1 & 6 & & & \\ 7 & 5 & 1 & 5 & -1 & & & \\ 1 & 0 & 2 & 0 & 2 & & & \\ \hline 30 & 0 & 60 & 50 & 0 & 60 & & \end{array} = 200$$

Q3

a)  $A = \begin{bmatrix} 5 & -1 & 6 \\ 7 & 5 & -1 \\ 1 & 0 & 2 \end{bmatrix}$   $B = \begin{pmatrix} 3, 1, 1 \\ 2, 5, 4 \\ -3, 1, 1 \end{pmatrix}$   $C = \begin{pmatrix} 6, 5 \\ 4, 3 \\ 2, 1 \end{pmatrix}$   $D = \begin{pmatrix} 5, 3 \\ 1, 1 \end{pmatrix}$

$$AB = \begin{bmatrix} 5 \times 5 + -1 \times 1 \\ 6 \times 5 + 7 \times 1 \end{bmatrix}$$

X

$$D = \begin{pmatrix} 5, 3 \\ 1, 1 \end{pmatrix}$$

B =

$$\begin{bmatrix} 5, -1, 6 \\ 7, 5, -1 \\ 1, 0, 2 \end{bmatrix}$$

3b)

$$\begin{pmatrix} 5 & 2 & 9x^2 + 3x \\ 1 & 1 & 4 \\ 2 & -3 & 13 \end{pmatrix} = \begin{pmatrix} 5 & 2 & 7 \\ 1 & 7 & 4 \\ 2 & -1 & 13 \end{pmatrix} =$$

$$9x^2 + 3x = 7$$

①

3D)

$$\begin{cases} 5x + 3y + z = 25 \\ 3x + 2y + 3z = 26 \\ 2x + y - 5z = -6 \end{cases}$$

$$\begin{bmatrix} 5 & 3 & 1 \\ 3 & 2 & 3 \\ 2 & 1 & -5 \end{bmatrix} \begin{vmatrix} x \\ y \\ z \end{vmatrix} = \begin{vmatrix} 25 \\ 26 \\ -6 \end{vmatrix} \quad (1)$$

$$a = \begin{bmatrix} -2 & 3 \\ 1 & -5 \end{bmatrix} - b \begin{bmatrix} 3 & 3 \\ 2 & 1 \end{bmatrix} + c \begin{bmatrix} 3 & -2 \\ 2 & 1 \end{bmatrix}$$

$$\begin{array}{l} \text{ad-bc} \\ 5 \begin{vmatrix} -2 & -5 - 3 \times 1 \\ 10 & -3 \end{vmatrix} - 3 \begin{vmatrix} 3 \times 1 - 3 \times 2 \\ 3 - 6 \end{vmatrix} + 2 \begin{vmatrix} 3 \times 1 - -2 \times 2 \\ 3 - -4 \end{vmatrix} \\ 5 \times 7 = 35 - -3 \times -3 + 2 \times 7 \\ = 9 + 14 \\ |A| = 40 \quad \times \end{array}$$

$$A) \begin{bmatrix} 25 & 3 & 1 \\ 26 & 2 & 3 \\ -6 & 1 & -5 \end{bmatrix} \begin{vmatrix} x \\ y \\ z \end{vmatrix} \begin{vmatrix} -2 & 3 \\ 1 & 5 \end{vmatrix} - 3 \begin{vmatrix} 26 & 3 \\ -6 & 1 \end{vmatrix} + 2 \begin{vmatrix} 26 & -2 \\ -6 & 1 \end{vmatrix} = 221$$

$-10 - 3 = -13$        $26 - -18 = 44$        $26 - 12 = 14$

$$B) \begin{bmatrix} 5 & 25 & 2 \\ 3 & 26 & 3 \\ 2 & -6 & 5 \end{bmatrix} \begin{vmatrix} x \\ y \\ z \end{vmatrix} \begin{vmatrix} 26 & 3 \\ -6 & 5 \end{vmatrix} - 25 \begin{vmatrix} 3 & 3 \\ 2 & -6 \end{vmatrix} + 2 \begin{vmatrix} 3 & 26 \\ 2 & -6 \end{vmatrix} = 1200$$

$130 - -18 = 148$        $-18 - 6 = -24$        $-18 - 52 = -70$

$$C) \begin{bmatrix} 5 & 3 & 25 \\ 3 & -2 & 26 \\ 2 & 1 & -6 \end{bmatrix} \begin{vmatrix} x \\ y \\ z \end{vmatrix} \begin{vmatrix} -2 & 26 \\ 1 & -6 \end{vmatrix} - 3 \begin{vmatrix} 3 & 26 \\ 2 & 1 \end{vmatrix} + 25 \begin{vmatrix} 3 & -2 \\ 2 & 1 \end{vmatrix} = 252$$

$12 - 26 = -14$        $3 \times 52 = 156$        $3 - -4 = 7$

$$\frac{221}{40} \quad \times \quad \frac{1200}{40} \quad \times \quad \frac{252}{40} \quad \times$$

$$= 5.525 \quad (-) = 30 \quad (+) = 6.3$$

$$-78.175$$

$$(v) |A| = \begin{vmatrix} a & b & c \\ 5 & -1 & 6 \\ 0 & 7 & 5 \\ 1 & 0 & 2 \end{vmatrix}$$

$$= a \begin{vmatrix} 5 & -1 \\ 0 & 2 \end{vmatrix} - b \begin{vmatrix} 7 & -1 \\ 1 & 2 \end{vmatrix} + c \begin{vmatrix} 7 & 5 \\ 1 & 0 \end{vmatrix} \quad \text{ad-bc}$$

$$5 \begin{vmatrix} 5 \times 2 - -1 \times 0 \\ \checkmark \end{vmatrix} - 1 \begin{vmatrix} 7 \times 2 - -1 \times 1 \\ \checkmark \end{vmatrix} + 6 \begin{vmatrix} 7 \times 0 - 5 \times 1 \\ \checkmark \end{vmatrix} \quad (1)$$

$$5 \begin{vmatrix} 10 - 0 \\ 1 \end{vmatrix} - 1 \begin{vmatrix} 14 + 1 \\ 1 \end{vmatrix} + 6 \begin{vmatrix} 0 - 5 \\ -5 \end{vmatrix}$$

$$50 - 15 + -30$$

$$|A| = 5 \quad \checkmark$$

$$(vi) |B| = \begin{vmatrix} a & b & c \\ 3 & 1 & 1 \\ a & 2 & 5 \\ -3 & 1 & 1 \end{vmatrix}$$

$$\text{ad-bc}$$

$$= a \begin{vmatrix} -5 & 4 \\ 1 & 1 \end{vmatrix} - b \begin{vmatrix} 2 & 4 \\ -3 & 1 \end{vmatrix} + c \begin{vmatrix} 2 & -5 \\ -3 & 1 \end{vmatrix} \quad (1)$$

$$3 \begin{vmatrix} -5 \times 1 - 4 \times 1 \\ -5 - 4 \end{vmatrix} - 1 \begin{vmatrix} 2 \times 1 - 4 \times -3 \\ 2 - -12 \end{vmatrix} + 1 \begin{vmatrix} 2 \times 1 - -5 \times -3 \\ 2 - 15 \end{vmatrix}$$

$$3 \times -9 - 1 \times 14 + 1 \times -13$$

$$-27 - 14 - 13$$

$$|B| = -54 \quad \checkmark$$