



**Instructions to candidates**

**Duration:** One(01) hour

**Number of questions:** Two(02) Essay Questions

**Mark allocation:** 100 mark

Use standard symbols without definition.

Scientific calculators are allowed.

**Answer all questions**

1.

- a. If a matrix has 18 elements, what are the possible orders it can have? What, if it has 19 elements? (06 mark)

b. Find  $x$  and  $y$  when  $(x \ y) \begin{pmatrix} 2 & 3 \\ 0 & 1 \end{pmatrix} = (6 \ 10)$ . (06 mark)

c. Let  $A = \begin{pmatrix} 2 & 1 & -1 \\ 3 & -1 & 0 \\ 2 & 5 & 6 \end{pmatrix}$  and  $B = \begin{pmatrix} 2 & -1 & 4 \\ -3 & 0 & 1 \\ -1 & 1 & 2 \end{pmatrix}$ , find:

- i.  $3A - 2B$  (03 mark)  
ii. product of matrix  $A$  and  $B$  (06 mark)  
iii. transpose of matrix  $B$  (02 mark)

- d. Find the *minors*, *cofactors*, and *adjoint matrix* of matrix  $C$ . Hence, obtain the inverse matrix of matrix  $C$ . (15 mark)

$$C = \begin{pmatrix} 2 & 5 & 3 \\ 3 & 1 & 2 \\ 1 & 2 & 1 \end{pmatrix}$$

- e. Use **Cramer's rule** to solve the following system of linear equations. (12 mark)

$$\begin{aligned} x + 4y + 3z &= 1 \\ 2x + 5y + 4z &= 4 \\ x - 3y - 2z &= 5 \end{aligned}$$



2.

a. Determine the values of  $c$  such that  $|c\underline{u}| = 3$ , where  $\underline{u} = i + 2j + 3k$ . (04 mark)

b. If  $\underline{v} = 3i - j + 4k$  and  $\underline{w} = 2i + 2j - k$ , determine:

i. the dot product of  $\underline{v}$  and  $\underline{w}$ . (03 mark)

ii. the cross product of  $\underline{v}$  and  $\underline{w}$ . (04 mark)

iii. the angle between two vectors,  $\underline{v}$  and  $\underline{w}$ . (05 mark)

c. Evaluate the following expressions and write your answer in the form of  $a + bi$ .

i.  $(1 - 2i)(8 - 3i)$  (02 mark)

ii.  $\frac{3 + 2i}{1 - 4i}$  (04 mark)

d. Prove the following properties of complex numbers, where  $z, w \in \mathbb{C}$ .

i.  $\overline{z + w} = \overline{z} + \overline{w}$  (04 mark)

ii.  $z\overline{z} = |z|^2$  (04 mark)

e. Solve the equation,  $2x^2 - 6x + 5 = 0$  for  $x$ . (05 mark)

f. Determine the modulus and principle argument of  $-2\sqrt{3} + 2i$ . (06 mark)

g. If  $z = 1 - \sqrt{3}i$ , then find:

i. the polar form of  $z$ . (06 mark)

ii. the exponential form of  $z$ . (03 mark)