الجامعة الوطنية
National University
Science & Technology للعلوم والتكنولوجيا
كلية عمان البحرية الدولية
International Maritime College Oman

Final Exam
DMATH-II: MATH 2
Spring 2025

Points of attention:

- For each question, the maximum earned points are specified in the question.
- Write clearly! Answers that are not readable are not marked and don't earn marks!
- All answers should be written in English using **blue or black pens** only.
- Use the pencil only for diagrams and graphs.
- Show all the calculation steps in the given space.
- When finished, submit the question paper, together with the answer scripts and the signed cover page to the invigilator.
- Any cheating/copying may result in an instant failing of the examination.

Exam Duration: 2.5 hrs
Instructor's Name: Dr. Taofeek Olanrewaju Alade
Exam Date: 18/06/2025
Program: DO

	40

Student Information			
Name:		ID:	
Signature:			

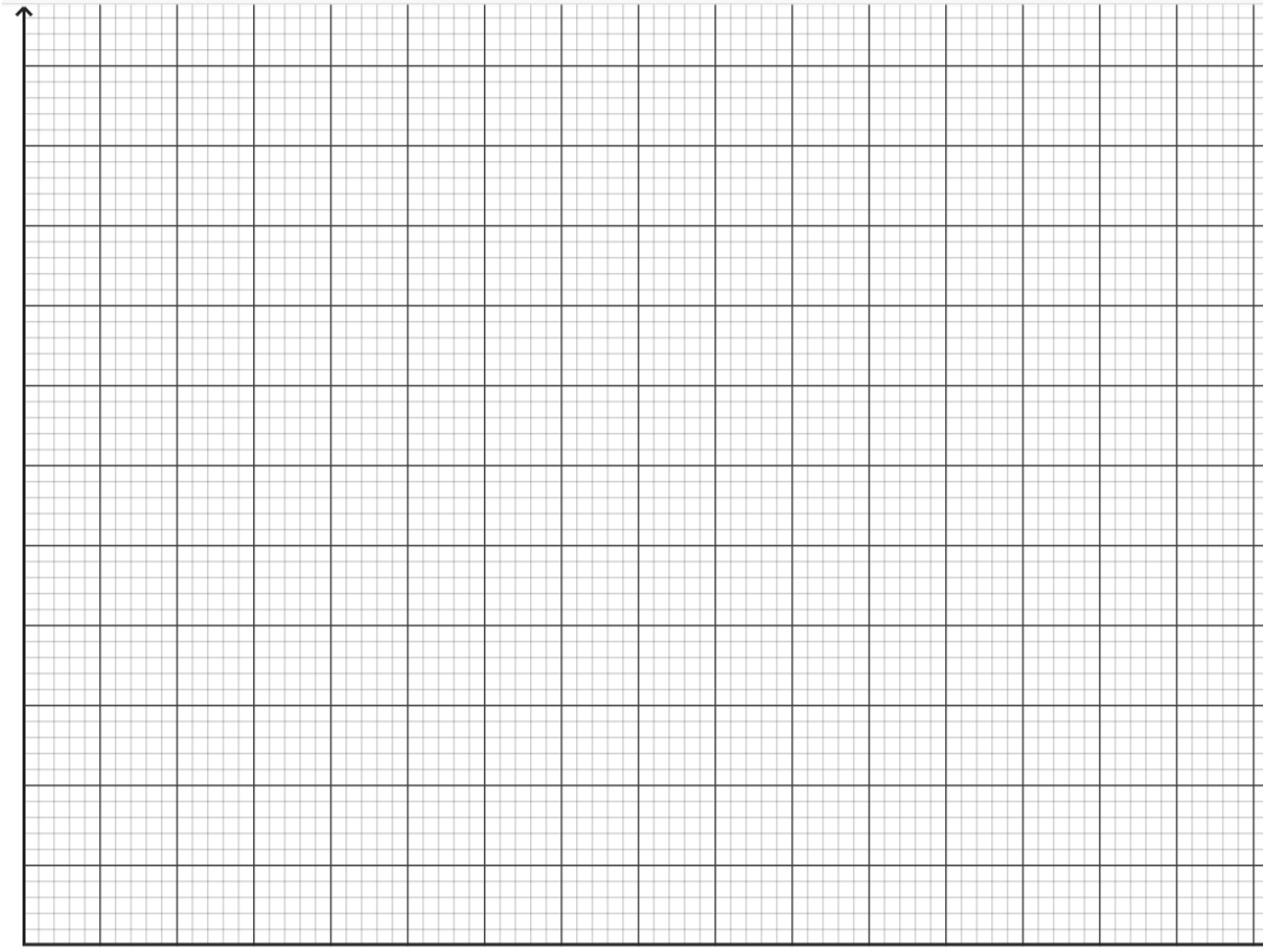
Invigilator			
Initials:		☐ Student ID checked	
Time received:			

Question 1 **[3 marks]**

A ship is tied to the dock with two ropes. The forces (tensions) in the two ropes are given as: $(10 + 15j)\ lb$ and $(40 - 20j)\ lb$.

Determine the resultant force, graphically and algebraically.

Note: Use pencil and ruler for all drawings



Question 2 **[5 marks]**

Points P, Q and R have coordinates $(3, 1, 0)$, $(6, -3, 4)$ and $(3, 3, 7)$ respectively.

a) State the position vectors of P, Q and R. (1 mark)

b) Find $\overrightarrow{PQ}$ and $\overrightarrow{QR}$. (1 mark)

c) Find $|\overrightarrow{PQ}|$ and $|\overrightarrow{QR}|$. (1 mark)

d) Find the direction ratios of $\overrightarrow{PQ}$ and $\overrightarrow{QR}$. (1 mark)

e) Find the direction cosines of $\overrightarrow{PQ}$ and $\overrightarrow{QR}$. (1 mark)

Question 3 **[4 marks]**

Apply De Moivre's theorem to determine the cube roots of the complex number

$$-9 - j$$

Question 4 **[5 marks]**

Let $A(4, 0, 4),\ B(\ 1, -1, 1)\ and\ C(6, -3,\ 2)$ be the vertices of triangle ΔABC, use vector product method to determine the area.

Question 5 **[4 marks]**

If a and b are two vectors where $a = 3i + 2j - k$ and $b = 4i + j - 3k$. Determine the angle between the vectors by using scalar product of vectors.

Question 6 **[6 marks]**

a. Use a table of values to estimate the value of the following limit (4 marks)

$$\lim_{x \to 2} \frac{x - 2}{x^2 + x - 6}$$

b. Evaluate the following limit, if it exists (2 marks)

$$\lim_{x\to\infty} \frac{5x^2+7}{1+2x^2}$$

Question 7 **[6 marks]**

As a deck officer, you are analyzing data from three different navigational sensors. Each sensor provides a reading that depends on three unknown factors: wind influence (x), current drift (y), and steering error (z). The relationships are given by the following system of equations:

$$3x - 3y + 9z = 30$$

$$y - 3x + 4z = 20$$

$$4x + 2y + 2z = 6$$

To understand the individual effect of each factor, solve this system using **Cramer's Rule**.

Question 8 **[7 marks]**

As a deck officer, you are using a matrix to correct the ship's position based on three different navigation systems. The correction data is given in this matrix:

$$A = \begin{pmatrix} 4 & -2 & 3 \\ 1 & 5 & -1 \\ 2 & 0 & 6 \end{pmatrix}$$

To reverse these corrections and check the original readings, you need to find the inverse of matrix A. What is the inverse of this matrix?

Formula Sheet

1. De Moivre's theorem
   $[r(cos\ \theta + j\ sin\theta)]^n = [r^n(cos\ n\theta + j\ sin\ n\theta)]$

2. Scalar or Dot Product of vectors
   $$a \cdot b = |a||b|\ cos\ \theta$$

3. Vector or Cross product of vectors
   $$a \times b = |a||b|\ sin\ \theta$$

4. Inverse of a matrix
   $$A^{-1} = \frac{1}{|A|} \times \text{adjoint } (A)$$

MLO & Bloom's Level of Complexity

Q #	MLO Addressed	Complexity Level	Mark	Remark
7, 8	**2, 3, 5**	Application	**13**	
1, 2	**1,**	Understanding/ Analysing	**8**	
6	**4**	Evaluating	**6**	
3, 5	**2**	Analysing	**8**	
4	**1, 3**	Remembering	**5**	