

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

	<b>40</b>

**Student Information**

Name:  ID:   
Signature:

**Invigilator**

Initials:  ☐ Student ID checked  
Time received:

**Question 1****[6 marks]**

- a. Use a table of values to estimate the value of the following limit

(4 marks)

$$\lim_{x \rightarrow 1} \frac{x - 1}{x^3 - 1}$$

- b. Evaluate the following limit, if it exists

(2 marks)

$$\lim_{x \rightarrow \infty} \frac{5x^2 + 2x + 1}{x^2 - 4x + 3}$$

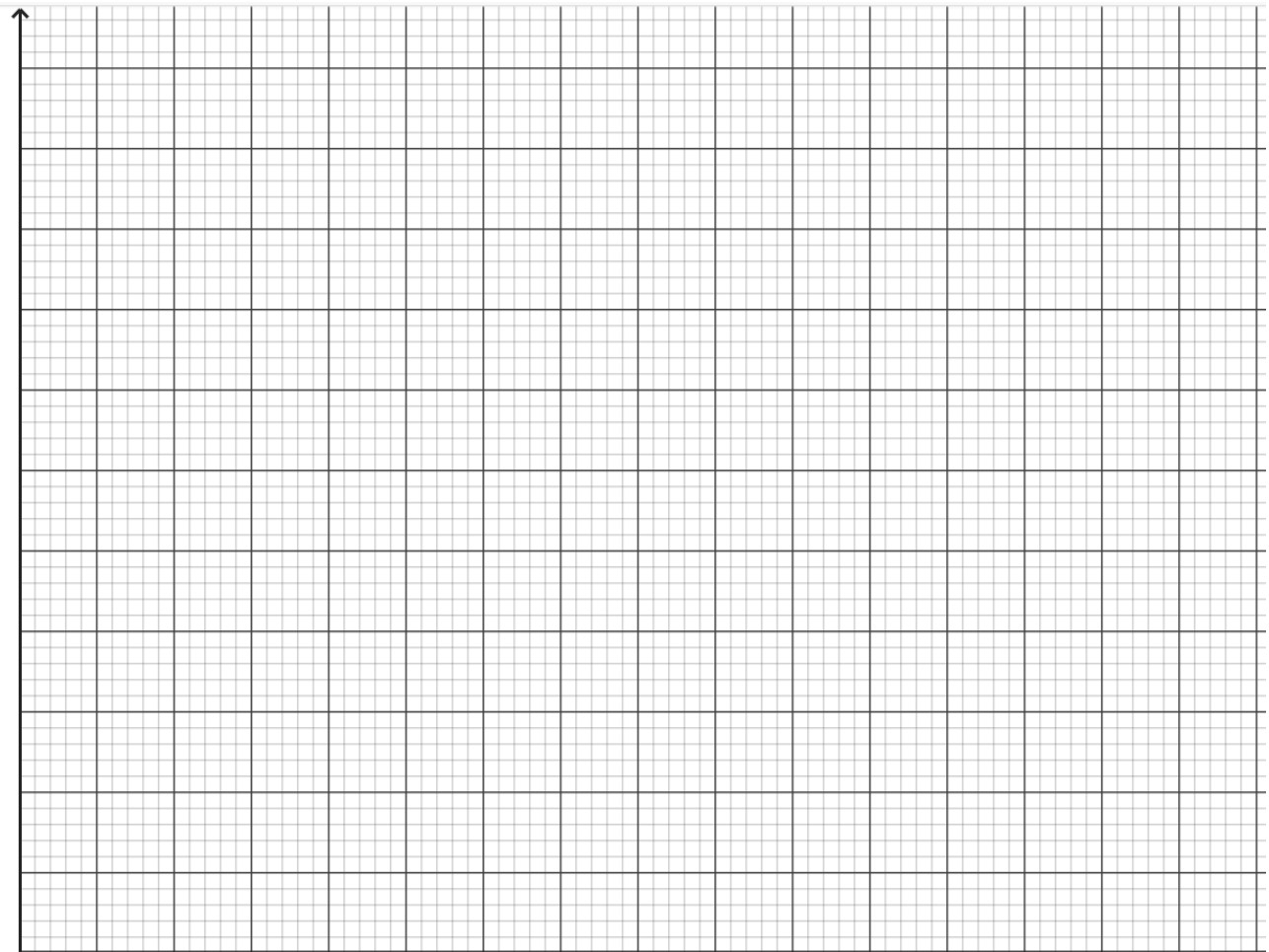
**Question 2****[3 marks]**

A vessel is anchored at sea and is being held in position by two mooring lines. The tension forces exerted by the mooring lines on the vessel are represented by the vectors:

$$F_1 = (25 + 10j) \text{ lb}, F_2 = (-10 + 15j) \text{ lb}.$$

Determine the resultant force, graphically and algebraically.

**Note:** Use pencil and ruler for all drawings



**Question 3****[5 marks]**

Points  $X, Y$  and  $Z$  have coordinates  $(5, 2, -1)$ ,  $(6, -3, 4)$  and  $(2, 3, 8)$  respectively.

- a) State the position vectors of  $X, Y$  and  $Z$ . (1 mark)
- b) Calculate  $\overrightarrow{XY}$  and  $\overrightarrow{YZ}$ . (1 mark)
- c) Determine  $|\overrightarrow{XY}|$  and  $|\overrightarrow{YZ}|$ . (1 mark)
- d) Find the direction ratios of  $\overrightarrow{XY}$  and  $\overrightarrow{YZ}$ . (1 mark)
- e) Calculate the direction cosines of  $\overrightarrow{XY}$  and  $\overrightarrow{YZ}$ . (1 mark)

**Question 4****[4 marks]**

Determine all the cube roots of the complex number  $-6 - 3j$  using **De Moivre's Theorem**, and express each root in rectangular form  $(a + bj)$ .

**Question 5****[5 marks]**

Determine the area of triangle  $XYZ$  with vertices at  $X(6, -2, 1)$ ,  $Y(3, -1, 2)$  and  $Z(6, -3, 2)$  using the cross product of vectors.

**Question 6****[4 marks]**

If  $A$  and  $B$  are two vectors where  $A = 3i - 5j - 2k$  and  $B = 3i + j - 4k$ . Determine the angle between the vectors by using scalar product of vectors.



**Question 7****[7 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:

$$2x + 4y - 6z = 10$$

$$-3x + 5y + z = -8$$

$$x - 2y + 3z = 5$$

To understand the individual effect of each factor, solve this system using **the inverse matrix method**.



**Question 8****[6 marks]**

As a Junior Deck Officer aboard the container vessel Pacific Calculator, you're training to verify cargo loading calculations. The Chief Engineer provides this stability condition report showing the mathematical relationship between cargo weights in three compartments:

$$3W_1 - W_2 + 2W_3 = 7$$

$$W_1 + 2W_2 - W_3 = -1$$

$$2W_1 + 2W_2 + 3W_3 = 8$$

Use **Gaussian elimination method** to determine the cargo weight distribution



**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	
2, 6	1,	Understanding/ Analysing	7	
1	4	Evaluating	6	
3, 5	2	Analysing	10	
4	1, 3	Remembering	4	