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

Final Exam
DMATH-III: MATH 3
Fall 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 hours
Instructor's Name:	Dr. Rokhsaneh Yousef Zehi & Muhammad Javed
Exam Date:	24/12/2025
Program:	DO

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Student Information			
Name:		ID:	
Signature:			

Invigilator			
Initials:		☐ Student ID checked	
Time received:			

Question 1 **[4 marks]**

A square metal plate with a side length of $\boldsymbol{x}\ cm$ is being heated and the side (x) is expanding at a rate of $0.4\ cm/min$.

(a) Determine the rate of change of the area with respect to time when $x = 10\ cm$.

(2 marks)

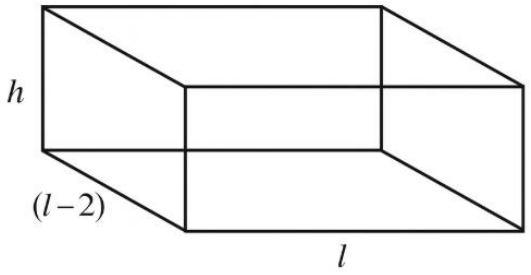
(b) Determine the rate of change of the perimeter with respect to time when $x = 10\ cm$.

(2 marks)

Question 2 **[5 marks]**

A storage container is to be made in the shape of a cuboid using 12 metal bars. Each of the four vertical bars has height $\boldsymbol{h}$ m. Each of the longer horizontal bars has length $\boldsymbol{l}$ m, and each of the shorter horizontal bars has length $(\boldsymbol{l}-\mathbf{2})$ m. The total length of all 12 bars must be $\mathbf{36}$ meter. The aim is to construct the container with the maximum possible volume.

Determine the value of $\boldsymbol{l}$ that will maximize the volume of the container.



Question 3 **[6 marks]**

Find all the stationary points of the following function and then determine whether each one is a maximum, minimum, or point of inflection.

$$\boldsymbol{f(x) = x^5 - 15x^3}$$

Question 4 **[5 marks]**

Calculate the following integrals:

(a) $\int (\boldsymbol{2x^{-2} + 4x^3 - 5x + 3})\, \boldsymbol{dx}$ (2 marks)

(b) $\int \left(\frac{3}{t^2} + \frac{t^3}{\sqrt{t}}\right) dt$ (3 marks)

Question 5 **[5 marks]**

Approximate the value of the definite integral

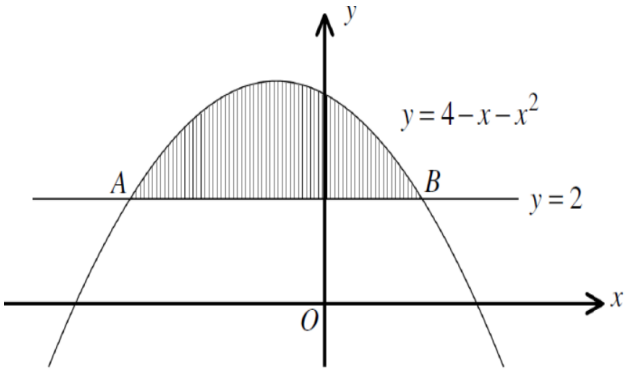
$$\int_{1}^{4} x\sqrt{2x+1}\,dx$$

using the **Simpson's Rule** with $n = 6$ subintervals. Write your answer correct to 3 decimal places.

Question 6 **[5 marks]**

The shaded area below shows the area bounded by the curve $\boldsymbol{y = 4 - x - x^2}$ and the line $\boldsymbol{y = 2}$ from $x = -2$ to $x = 1$.

Determine the shaded area.



Question 7 **[5 marks]**

A fuel tank is created by revolving the curve

$$\boldsymbol{y = \frac{1}{3} x \sqrt{3x - x^2}}$$

about the **x-axis**, where y is the height (in m) and x is the horizontal distance (in m).

Using **Disk method**, determine the volume of the tank, formed by revolving this curve from $x = 0$ to $x = 3$.

Question 8 **[5 marks]**

The rate at which seawater flows into a ship's ballast tank is given by:

$$\frac{dV}{dt} = \frac{300\,t}{\sqrt{t^2 + 25}}$$

where V is the volume of seawater in the tank (in m^3), and t is the time in hours.

Determine the total volume of seawater that enters the ballast tank between $t = 0$ hour and $t = 2$ hour.

This page is for rough work.

Formula sheet:

Area of a square	$\boldsymbol{A = x^2}$
Perimeter of square	$\boldsymbol{P = 4x}$
Volume of cuboid	$\boldsymbol{V = length \times width \times height}$
Simpson's rule	$\boldsymbol{\int_a^b f(x)dx \approx \frac{h}{3}[y_0 + 4y_1 + 2y_2 + \cdots + 4y_{n-1} + y_n]}$

MLO and Bloom's Level of Complexity

Q #	MLO Addressed	Complexity Level	Mark	Remark
1	**2,3**	Application, Analysis	**4**	
2	**3,4**	Analysis, Evaluate	**5**	
3	**1,2**	Application	**6**	
4	**1**	Application	**5**	
5	**1**	Application	**5**	
6	**1**	Application	**5**	
7	**2,3**	Application, Analysis	**5**	
8	**2,3**	Application, Analysis	**5**	

References:

1. J. Washington, A., 2014. Basic Technical Mathematics with Calculus. 10 ed. Harlow: Pearson Education Limited.
2. Stewart, J., 2008. *Calculus: Early Transcendentals*. 6th ed. Boston: Brooks/Cole.