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

Final Exam
DMATH-III: MATH 3
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 hours
Instructor's Name:	Dr. Rokhsaneh Yousef Zehi
Exam Date:	17/06/2025
Program:	DO

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Student Information			
Name:		ID:	
Signature:			

Invigilator			
Initials:		☐ Student ID checked	
Time received:			

Question 1 **[4 marks]**

The current I (in amperes) flowing through a resistor is given by the equation

$$I = \frac{3R^2 - 4}{(2R + 3)^3}$$

Where R is the resistance (in Ω) in the circuit. Determine the rate of change of electric current (I) with respect to resistance (R) when $R = 2$.

Question 2 **[5 marks]**

Given the following implicit function

$$x^2y^2 + 3x^2 = y^3 + 2$$

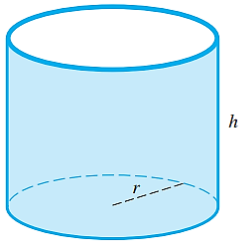
(a) Determine the slope of the tangent line at the point $(-1,1)$. (3 marks)

(b) Obtain the equation of the normal line to the curve at the point $(-1,1)$. (2 marks)

Question 3 **[7 marks]**

A shipping company is designing a cylindrical oil-storage tank with a capacity of 800 KL for one of its vessels. To minimize material costs, the company seeks to design the tank using the least amount of sheet metal.

Determine the dimensions (radius and height) of the tank that will minimize the surface area.



Question 4 **[5 marks]**

Two cargo ships depart from Muscat, Oman, at 07:00 AM. Ship A travels **south** toward Sur at **15 km/h**, and Ship B travels **west** toward Sohar at **20 km/h**. How fast are the two cargo ships moving apart at 10:00 AM?

Question 5 **[5 marks]**

A small cargo boat is traveling through a river, and its displacement is given by:

$$\mathbf{S} = \int_{t_1}^{t_2} \frac{\mathbf{10}t}{(t^2+\mathbf{2})^3}\,dt$$

Determine the total distance the boat travels (Displacement s) between $t_1 = 1$ hour and $t_2 = 4$ hours.

Question 6 **[5 marks]**

Approximate the value of the definite integral

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

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

Question 7 **[5 marks]**

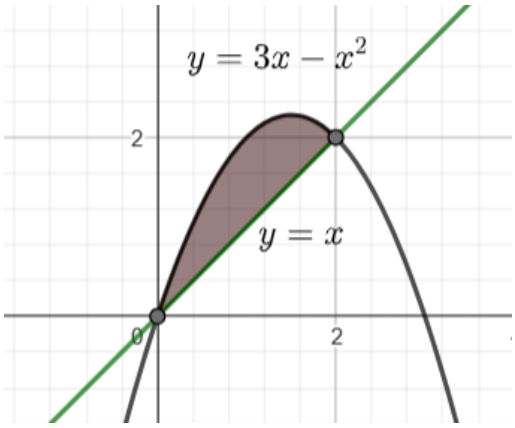
A ship's fuel tank is modeled by revolving the region bounded by the graph of

$$y = 2\sqrt{6 - x^2}$$

about the x-axis, where x and y are measured in meters. Find the volume of the fuel tank where $x = 0$ to $x = 2.4$.

Question 8 **[4 marks]**

Determine the area bounded by $y = 3x - x^2$ and $y = x$ between $x = 0$ and $x = 2$ as shown below.



This page is for rough work.

Formula sheet:

Product Rule	$\frac{dy}{dx} = u'v + v'u$
Quotient Rule	$\frac{dy}{dx} = \frac{u'v - v'u}{v^2}$
Volume of cylinder	$v = \pi r^2 h$
Surface are of cylinder	$A = 2\pi r^2 + 2\pi rh$
Simpson's rule	$\int_a^b f(x)dx \approx \frac{h}{3}[y_0 + 4y_1 + 2y_2 + \cdots + 4y_{n-1} + y_n]$

MLO and Bloom's Level of Complexity

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

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.