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

Final Exam
PMATH-I.II: ARITHMATICS-II
Spring 2026

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:	Muhammad Javed
Exam Date:	14/05/2026
Program:	LTM

	40
	10

Student Information			
Name:		ID:	
Signature:			

Invigilator			
Initials:		☐ Student ID checked	
Time received:			

Question 1 **[4 marks]**

A spherical air-storage container is used in a logistics warehouse to temporarily store compressed air for packaging operations. As air is pumped in, the container expands uniformly.

a. Determine the rate of change of the container's storage volume with respect to its radius. (2 marks)

b. Determine the relative rate of change of volume with respect to the radius. (1 mark)

c. Calculate this rate when the radius of the container is 2 feet. (1 mark)

Note: Volume (Sphere)$= \frac{4}{3}\pi r^3$

Question 2 **[5 marks]**

In a logistics planning model for managing storage and shipping costs of materials in a manufacturing firm, the total cost function is defined as

$$C(k) = 75\left(120 + 6k + \frac{200}{k}\right), 2 \leq k \leq 60$$

Where $C(k)$ is the total cost in dollars for storage and transportation over a planning period, k represents the amount of material (in tons) transported in each shipment and a shipment of k tons is made every $k$days

a. Compute the total cost when $x = 2$. (1 mark)
b. Determine the value of k that minimizes the total cost. (3 marks)
c. Calculate the minimum total cost. (1 marks)

Question 3 **[7 marks]**

Suppose a company's operational cost function (in billions of dollars) depends on the shipment volume I(in billions of units) and is given by:

$$C(x) = \frac{9x + 0.8\sqrt{x^3} - 0.3\sqrt{x}}{\sqrt{x}}$$

a. Determine the marginal cost when the shipment volume is $x = 25$. (4 marks)

b. Find the relative rate of change of cost at $x = 25$, and briefly explain its meaning for decision-making in logistics. (3 marks)

Question 4 **[8 marks]**

Evaluate the following , show steps

a. Determine the derivative of

$$(y) = (1 - y^2)(5y - 6y^2 - 3y^3)$$ (3 marks)

b. Find the anti-derivative of

$$g(x) = x^2\left(x^3 - \frac{x}{\sqrt{3}} - \frac{3}{\sqrt{x}}\right)$$ (3 marks)

c. Determine the integral (2 marks)

$$\int_{-2}^{1}(5x + 1)dx$$

Question 5 **[5 marks]**

A manufacturing and logistics company produces goods for regional distribution. The fixed cost of production is $3,500 per week. Fixed costs, such as warehouse rent and equipment insurance, remain constant regardless of the production level.

The marginal cost function (in dollars per unit) is given by

$$\frac{dC}{dq} = 0.000002\,(0.003q^2 - 20q) + 0.15$$

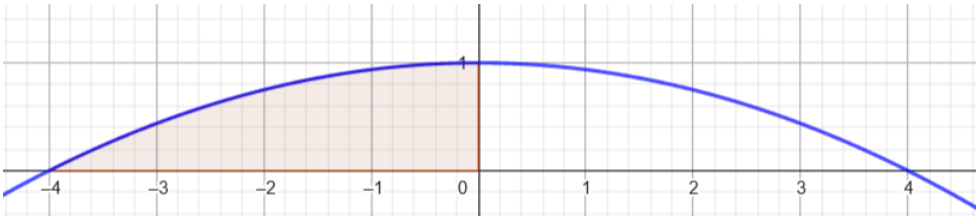
where C is the total cost (in dollars), and q is the number of units produced per week.

a. Determine the total cost function, $C(q)$, by integrating the marginal cost function. (3 marks)

b. Use the given fixed cost to find the constant of integration. (2 marks)

Question 6 **[5 marks]**

The following graph shows a region in the first quadrant bounded by $g(x) = -\frac{1}{16}x^2 + 1$, the line $x = 0$, and the line $y = 0$. All lengths are measured in centimeters.



a. Write down the definite integral that represents the area of the region. (2 marks)

b. Evaluate the integral and hence find the area of the region. (3 marks)

Question 7 **[6 marks]**

The region is bounded by the curve $y = x^2$ and the line $y = x$, where x and y are measured in meters.

a. Write down the definite integral that represents the area of the region bounded by the curve and the line $y = x$. (3 marks)

b. Evaluate the integral to find the area of the bounded region, round the answer to one decimal place. (3 marks)

MLO and Bloom's Level of Complexity

Q #	MLO Addressed	Complexity Level	Mark	Remark
1	2	Apply	4	Real-life logistics
2	2	Apply	5	Optimization in logistics
3	1 and 3	Analyze	7	Marginal cost & relative rate of change
4	1	Apply	8	Derivatives, anti-derivatives, definite integral
5	2	Apply	5	Integration with initial condition
6	2	Apply	5	Area under curve (first quadrant)
7	2 and 4	Evaluate	6	Area between two curves

Reference:

JR, E. F. H., 2019. *Introductory Mathematical Analysis*. 14 ed. Ontario: Pearson.