CONFIDENTIAL

UNIVERSITI KUALA LUMPUR
Malaysian Institute of Marine Engineering Technology

FINAL EXAMINATION
FEBRUARY 2025 SEMESTER SESSION

SUBJECT CODE	:	**LMD13902**
SUBJECT TITLE	:	**TECHNICAL MATHEMATICS 2**
PROGRAMME NAME **(FOR MPU: PROGRAMME LEVEL)**	:	**DIPLOMA OF ENGINEERING TECHNOLOGY IN MARINE ENGINEERING**
TIME / DURATION	:	**2.00 PM - 4.30PM** **(2 HOURS 30 MINUTES)**
DATE	:	**28 JUNE 2025**

INSTRUCTIONS TO CANDIDATES

1. Please read **CAREFULLY** the instructions given in the question paper.
2. This question paper has information printed on both sides of the paper.
3. This question paper consists of **TWO (2)** sections; Section A and Section B.
4. Answer **ALL** question in Section A, and **TWO (2)** questions ONLY in Section B.
5. Please write your answers on this answer booklet provided.
6. Answer **ALL** questions in English language **ONLY**.
7. Answer should be written in blue or black ink except for sketching, graphic and illustration.
8. Formula sheet has been appended for your reference.

THERE ARE 11 PAGES OF QUESTIONS, INCLUDING THIS PAGE.

(Total: 100 marks)
SECTION A (60 marks)
INSTRUCTION: Answer ALL questions.

Question 1

With reference to Trigonometry and Geometry:

(a) In Geometry, a triangle is a three-sided polygon that consists of three edges and three vertices. The most important property of a triangle is that the sum of the internal angles of a triangle is equal to 180 degrees. Identify any THREE (3) types of triangle.

(3 marks)

(b) Trigonometry is the branch of mathematics that concerned with specific functions of angles and their application to calculations. State any THREE (3) applications of Trigonometry in engineering field.

(3 marks)

(c) Figure 1 shows a combination of three angles. By referring to the figure, state the value of:

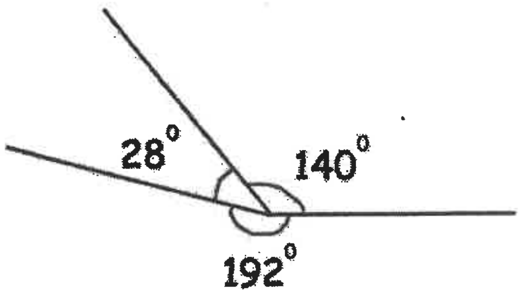

Figure 1: Angle

i. Acute angle.

(1 mark)

ii. Obtuse angle.

(1 mark)

iii. Reflex angle.

(1 mark)

iv. Sum of all angles.

(1 mark)

(d) Figure 2 shows a right triangle, ABC. Based on the given dimension in Figure 2, state the value of:

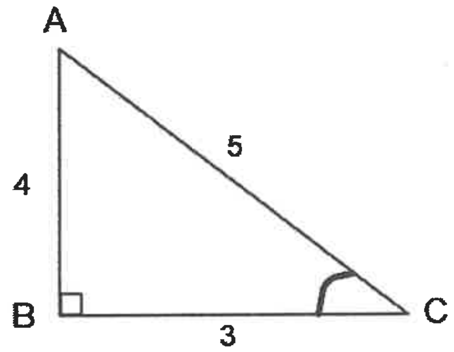

Figure 2: Right Triangle ABC

i. Sin C.

(1 mark)

ii. Cos C.

(1 mark)

iii. Tan C.

(1 mark)

iv. Opposite side of angle C.

(1 mark)

(e) Angle Unit refers to the unit of measurement used to represent angles. It defines how angular values are interpreted and used within the programming environment. Common angle units are in degree and radians. Express the following radian angle in degrees and minutes.

i. 1.25 radians.

(2 marks)

ii. 4.02 radians.

(2 marks)

iii. 7.22 radians.

(2 marks)

Question 2

With reference to Percentage and Trigonometry:

(a) A vessel consumes 15,000 liters of fuel on a voyage from Port A to Port B. After some modifications to the engine and hull, the fuel consumption is reduced by 12% on the return trip. Calculate:

i. the amount of fuel saved on the return trip.

(2 marks)

ii. the total fuel consumption of the vessel.

(4 marks)

(b) As observed from the top of a 150 m tall lighthouse, the angles of depression of two ships approaching it are 30^0 and 45^0 as in Figure 3. If one ship is directly behind the other, find the distance between the two ships.

(6 marks)

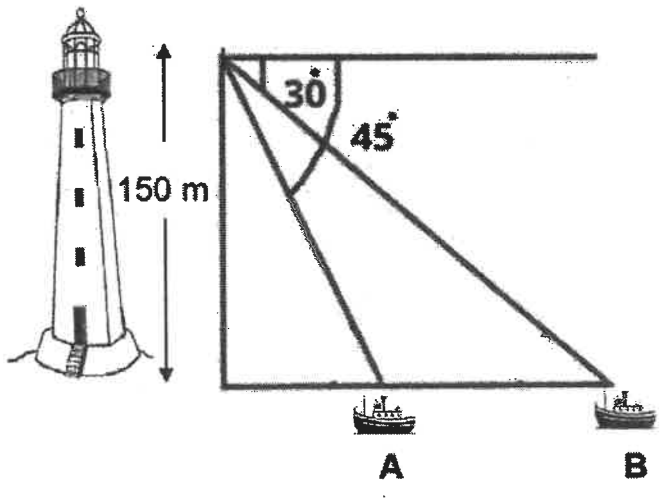

Figure 3: Distance between Ship A and Ship B

(c) Figure 4 shows the positions of two ships, A and B, and a lighthouse L. Ship A is 5 km from L on a bearing of 070° from L. Ship B is 3 km from L on a bearing of 210° from L.

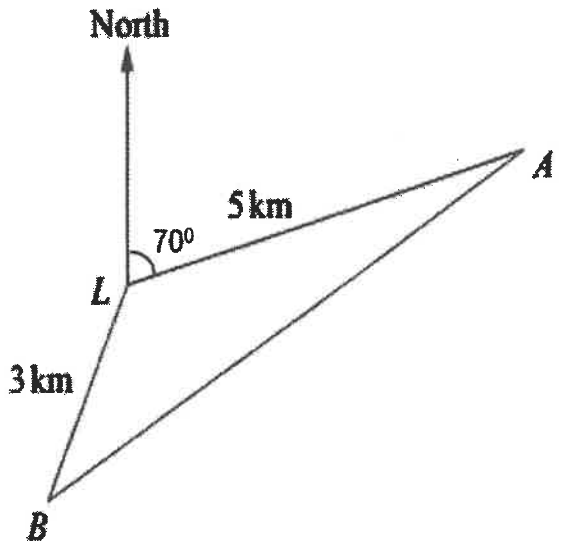

Figure 4: Position of Two Ships

Calculate:

i. the distance between Ship A and Ship B. Give your answer correct to 3 significant figures.

(5 marks)

ii. angle B.

(3 marks)

Question 3

With reference to Geometry:

(a) A horizontal cylindrical fuel tank has a diameter of **250 centimeters** and a length of **6 meters**. Calculate:

i. the volume of the tank in $\mathbf{m^3}$.

(3 marks)

ii. the curved surface area of the tank $\mathbf{m^2}$.

(2 marks)

(b) A marine engineer is tasked with laying a subsea power cable in a sector-shaped area of the ocean. The radius of the area is 20 kilometers, and the central angle of the sector is 135°. Calculate:

i. the area of the sector where the subsea cable will be laid.

(2 marks)

ii. the length of the arc along which the cable will be placed.

(2 marks)

(c) Figure 5 shows a rectangular water container. The container is $\frac{1}{2}$ full of water. A cup can hold 175 ml of water. Determine the number of cups that can be completely filled with water.

(5 marks)

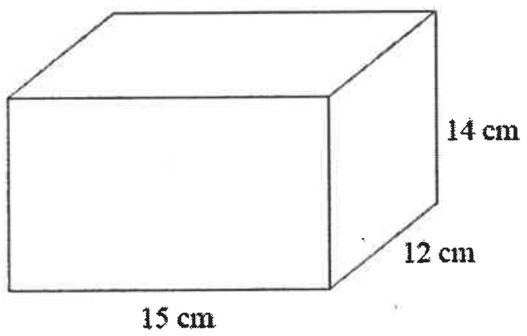

Figure 5: Rectangular Water Container

(d) Figure 6 shows a triangle PQR and a trapezium DEFG. The area of the triangle is **equal** to the area of the trapezium. Calculate:

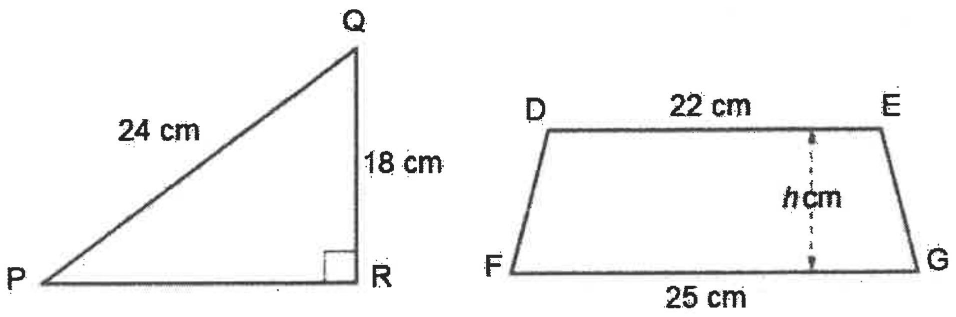

Figure 6: Triangle PQR and Trapezium DEFG

i. the area of the triangle.

(4 marks)

ii. the length h in cm.

(2 marks)

SECTION B (Total: 40 marks)

INSTRUCTION: Answer ONLY TWO (2) questions.

Please use the answer booklet provided.

Question 4

With reference to Differentiation:

(a) Find the derivative of the following functions:

i. $y = e^{3z} - \frac{3}{6z^2}$.

(3 marks)

ii. $y = \sqrt{2x^3 - 8x + 5}$.

(3 marks)

iii. $y = \frac{5\sin(2w)}{w+3}$.

(4 marks)

(b) A shipping company wants to design a cylindrical water tank with **no top** as shown in Figure 7. The volume of the tank must be 32 m^3.

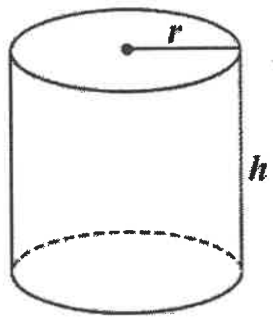

Figure 7: Cylindrical Water Tank

i. Show that the surface of the tank, A m^2 is given by

$$A = \pi r^2 + \left(\frac{64}{r}\right)$$

(4 marks)

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

(6 marks)

Question 5
With reference to Differentiation and Integration:

(a) Solve the following integrals by using suitable integration method.

i. $\int 6x^2(2x^3+1)^7 \, dx.$

(4 marks)

ii. $\int \frac{x}{(x+4)(x-1)} dx.$

(8 marks)

(b) Given $x^2 + y + y^4 = 10$.

i. Find dy/dx by implicit differentiation.

(6 marks)

ii. Hence, calculate the gradient at point (2,1) .

(2 marks)

Question 6
With reference to Integration:

(a) Integrate the following using suitable integration method:

i. $\int (6x^5 - 3x + 2)\,dx$

(2 marks)

ii. $\int \frac{6}{2x+1}\,dx$

(2 marks)

iii. $\int \left(e^{3z} - \frac{3}{6z^2}\right)dz$

(3 marks)

iv. $\int (\sec^2 4\theta + \sin 3\theta + 2)\,d\theta$

(3 marks)

(b) Figure 8 shows an area enclosed by the curve $y = 4x - x^2 - 1$ and line $y = x + 1$.

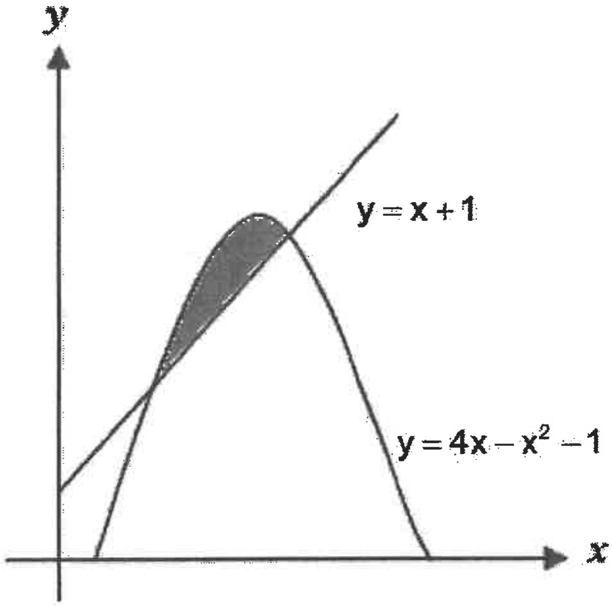

Figure 8: Area Between Curves

Compute:

i. the x-intersect between the curves.

(4 marks)

ii. the area under the region enclosed by the curve and the line.

(6 marks)

END OF EXAMINATION PAPER

DIFFERENTIATION

STANDARD FORM	GENERAL FORM
$\frac{d}{dx}(\sin x) = \cos x$	$\frac{d}{dx}(\sin f(x)) = f'(x)\cos f(x)$
$\frac{d}{dx}(\cos x) = -\sin x$	$\frac{d}{dx}(\cos f(x)) = -f'(x)\sin f(x)$
$\frac{d}{dx}(\tan x) = \sec^2 x$	$\frac{d}{dx}(\tan f(x)) = f'(x)\sec^2 f(x)$
$\frac{d}{dx}(\csc x) = -\csc x \cot x$	$\frac{d}{dx}(\csc f(x)) = -f'(x)\csc f(x)\cot f(x)$
$\frac{d}{dx}(\sec x) = \sec x \tan x$	$\frac{d}{dx}(\sec f(x)) = f'(x)\sec f(x)\tan f(x)$
$\frac{d}{dx}(\cot x) = -\csc^2 x$	$\frac{d}{dx}(\cot f(x)) = -f'(x)\csc^2 f(x)$

EXPONENTIAL FUNCTION

STANDARD FORM	GENERAL FORM
$\frac{d}{dx}e^x = e^x$	$\frac{d}{dx}e^{f(x)} = f'(x)e^{f(x)}$

LOGARITHMIC FUNCTION

STANDARD FORM	GENERAL FORM
$\frac{d}{dx}\ln x = \frac{1}{x}$	$\frac{d}{dx}\ln f(x) = \frac{f'(x)}{f(x)}$

INTEGRATION

STANDARD FORM	GENERAL FORM Where : $f(x) = ax + b$
$\int \cos x\,dx = \sin x + c$	$\int \cos f(x)dx = \dfrac{\sin f(x)}{f'(x)} + c$
$\int \sin x\,dx = -\cos x + c$	$\int \sin f(x)dx = \dfrac{-\cos f(x)}{f'(x)} + c$
$\int \sec^2 x\,dx = \tan x + c$	$\int \sec^2 f(x)dx = \dfrac{\tan f(x)}{f'(x)} + c$
$\int \sec x \tan x\,dx = \sec x + c$	$\int \sec f(x) \tan f(x)dx = \dfrac{\sec f(x)}{f'(x)} + c$
$\int \csc x \cot x\,dx = -\csc x + c$	$\int \csc f(x) \cot f(x)dx = \dfrac{-\csc f(x)}{f'(x)} + c$
$\int \csc^2 x\,dx = -\cot x + c$	$\int \csc^2 f(x)dx = \dfrac{-\cot f(x)}{f'(x)} + c$
$\int \tan x\,dx = \ln\lvert\sec x\rvert + c$	$\int \tan x\,dx = \dfrac{\ln\lvert\sec f(x)\rvert}{f'(x)} + c$
$\int \sec x\,dx = \ln\lvert\sec x + \tan x\rvert + c$	$\int \sec x\ dx = \dfrac{\ln\lvert\sec f(x) + \tan f(x)\rvert}{f'(x)} + c$
$\int \cot x\,dx = \ln\lvert\sin x\rvert + c$	$\int \cot x\,dx = \dfrac{\ln\lvert\sin f(x)\rvert}{f'(x)} + c$
$\int \csc x\,dx = -\ln\lvert\csc x + \cot x\rvert + c$	$\int \csc x dx = \dfrac{-\ln\lvert\csc f(x) + \cot f(x)\rvert}{f'(x)} + c$

EXPONENTIAL FUNCTION

STANDARD FORM	GENERAL FORM Where : $f(x) = ax + b$
$\int e^x dx = e^x + c$	$\int e^{f(x)}\,dx = \dfrac{e^{f(x)}}{f'(x)} + c$

LOGARITHMIC FUNCTION

STANDARD FORM	GENERAL FORM Where : $f(x) = ax + b$
$\int \dfrac{1}{x}dx = \ln\lvert x\rvert + c$	$\int \dfrac{1}{f(x)}dx = \dfrac{\ln\lvert f(x)\rvert}{f'(x)} + c$

SURFACE AREA

CIRCLE	πr^2
SPHERE	$4\pi r^2$
CYLINDER	$2\pi rh + 2\pi r^2$
CONE	$\pi rs + \pi r^2$
TRAPEZIUM	$\frac{1}{2}(a+b)h$

VOLUME

SPHERE	$\frac{4}{3}\pi r^3$
CONE	$\frac{1}{3}\pi r^2 h$
CYLINDER	$\pi r^2 h$