CONFIDENTIAL

UNIVERSITI KUALA LUMPUR
Malaysian Institute of Marine Engineering Technology

FINAL EXAMINATION
FEBRUARY 2025 SEMESTER SESSION

SUBJECT CODE	:	**LMB11703**
SUBJECT TITLE	:	**ENGINEERING MATHEMATICS 1**
PROGRAMME NAME (FOR MPU: PROGRAMME LEVEL)	:	**BACHELOR OF MARINE ENGINEERING TECHNOLOGY WITH HONOURS**
TIME / DURATION	:	**09.00 AM - 12.00 PM (3 HOURS)**
DATE	:	**23 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. Answer **FOUR (4)** questions only.
4. Please write your answers on this answer booklet provided.
5. Answer **ALL** questions in English language **ONLY**.
6. Answer should be written in blue or black except for sketching, graphic and illustration.
7. Formulate sheet has been appended for your reference.

THERE ARE 7 PAGES OF QUESTIONS, INCLUDING THIS PAGE.

(Total: 100 marks)

INSTRUCTION: Answer ONLY FOUR (4) questions.

Question 1

With reference to Logarithms and Indices, Algebra and Mensuration;

(a) A painter is looking to paint his deck. Figure 1 below shows a blueprint of the deck. A can of paint costs RM 30 and covers an area of 1.5 cm^2. Calculate the cost to paint the entire deck.

(5 marks)

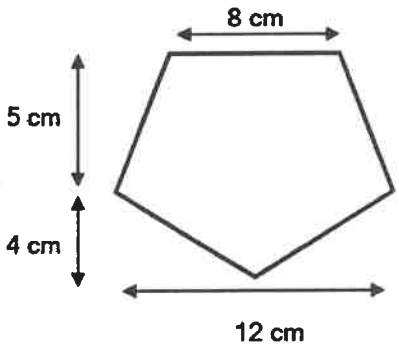

Figure 1: Deck Shape

(b) Express each of the following in terms of $\log a$ and $\log b$.

i. $log\left(\sqrt[6]{a^2 b}\right) + log\left(\frac{a}{b}\right)$.

(4 marks)

ii. $log\left(a\sqrt{b}\right) - log\left(\frac{b}{a^2}\right)$.

(6 marks)

(c) State THREE (3) types of solutions for quadratic equations.

(3 marks)

(d) Factorise $f(x) = x^3 - 7x - 6$ as far as possible.

(7 marks)

Question 2

With reference to Logarithms and Indices, Algebra and Mensuration:

(a) A sphere of diameter 14 cm, is dropped in a right circular cylindrical vessel, partly filled with water. If the sphere is completely submerged in water, the water level in the cylindrical vessel rises by $4\frac{1}{3}$ cm. Find the diameter of the cylindrical vessel.

(5 marks)

(b) Estimate the value of x, correct to 4 decimal places for the equation of $2^{2x-1} = 5^{3-x}$.

(6 marks)

(c) Solve the equation $4 + 3\log(2x) = 16$.

(4 marks)

(d) A square has an unknown side length of x. A rectangle has a side length that is four feet longer than the square and a width that is two feet shorter than the square as shown in Figure 2. The areas of both the square and the rectangle are equal. Determine the side length of the square.

(5 marks)

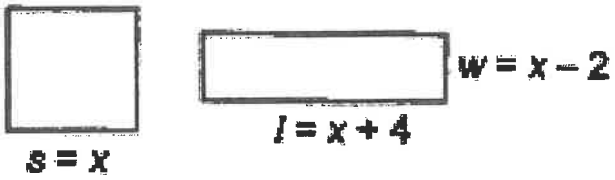

Figure 2: Rectangles

(e) If both $x-2$ and $x-\frac{1}{2}$ are factors of px^2+5x+r, show that $p=r$.

(5 marks)

Question 3

With reference to Logarithms and Indices, Algebra and Mensuration:

(a) Figure 3 represents a solid consisting of a right circular cylinder with a hemisphere at one end and a cone at the other. Their common radius is 7 cm. The height of the cylinder and the cone are each of 4 cm. Find the volume of the solid.

(5 marks)

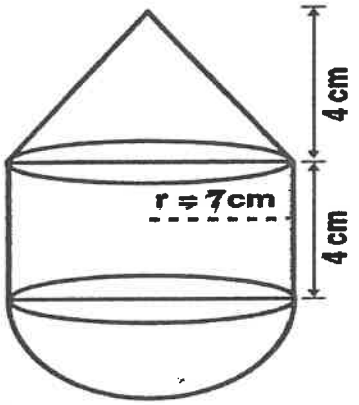

Figure 3: Solid Cylinder, Hemisphere and Cone

(b) Solve the simultaneous equations for:

$$x^2 + y^2 = 9$$
$$x + y = 2$$

Give your answer in THREE (3) significant figures.

(10 marks)

(c) Given that $\log(x^2 + y^2) - \log 3 = \log(x^2 - y^2)$, show that $y^2 = \frac{1}{2}x^2$.

(4 marks)

(d) Determine the value of mn such that $\log_3 m + 3\log_{27} n = 5$.

(6 marks)

Question 4

With reference to Logarithms and Indices, Algebra and Mensuration:

(a) In Figure 4, ABCD is a trapezium of area 27.5 cm^2 where AD and BC are parallel, $\angle DAB = 90°$, AD = 11 cm and BC = 5 cm. If ABE is a quadrant of a circle, find the area of the shaded region. Give the answer correct to THREE (3) decimal places.

(5 marks)

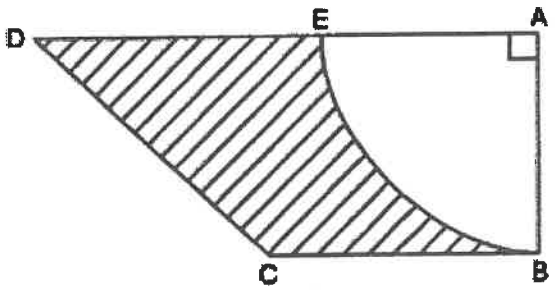

Figure 4: Trapezium

(b) Solve $2p^{-\frac{3}{2}} = 128$.

(5 marks)

(c) Find the value of x if given $\frac{1}{2}x + 3 = \frac{3}{5}x - 1$.

(5 marks)

(d) The function k is defined as $k(x) = mx + n$ where m and n are constants. If $k(6) = -1$ and $k(8) = 0$, determine the values of m and n.

(6 marks)

(e) Given $g(x) = \frac{x}{x+3} + \frac{3(2x+1)}{(x-2)(x+3)}$ where $x > 3$. By simplifying the given equation, prove that $g(x) = \frac{x+1}{x-2}$.

(4 marks)

Question 5

With reference to Logarithms and Indices, Algebra and Mensuration:

(a) Figure 5 shows an equilateral triangle ABC with sides of length 6 cm. P is the midpoint of AB. Q is the midpoint of AC and APQ is a sector of a circle with centre A. Calculate the area of the shaded region. Give your answer in TWO (2) decimal places.

(5 marks)

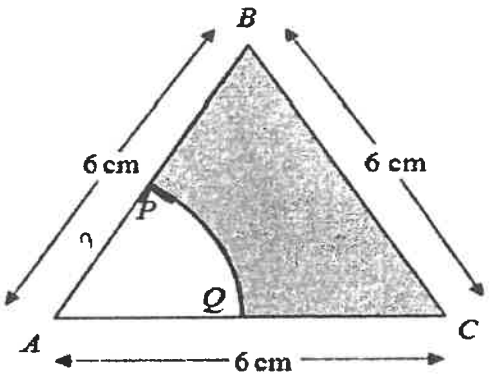

Figure 5: Rectangle ABCD and Circle

(b) Simplify

i. $\dfrac{13ab^4c^{-2}}{(26a^{-2}c^7)^3}$.

(5 marks)

ii. $log_5 25^x$.

(5 marks)

(c) Determine the quotient and remainder when $2x^2-5x-1$ is divided by $x-3$. Then, show that $x-2$ is a factor of $f(x)=x^5-2x^4+3x^3-6x^2-4x+8$.

(10 marks)

Question 6

With reference to Logarithms and Indices, Algebra and Mensuration:

(a) A cuboid with length 45 cm, width 20 cm and height 35 cm is completely filled with water. The water is then poured into a larger cuboid with length 100 cm and width 15 cm. Calculate the height of the water in the larger cuboid in meter.

(5 marks)

(b) Given that $log_p x = M$ and $log_p y = N$. Express the following logarithm in terms of M and N.

i. $log_p x^2 y$.

(2 marks)

ii. $log_p \left(\frac{xp}{y^2} \right)$.

(3 marks)

(c) Find h for $2^h \cdot 4^{h-3} = 8$.

(5 marks)

(d) A caterpillar is walking up a 500-meter-high hill. The trail has an incline of 12 degrees, as shown in Figure 6.

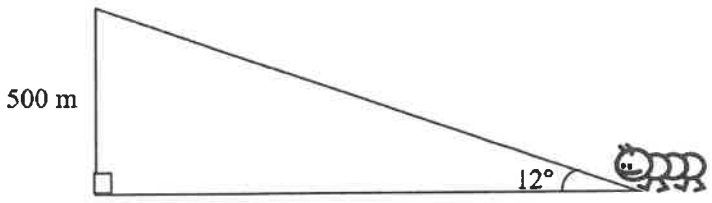

Figure 6: Walking Caterpillar

Determine:

i. how far it will walk to get to the top.

(4 marks)

ii. the area of the hill.

(6 marks)

END OF EXAMINATION PAPER

FORMULA SHEET

ALGEBRA

QUADRATIC & CUBIC FORMULA
$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$
$a^3 + b^3 = (a + b)(a^2 - ab + b^2)$
$a^3 - b^3 = (a - b)(a^2 + ab + b^2)$
HYPERBOLIC FUNCTION
$\sinh x = \frac{e^x - e^{-x}}{2}$
$\cosh x = \frac{e^x + e^{-x}}{2}$

COMPLEX NUMBER

POWER OF *i*
$i = \sqrt{-1}$ $i^2 = -1$ $i^3 = -i$ $i^4 = 1$
ALGEBRAIC FORM
$Z = a + bi$
TRIGONOMETRIC FORM
$Z = r(\cos\theta + i\sin\theta)$
POLAR FORM
$Z = r\angle\theta$
EXPONENTIAL FORM
$Z = re^{i\theta}$

SERIES

ARITHMETIC SERIES
$T_n = a + (n-1)d$ $S_n = \frac{n}{2}(2a + (n-1)d)$
GEOMETRIC SERIES
$T_n = ar^{n-1}$ $S_n = \frac{a(1-r^n)}{1-r}$ $S_\infty = \frac{a}{1-r}, \lvert r \rvert < 1$

TRIGONOMETRY 1

LAW OF SINE	LAW OF COSINE
$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$	$a^2 = b^2 + c^2 - 2bcCosA$

TRIGONOMETRY IDENTITIES

FUNDAMENTAL IDENTITIES	FORMULAS FOR NEGATIVES
$\csc\theta = \frac{1}{\sin\theta}$	$\sin(-\theta) = -\sin\theta$
$\sec\theta = \frac{1}{\cos\theta}$	$\cos(-\theta) = \cos\theta$
$\cot\theta = \frac{1}{\tan\theta} = \frac{\cos\theta}{\sin\theta}$	$\tan(-\theta) = -\tan\theta$
$\sin^2\theta + \cos^2\theta = 1$	$\csc(-\theta) = -\csc\theta$
$1 + \cot^2\theta = \csc^2\theta$	$\sec(-\theta) = \sec\theta$
$1 + \tan^2\theta = \sec^2\theta$	$\cot(-\theta) = -\cot\theta$
$\cos^2\theta = \frac{1}{2}(1 + \cos 2\theta)$	$\sin^2\theta = \frac{1}{2}(1 - \cos 2\theta)$

ADDITION FORMULAS	SUBTRACTION FORMULAS
$\sin(A+B) = \sin A\cos B + \cos A\sin B$	$\sin(A-B) = \sin A\cos B - \cos A\sin B$
$\cos(A+B) = \cos A\cos B - \sin A\sin B$	$\cos(A-B) = \cos A\cos B + \sin A\sin B$
$\tan(A+B) = \frac{\tan A + \tan B}{1 - \tan A\tan B}$	$\tan(A-B) = \frac{\tan A - \tan B}{1 + \tan A\tan B}$

HALF-ANGLE FORMULAS	DOUBLE-ANGLE FORMULAS
$\sin\frac{\theta}{2} = \pm\sqrt{\frac{1-\cos\theta}{2}}$	$\sin 2\theta = 2\sin\theta\cos\theta$
$\cos\frac{\theta}{2} = \pm\sqrt{\frac{1+\cos\theta}{2}}$	$\cos 2\theta = \cos^2\theta - \sin^2\theta$ $\ldots\ldots = 1 - 2\sin^2\theta$ $\ldots\ldots = 2\cos^2\theta - 1$
$\tan\frac{\theta}{2} = \pm\sqrt{\frac{1-\cos\theta}{1+\cos\theta}} = \frac{1-\cos\theta}{\sin\theta} = \frac{\sin\theta}{1+\cos\theta}$	$\tan 2\theta = \frac{2\tan\theta}{1-\tan^2\theta}$

PRODUCT-TO-SUM FORMULAS	SUM-TO-PRODUCT FORMULAS
$\sin\alpha\cos\beta = \frac{1}{2}[\sin(\alpha+\beta) + \sin(\alpha-\beta)]$	$\sin\alpha + \sin\beta = 2\sin\frac{\alpha+\beta}{2}\cos\frac{\alpha-\beta}{2}$
$\sin\alpha\sin\beta = \frac{1}{2}[\cos(\alpha-\beta) - \cos(\alpha+\beta)]$	$\sin\alpha - \sin\beta = 2\cos\frac{\alpha+\beta}{2}\sin\frac{\alpha-\beta}{2}$
$\cos\alpha\sin\beta = \frac{1}{2}[\sin(\alpha+\beta) - \sin(\alpha-\beta)]$	$\cos\alpha + \cos\beta = 2\cos\frac{\alpha+\beta}{2}\cos\frac{\alpha-\beta}{2}$
$\cos\alpha\cos\beta = \frac{1}{2}[\cos(\alpha+\beta) + \cos(\alpha-\beta)]$	$\cos\alpha - \cos\beta = -2\sin\frac{\alpha+\beta}{2}\sin\frac{\alpha-\beta}{2}$