



ZIMBABWE

**MINISTRY OF HIGHER AND TERTIARY EDUCATION,
INNOVATION, SCIENCE AND TECHNOLOGY
DEVELOPMENT**

**HIGHER EDUCATION EXAMINATIONS COUNCIL
(HEXCO)**

NATIONAL CERTIFICATE

IN

MECHANICAL ENGINEERING

SUBJECT: Engineering Mathematics
MODULE: Applied Engineering Science
And Calculations
MODULE: Applied Engineering Mathematics

PAPER NO: 340/18/S02
340/22/M02A
340/24/M02

DURATION: 3 Hours

NOVEMBER/ DECEMBER 2025 EXAMINATION

REQUIREMENTS

Graph Paper, Answer Booklet, Scientific Calculator

INSTRUCTIONS TO CANDIDATES

1. Question one (1) is compulsory (40 marks).
2. Answer any four (4) questions from Section B (15 marks each).
3. Start each question from Section B on a fresh page.
4. Show all relevant working.
5. Do not write your name inside or outside the answer booklet or graph paper.
6. Do not write anything on the question paper.

This paper consists of 4 printed pages.

PAPER NO: 340/18/S02 & 340/22/M02A & 340/24/M02: ENGINEERING
MATHEMATICS & APPLIED ENGINEERING SCIENCE AND CALCULATIONS &
ENGINEERING MATHEMATICS

SECTION A

QUESTION 1

- a) Evaluate $\frac{\log 9 - \log 3 + \frac{1}{4} \log 81}{\log 9}$ using the laws of logarithms. (5 marks)
- b) Find the roots of $3x^2 - x - 2 = 0$ using the method of completing the square (5 marks)
- c) Given that $\left(p + \frac{a}{v^2}\right)(v - b) = RT$, make p the subject of the formula. (5 marks)
- d) Given that $\sin B = \frac{20}{29}$, express the following as fractions:
- a) $\cos B$ (3 marks)
- b) $\tan B$ (2 marks)
- e) Show that triangle ABC with vertices at (7;3) (-4;1) and (-3;-2) respectively is isosceles (5 marks)
- f) In a circle with centre O and radius 5cm, AB is a chord of length 8cm. Find the area of the sector AOB. (5 marks)
- g) Differentiate $y = -3x^3$ from first principles. (5 marks)
- h) Evaluate $\int_3^6 (6 - x) \cdot dx$ (5 marks)

SECTION B

QUESTION 2

- a) The cross sections of two containers are circular. The two circles have diameters which differ by 2cm. If the sum of the areas of the two (2) circles is 146cm^2 , calculate the two radii. (9 marks)
- b) F is connected to L by the following formula: $F = aL + b$, where a and b are constants. When F is 5.6, $L=8$ and when F is 4.4, $L=2$
- i) Calculate the values of the constants a and b. (4 marks)
- ii) Find the value of F when L is 6. (2 marks)

QUESTION 3

From the top of a vertical cliff 75.0m high, forming one bank of a river, the angles of depression of the top and bottom of a vertical cliff which forms the opposite bank are 22° and 58° respectively. Determine the height of the second cliff and the width of the river. (15 marks)

QUESTION 4

- a) An alternating current (i) has the following values at equal intervals of 2ms

Time (ms)	0	2	4	6	8	10	12
Current (A)	0	1,7	3,5	5,0	3,7	2,0	0

Estimate the total current over the 12ms period using Simpson's rule. (5 marks)

- b) A square pyramid has a height of 4cm. If a side of the base is 2,4cm, find the total surface area of the pyramid. (10 marks)

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QUESTION 5

A rectangular block of metal with a square base and height h cm has a total surface area of 250cm^2 .

- Show that its volume is given by the equation: $v=62,5b - 0,5b^3$ where b is the length of side of the square cross section of the block. (6 marks)
- Find the dimensions of the block if the volume is to be maximum. (7 marks)
- Hence, find its maximum volume. (2 marks)

(Area of block=Area of 4 sides +ToP +Bottom)
(Volume of block =Base area x Height)

QUESTION 6

Two variables x and y are believed to obey the law of the form $y = ab^x$. Experimental values linking x and y are shown in the table below:

x	0	1.0	1.5	2.5	3.0	3.7
y	10.000	4.732	3.162	1.496	1.000	0.596

- Draw a straight line of $\log y$ against x (Scale: x – axis: 2cm: 1 unit; $\log y$: 8cm: 1 unit) (8 marks)
- Use the graph to find the values of the constants a and b . (5 marks)
- Find the value of y when $x = 1,9$. (2 marks)

QUESTION 7

Sketch the graph of $y = x^3 + 2x^2 - 5x - 6$ between $x = -3$ and $x = 2$ and determine using integration the area enclosed by the curve and the axis. (15 marks)

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