



ZIMBABWE

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

**HIGHER EDUCATION EXAMINATIONS COUNCIL
(HEXCO)**

NATIONAL CERTIFICATE

IN

**MOTOR VEHICLE MECHANICS, AUTOMOBILE ELECTRICS AND
ELECTRONICS, DIESEL PLANT FITTING, MOTOR VEHICLE BODY REPAIRS &
REFINISHING, PRECISION MACHINING, MOTOR CYCLE MECHANICS**

**SUBJECT: Engineering Mathematics PAPER NO: 346/13/S08
346/18/S08**

DURATION: 3 Hours

MARCH/APRIL 2021 EXAMINATION

REQUIREMENTS

1. Scientific calculator
2. Drawing instruments, plain paper, graph paper

INSTRUCTIONS TO CANDIDATE

Section A: Answer all questions (40 marks)

Section B: Answer any five (5) question (60 marks)

This paper consists of 4 printed pages.

SECTION A: Answer all questions 40 marks

QUESTION 1

- a) Approximate the following to 4 decimal and 4 significant figures
1.0033465 (2 marks)
- b) Change 111001011.101011_2 to hexadecimal (2 marks)
- c) Factorise $4x^2 - 25$ (2 marks)
- d) 'Nest' and find the remainder if
 $(3x^3 - 3x + 5) \div (x - 3)$ (4 marks)
- e) Given that $\log 2 = 0.301$ and $\log 3 = 0.477$. Find:
i) $\log 5$ (2 marks)
ii) $\log 0.9$ (2 marks)
- f) Transpose the formula $K = \frac{1}{2}MV^2$ to make V the subject (3 marks)
- g) Find the differential coefficient of $\frac{x^2}{2x^4} + 3x + 5$ (2 marks)
- h) $\int_1^2 (5x^4 - 3)dx$ (3 marks)
- i) Simplify
i) $a^x x^{-x+1}$ (2 marks)
ii) $\frac{a^{3x} a}{a^{2x}}$ (2 marks)
- j) Determine the value of 'a' if $x + 2$ is a factor of $x^3 - ax^2 + 7x + 10$ (3 marks)
- k) Solve simultaneously using a matrix method
 $2x + 5y = -11$
 $3x - 4y = 18$ (5 marks)
- l) Express without logarithms
 $\ln P = \frac{1}{2} \ln(Q + 1) - \ln R + 2$ (3 marks)
- m) Two points A and B have coordinates (4,1) and (7,5) respectively, Find the distance AB (2 marks)

SECTION B

Answer any 5 (five) questions. Each question carries 12 marks (60 marks)

QUESTION 2

- a) A square engine has a bore diameter of 82mm and the connecting rod is 160mm long. Calculate;
- i) The angle of obliquity of the connecting rod when the crank angle is 45° from t.d.c. (4 marks)
- ii) Piston travel when crank angle is at maximum angularity (4 marks)
- b) A flagpole stand on the edge of the top of a building. At a point 200m from the building the angles of elevation of the top and bottom of the pole are 32° and 30° respectively. Calculate the height of the flagpole. (4 marks)

QUESTION 3

- a) Solve simultaneously
 $\log(x + y) = 0; 2\log x = \log(y + 1)$ (6 marks)
- b) Express in terms of $\log_4 x$ and $\log y$ as simply as possible $\log_9 xy$. (6 marks)

QUESTION 4

the determinant
Use method to solve the following set of linear equations

$$\begin{aligned} 3x + 2y + Z &= 2 \\ x - 3y + 2Z &= 1 \\ 2x + y - 3Z &= -9 \end{aligned}$$

(12 marks)

QUESTION 5

The equation (curve) $y = x^4 - 32x + 5$ has a single stationery point, M .

- a) Find $\frac{dy}{dx}$ (2 marks)
- b) Hence find x -coordinate of M (3 marks)
- c) Find $\frac{d}{dx}\left(\frac{dy}{dx}\right)$ (2 marks)
- d) Hence, or otherwise, determine whether M is a maximum or minimum point (3 marks)

- e) Determine whether the curve is increasing or decreasing at the point on the curve where $x = 0$ (2 marks)

QUESTION 6

A triangle has point, A at (7.9), B at (3.5) and C at (5,10). find the equations(s) of the line joining the mid-points of AB and AC. Find the equation of a tangent to the midpoint of AB. (12 marks)

QUESTION 7

- a) Solve for x in the given indicial equation (8 marks)
 $4(3^{2x+1}) - 17(3^x) - 7 = 0$
- b) Find the factors of: (4 marks)
- i) $x^3 - 6x^2 + 11x - 6$ (2 marks)
- ii) $16x^2 + 40xy + 2525y^2$

QUESTION 8

Differentiate from first principles $y = 2x^3 - 2x + 1$ (12 marks)

QUESTION 9

- a) Find the depth in metres of a hemispherical bowl that will hold 12.75kg of water (4 marks)
- b) Evaluate $\int_1^3 \left(2x^3 - \frac{4}{x^2} + 3 \right) dx$ (4 marks)
- c) Find the curve and constant of integration given that $\frac{dy}{dx} = 4x + 3$ and the curve passes through $(2, -3)$ (4 marks)

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