



TECHNICAL UNIVERSITY OF MOMBASA
Faculty of Applied & Health
Sciences

DEPARTMENT OF MATHEMATICS & PHYSICS

DIPLOMA IN MECHANICAL ENGINEERING

AMA 2104: ENGINEERING MATHEMATICS I

SPECIAL/SUPPLEMENTARY EXAMINATION

SERIES: OCTOBER 2013

TIME: 2 HOURS

Instructions to Candidates:

You should have the following for this examination

- *Answer Booklet*
- *Mathematical Tables*
- *Scientific Calculator*

This paper consist of **FIVE** questions in **TWO** sections **A & B**

Answer question **ONE (COMPULSORY)** and any other **TWO** questions

Maximum marks for each part of a question are as shown
This paper consists of **THREE** printed pages

SECTION A (COMPULSORY)

Question One

a) Solve the following equations for the value of x:

$$32x - 9x - \frac{1}{2} = 6$$

(i)

$$16 \log_x 3 = \log_3 x$$

(ii)

(10 marks)

b) The sum of the first ten terms of an arithmetic progression and the 10th term of the progression both are $-\frac{5}{2}$. Determine the 1st term and the common difference of the arithmetic progression.

(6 marks)

c) (i) Prove that:

$$\frac{\sin A + \sin 2A}{1 + \cos A + \cos 2A} = \tan A$$

$$\tan x = \frac{1}{2} \quad \text{and} \quad \tan y = \frac{1}{3}$$

(ii) If $x = 45^\circ$ and where x and y are acute angles show without using tables that $x + y$

(8 marks)

$$\frac{1}{(1.96)^3}$$

d) Use binomial theorem to evaluate correct to three decimal places.

(6 marks)

SECTION B (Answer any TWO questions from this section)

Question Two

a) Evaluate the following without using tables:

$$\frac{12^{\frac{3}{2}} \times 16^{\frac{1}{8}}}{27^{\frac{1}{6}} \times 18^{\frac{1}{2}}}$$

(i)

$$\log_6 81 \times \log_9 216$$

(ii)

(7 marks)

b) (i) Given $p = \log_8 N$ and $q = \log_2 2N$ show that $q = 3p + 1$

$$(ii) \text{ Given } x^3 z = 1, x^2 = y \quad \text{and} \quad z = y^n$$

determine without using tables the value of n **(8 marks)**

- c) (i) Given $\log_{10} 2 = 0.3010$ and $\log_{10} 2.5$ determine without using tables
- (ii) If $\log_{10} 2 = p$ and $q = \log_{10} 3$, express $\log_{10} \sqrt{\frac{3}{5}}$ in terms of p and q **(5 marks)**

Question Three

- a) (i) If $\tan x = \cos x$, show that $\sin x = \frac{-1 + \sqrt{5}}{2}$
- (ii) Given $\cos 40^\circ = 0.7760$ and $\cos 20^\circ$, evaluate $\cos 20^\circ$ without using tables. **(8 marks)**
- b) If $\tan A = 2$ and $\tan B = 7$, determine $\tan(2A - B)$ without using tables. **(5 marks)**
- c) If $5 \cos \theta + 12 \sin \theta = A \sin(\theta + x)$ determine the values of A and x hence solve the equation $5 \cos \theta + 12 \sin \theta = 5$ for $0^\circ \leq \theta \leq 360^\circ$ **(7 marks)**

Question Four

- a) Solve for x in the following equation:
- (i) $x^{\frac{2}{3}} - 5x^{\frac{1}{3}} + 6 = 0$
- (ii) $10^{2x} + 10x = 20$ **(10 marks)**
- b) A geometric progression has a first term a and a common ratio r.
- (i) Given that the sum of the first n term is 422, show that:
- $$ar^{n-1} = \frac{422(r-1) + a}{r}$$
- (ii) If the first is 32 and the nth term is 162, determine the value of r and n **(10 marks)**

Question Five

- a) The number of diagonals in a regular n-sided polygon is given by $\frac{n^2 - n}{2}$. If a polygon has 65 diagonals, determine the sides on the polygon.
- b) A team of eight students goes on excursions in two cars, of which one can seat five and the other only four. Determine the number of ways they can travel. **(10 marks)**
- c) The second moment of area I_a of a rectangle of breadth b and length l through its centroid is given by $I_a = \frac{bl^3}{12}$. Determine using binomial the percentage change in the second moment of area if b is increased by 3.5% and l is decreased by 2.5%. **(10 marks)**