

TOM MBOYA UNIVERSITY COLLEGE

UNIVERSITY EXAMINATION 2023 / 2024

FIRST YEAR FIRST SEMESTER EXAMINATION FOR THE
DEGREE OF BACHELOR OF EDUCATION AND SCIENCE IN
MATHEMATICS

MMA 100: BASIC MATHEMATICS

Instructions:

- Answer QUESTION ONE (30 marks) and any other TWO questions (20 marks each).
- Proofs should be written carefully.
- Cheating is NOT allowed and will be harshly punished.
- Observe further instructions on the answer booklet.

QUESTION ONE (Compulsory)

[30 Marks]

- (a) Define a set. [2 mks]
- (b) Prove that there exists only one set with no element. [3 mks]
- (c) If $A = \{1, 2, 3, 5, 6, 7\}$ and $B = \{3, 5, 9\}$. Find
- (i) $A - B$ [2 mks]
- (ii) $B - A$ [2 mks]
- (d) Express each of the following as a sum or difference.
- (i) $\sin 40^\circ \cos 30^\circ$ [2 mks]
- (ii) $\cos 110^\circ \sin 55^\circ$ [2 mks]
- (e) Simplify $\cos \theta (\tan \theta - \sec \theta)$. [3 mks]
- (f) Define a complex number. [2 mks]
- (g) If $z_1 = 2 + 4i$ and $z_2 = -3 + 8i$. Find
- (i) $z_1 + z_2$ [2 mks]
- (ii) $z_1 z_2$ [3 mks]
- (h) Distinguish between combination and permutation. [2 mks]
- (i) Consider the word TALLAHASSEE.
- (i) How many distinguishable arrangements of the word are possible? [3 mks]
- (ii) How many of these arrangements have no adjacent As? [2 mks]

QUESTION TWO

[20 Marks]

- (a) Define the following terms. [5 mks]
- (i) Proper subset.
- (ii) Cardinality of a set.
- (iii) Power set.
- (b) Prove that $A \cup (B - A) = A \cup B$ by the Elements Argument method. [5 mks]
- (c) Each of the 100 students in the first year of Open Universitys Computer Science Department studies at least one of the subsidiary subjects: mathematics, electronics and accounting. Given that 65 study mathematics, 45 study electronics, 42 study accounting, 20 study mathematics and electronics, 25 study mathematics and accounting, and 15 study electronics and accounting, find the number who study:

- (i) all three subsidiary subjects; [3 mks]
- (ii) mathematics and electronics but not accounting; [3 mks]
- (iii) only electronics as a subsidiary subject. [4 mks]

QUESTION THREE

[20 Marks]

(a) Simplify

(i) $\sin^2 x \cos^2 x + \cos^4 x$. [2 mks]

(ii) $\frac{\cot(-\theta)}{\csc(-\theta)}$. [3 mks]

(b) Express each of the following as a product.

(i) $\sin 50^\circ + \sin 40^\circ$. [2 mks]

(ii) $\sin 70^\circ - \sin 20^\circ$. [2 mks]

(c) Prove that $\frac{\sin 4A + \sin 2A}{\cos 4A + \cos 2A} = \tan 3A$. [5 mks]

(d) Find the general solution of the equation $12 \sec^2 \theta - 13 \tan \theta - 9 = 0$ [6 mks]

QUESTION FOUR

[20 Marks]

(a) If $z_1 = 2 - 3i$ and $z_2 = 4 + 6i$. Find $\frac{z_1}{z_2}$. [3 mks]

(b) (i) Express $-\sqrt{3} - i$ in polar form. [4 mks]

(ii) Compute z^3 for $z = -\sqrt{3} - i$ [5 mks]

(c) Find the three cube roots of $z = i$. [8 mks]

QUESTION FIVE

[20 Marks]

(a) (i) Define combination. [2 mks]

(ii) A campaign manager must assign 15 campaigners to three matatus: 6 in the first matatu, 5 in the second, and 4 in the third. In how many ways can this be done. [4 mks]

(b) In how many different ways can a quiz be answered under each of the following conditions?

(i) The quiz consists of three multiple-choice questions with four choices for each. [2 mks]

- (ii) The quiz consist of three multiple-choice questions(with four choices for each) and five true-false questions. [2 mks]
- (c) (i) Find the Binomial expansion of $(2x + 3y)^5$. . [5 mks]
- (ii) Find the coefficient of the fifth term.. [2 mks]
- (iii) Use your result to approximate $(2.15)^5$. [3 mks]

END
ALL THE BEST

MMA 100: BASIC MATHEMATICS

Course Instructor: Erick Gori

Course Description

- Sets: Operation on set, Venn diagrams.
- Trigonometric functions; their graphs and inverses, conversions from degrees to radians and vice versa, Addition, multiple angle and sectors formulae, trigonometric identities and equations, sine and cosine rule, standard trigonometric formulae.
- Permutations and combination, Binomial theorem and its geometric representations.
- Complex numbers modulus, arguments, de Moivre's theorem, applications. Roots of complex numbers: Hyperbolic function: properties, graphs.
- Algebra: Surd, logarithms and indices, equations and inequalities, Remainder theorem and its application.
- Series: Arithmetic and geometric series.
- Systems of linear equations.