



UNIVERSITY EXAMINATIONS

FIRST SEMESTER 2025/2026 ACADEMIC YEAR

**FIRST YEAR EXAMINATION FOR THE DEGREES OF
BACHELOR OF EDUCATION (SCIENCE/ARTS), BSC
(STATISTICS), BSC (ECON-STATISTICS)**

MATH 112: BASIC MATHEMATICS

STREAM: R

TIME: 2 HRS

DAY: TUESDAY [8.30 – 10.30 P.M]

DATE: 27/01/2026

THIS QUESTION PAPER CONSISTS OF FOUR (4) PAGES

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INSTRUCTION: ANSWER QUESTION ONE ANY OTHER TWO

QUESTION ONE (30 MARKS)

- a) Distinguish between finite set and infinite set (2 marks)
- b) Calculate the angle θ subtended by the two adjacent wooden spokes of a bullock cart wheel is shown in the figure. Express the angle in both radian and degree. (3 marks)



- c) Simplify each of the following trigonometric expressions
- (i) $\frac{\cot(-\theta)}{\csc(-\theta)}$ (3 marks)
- (ii) $\frac{2\sin^2\theta + \sin(\theta-3)}{1 - \cos^2\theta - \sin\theta}$ (3 marks)
- d) Find the range of $f: R \rightarrow R$ defined by $f(x) = \frac{3x}{x^2+1}$ (4 marks)
- e) Show that an empty set is unique (4 marks)
- f) Given $f(x) = \sqrt{x+2}$ and $g(x) = \sqrt{\ln(1-x^2)}$ find $(g \circ f)(x)$ (3 marks)
- g) 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. (3mks)
- h) Given the set $A = \{2,1,3,5\}$, $B = \{x,t,7,1\}$ and the universal set $U = \{1,2,3,4,5,6,7,8,9,s,t,x,y\}$. Determine
- i. $(A \cup B^c)$ (3 marks)
- ii. $(A \cap B)$ (2 marks)

QUESTION TWO (20 MARKS)

- a) In the year 2011, Fortune Magazine surveyed the presidents of the 500 largest corporations in the United States. Of these 500 people, 310 had degrees (of any sort) in business, 238 had undergraduate degrees in business, and 184 had postgraduate degrees in business.
- (i). How many presidents had both undergraduate and postgraduate degrees in business? (4 marks)
 - (ii). How many presidents had no undergraduate and no postgraduate degree in business? (3 marks)
 - (iii). How many presidents had undergraduate degree in business and no postgraduate degree in business?
 - (iv). How many presidents had at most one degree (2 marks)
- b) Determine the number of ways in which 3 balls can be picked from a basket containing 5 green balls, 2 white balls and 4 yellow balls if
- i. All three have different colours (3 marks)
 - ii. All three are of the same colour (3 marks)
 - iii. Exactly one ball is white (4 marks)

QUESTION THREE (20 MARKS)

- a) Distinguish between a surjective and bijective function (2 marks)
- b) Given the functions $f(x) = x^2 + 2x + 1$
 - i. Show that $f(x + 2) - f(x) = 4x + 8$ (4 marks)
 - ii. Evaluate $(f \circ g)^{-1}(3)$ (4 marks)
- c) Construct a truth table to show that $s \Leftrightarrow t \equiv (s \Rightarrow t) \wedge (t \Rightarrow s)$ (5 marks)
- d) Use binomial theorem to expand and simplify $(1 + x)^6$ and use your results to solve $(1.1)^6$

QUESTION FOUR (20 MARKS)

- a) Prove that $\sqrt{5}$ is an irrational number (4 marks)
- b) Simplify $\frac{(1+i)^6}{(1-i\sqrt{3})^4}$, Use De'Moivres theorem (5 marks)
- c) Let $A = \{1, 2\}$ and $B = \{1, 2, 3, 4\}$, $C = \{5, 6\}$ and $D = \{5, 6, 7, 8\}$. Verify whether $A \times C$ is a subset of $B \times D$? (5mks)
- d) The sequence $a_1, a_2, a_3 \dots$ is defined by $a_1 = 1, a_2 = 2$ and $a_n = 2a_{n-1} - a_{n-2}$ for all $n \geq 3$ prove that $a_n = n$ for all $n \in N$. (6 marks)

QUESTION FIVE (20 MARKS)

- a) Show that
- i) $\frac{\tan\theta + \sec\theta - 1}{\tan\theta - \sec\theta + 1} = \frac{1 + \sin\theta}{\cos\theta}$ (3 marks)
- ii) $\frac{\cos\theta}{1 - \tan\theta} + \frac{\sin\theta}{1 - \cot\theta} = \sin\theta + \cos\theta$ (3 marks)
- b) Prove by mathematical induction that;
- $1 + 2 + 3 + 4 + \dots + n = \frac{n(n+1)}{2}$ (4 marks)
- c) Obtain the coefficient of x^4 in the binomial expansion
- $(x^2 + \frac{1}{x^3})^{12}$ (5 marks)
- d) Express the given fraction in the form $x + iy$, where $x, y \in R$
- $\frac{3i}{2 + \sqrt{-5}}$ (5mks)