

UNIVERSITY EXAMINATIONS

1ST SEMESTER 2022/2023 ACADEMIC YEAR

FIRST YEAR EXAMINATION FOR THE DEGREES OF
BACHELOR OF SCIENCE (BIOMED)/BACHELOR OF
SCIENCE (BIOCHEMISTRY)/BACHELOR OF
EDUCATION(SCIENCE)/BACHELOR OF SCIENCE
(AGED)/BACHELOR OF AGRIBUSINESS
MANAGEMENT

MATH 112: BASIC MATHEMATICS

STREAM: R

TIME: 2 HRS

DAY: WED [14.30 – 16.30]

DATE: 07/12/2022

THIS QUESTION PAPER CONSISTS OF THREE (3) PAGES

PLEASE DO NOT OPEN UNTIL THE INVIGILATOR SAYS SO.

INSTRUCTION: ANSWER QUESTION ONE ANY OTHER TWO**QUESTION ONE (30 MARKS)**

- (a) Given the set $A = \{x : 1 \leq x \leq 18, x \text{ is a multiple of } 3\}$ and $B = \{x : 1 \leq x \leq 18, x \text{ is odd}\}$. Let $X = \{x : 1 \leq x \leq 18, x \in \mathbb{Z}\}$ be the universal set. Determine
- $(A \cup B) \Delta (A \cap B)$ (4 marks)
 - $(A | B') | (B' | A)$ (4 marks)
- (b) Given the complex numbers $z = -2 + 2i$ determine the modulus of
- z^2 (4 marks)
 - $\frac{z}{z}$ (4 marks)
- (c) Investigate whether the given proposition is logically true
- $\sim [c \wedge a] \leftrightarrow [c \rightarrow \sim a]$ (4 marks)
 - Express the following in polar form (use Euler's Identity)
 $z = 2 + 2i\sqrt{3}$ (4 marks)
- (d) With an illustration, distinguish between an injective and surjective Functions. (3 marks)
- (e) Given $f(x) = x^2$ and $g(x) = x + 5$, determine $f \circ g(x)$ (3 marks)

QUESTION TWO (20 MARKS)

- (a) Solve the following equations
- $(n-2)! + (n-3)! = 5!(n-1)$ (3 marks)
 - $z^2 + 1 + i = 0$ (3 marks)
 - $\sin x = \frac{1}{2}$ for $0 \leq x \leq 360$ (3 marks)
- (b) In a class of 50 college freshmen, 30 are studying C^{++} , 25 are studying Java and 10 are studying both languages. by using a venn diagram determine;
- The number of freshmen who are studying either of the computer languages (4 marks)
 - The number of freshmen that are not studying either of the computer languages (3 marks)
- (c) Distinguish between a transitive and a reflexive relations giving an example in each case (4 marks)

QUESTION THREE (20 MARKS)

- (a) Construct a truth table to show that
 $\sim(p \vee q) \equiv (\sim p) \wedge (\sim q)$ (5 marks)



- (b) In a group of 40 students, 22 take algebra, 18 take biology, 14 take chemistry, 9 take algebra and biology, 7 take algebra and chemistry, 5 take biology and chemistry and 2 take all three courses.
- Draw a Venn diagram to represent the given information (3 marks)
 - How many students take at least one of the three courses? (4 marks)
- (c) Solve the following equation $12 \cos^2 \theta + \sin \theta = 11$ in the domain $0^\circ \leq \theta \leq 360^\circ$ (4 marks)
- (d) Given that $f(x) = \frac{1}{1-x}$, $g(x) = 2x-1$ and $h(x) = \frac{1}{2} - x$, evaluate x in the equation $f^{-1}g(x) = h^{-1}(x)$ (4 marks)

QUESTION FOUR(20MARKS)

- (a) Prove that $\sqrt{2}$ is an irrational number (5 marks)
- (b) Solve z in the equation $z^2 - 4z + 5 = 0$ (5 marks)
- (c) A relation is defined on the set of integers such that $xRy \Leftrightarrow (x-y)/3 \in \mathbb{Z}$. Determine whether R is an equivalence relation. (5 marks)
- (d) Obtain the coefficient of x^4 in the binomial expansion $(x^2 + \frac{1}{x^3})^{12}$ (5 marks)

QUESTION FIVE(20MARKS)

- (a) Prove by mathematical induction that;
 $1^2 + 2^2 + 3^2 + \dots + n^2 = \frac{n(n+1)(2n+1)}{6}$ (4 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
- All three have different colours (3 marks)
 - All three are of the same colour (3 marks)
 - Exactly one ball is white (4 marks)
- (c) Express the given fraction in the form $x + iy$, where $x, y \in \mathbb{R}$
 $\frac{i}{1 + \sqrt{-3}}$ (3 marks)
- (d) Calculate the number of all permutations in the letters of the word *mathematics* (3 marks)