

UNIVERSITY EXAMINATIONS

1ST SEMESTER 2022/2023 ACADEMIC YEAR

FIRST YEAR EXAMINATION FOR THE DEGREE OF
BACHELOR OF SCIENCE (ICT)

BICT 112: MATHEMATICS FOR IT

STREAM: R

TIME: 2 HRS

DAY: WED [14.30 – 16.30]

DATE: 07/12/2022

THIS QUESTION PAPER CONSISTS OF FOUR (4) PAGES

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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
- $(A \cup B) \setminus (A \cap B)$ (4 marks)
 - $(A \setminus B') \cup (B' \setminus A)$ (4 marks)
- (b) Solve the following equation
 $(n-2)! + (n-3)! = 5!(n-1)$ (4 marks)
- (c) Investigate whether the given proposition is logically true
- $\sim [c \wedge a] \leftrightarrow [c \rightarrow \sim a]$ (4 marks)
- (d) Three cards are chosen one after the other from a 52 card-deck. Find the number of ways this can be done:
- With replacement. (3 marks)
 - Without replacement (3 marks)
- (e) An algorithm with time complexity $O(f(n))$ and processing time $T(n) = cf(n)$, where $f(n)$ is unknown function of n , spends 10 seconds to process 1000 data items. How much time will be spent to process 100,000 data items if
- $f(n) = n$ (4 marks)
 - $f(n) = (n^3)$ (4 marks)

QUESTION TWO (20 MARKS)

- (a) Perform the following fraction conversions: -
- 1100.101_2 to decimal (3 marks)
 - 75_{10} to binary (3 marks)
- (b) With examples, distinguish between a transitive and a reflexive relation (4 marks)
- (c) Determine the number of ways in which 3 bulbs can be picked from a basket containing 5 green bulbs, 2 white bulbs and 4 yellow bulbs if
- All three have different colours (3 marks)
 - All three are of the same colour (3 marks)
 - Exactly one ball is white (4 marks)



QUESTION THREE(20MARKS)

(a) Evaluate the following limits;

$$(i) \lim_{x \rightarrow 2} 3x^2 - 4x + 7 \quad (3 \text{ marks})$$

$$(ii) \lim_{h \rightarrow 5} \frac{h^2 - 3h - 10}{h - 5} \quad (3 \text{ marks})$$

$$(iii) \lim_{y \rightarrow \infty} \frac{4y^3 - 3y^2 + 5y - 9}{5y^3 + 2y^2 - 6y + 3} \quad (4 \text{ marks})$$

(b) Construct a truth table to show that

$$\sim(p \vee q) \equiv (\sim p) \wedge (\sim q) \quad (5 \text{ marks})$$

(c) 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 don't take any of the three courses? (2 marks)

QUESTION FOUR(20MARKS)

(a) Define limit (2 marks)

(b) Given $f(x) = ax^2 + bx + c$, where a, b and c are constants, show that derivative of $f(x) = 2ax + b$ (use first principle method of differentiation) (5 marks)

(c) Given the equation of a curve $y = x^2$, find

- The equation of tangent (4 marks)
- The equation of normal at the point (1,1) (4 marks)

(d) 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)

QUESTION FIVE(20 MARKS)

(a) Prove by mathematical induction that;

$$1^2 + 2^2 + 3^2 + \dots + n^2 = \frac{n(n+1)(2n+1)}{6} \quad (5 \text{ marks})$$

(b) Given the functions f and g differentiable at x show that derivative of

$$f(x)g(x) = f(x)'g(x) + f(x)g'(x)$$

(5 marks)

- (c) The statement below shows some features of Big-O notation for the function $f = f(n)$ and $g = g(n)$. Determine whether each statement is True or False and correct the formula in the latter case.

statement	True or False	If false ,write the correct formula
Rule of sum $O(f + g) = O(f) + O(g)$		
Product rule $O(f.g) = O(f).O(g)$		
Transitivity rule If $g = O(f)$ and $h = O(f)$ then $g = O(h)$		

(6 marks)

- (d) Calculate the number of all permutations in the letters of the word *statistics*

(4 marks)