



MACHAKOS UNIVERSITY

University Examinations for 2022/2023 Academic Year

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF MATHEMATICS AND STATISTICS

FIRST YEAR FIRST SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (AGRICULTURAL EDUCATION AND EXTENSION)

KCU 101: FUNDAMENTALS OF MATHEMATICS

DATE:

TIME:

INSTRUCTIONS TO CANDIDATES.

1. This paper consists of **Five** questions.
2. Answer **Question 1** and any other **Two** questions.
3. You **must** have a scientific calculator for this paper.

QUESTION ONE (COMPULSORY) (30 MARKS)

- a) Simplify the following algebraic expression.

$$\frac{\frac{x}{y} + 1}{1 - \frac{y}{x}}$$

(3 marks)

- b) Define a linear equation

(1 mark)

- c) State whether the following equations are linear

i. $4x - 5 = 3$

(1 mark)

ii. $\frac{3}{x} - 2x = 1$

(1 mark)

- d) Solve the following quadratic equation $\frac{1}{3}x^2 - 2x + 4 = 0$

(3 marks)

- e) Find the values of x which satisfy the following inequalities.

i. $3x < 9x + 4$.

(2 marks)

ii. $x^2 \leq 5x - 6$.

(2 marks)

iii. $|x - 5| < 2$.

(1 mark)

- f) Solve the following system of linear equations using Gaussian elimination method.
 $x - 2y + 3z = 1$
 $x + 2y - z = 13$
 $3x + 2y - 5z = 3$ (4 marks)

- g) Evaluate the following integral $\int \frac{dx}{(4x+1)^4}$ (3 marks)

- h) Find the derivative of the following $f(x) = (2x - 1)^{10}$ (2 marks)

- i) Solve the following equation $e^{2x} - e^x - 6 = 0$ (3 marks)

- j) The table below shows the masses of 60 first year students in a class.

Mass (Kg)	90-99	100-109	110-119	120-129	130-139	140-149	150-159
Number of students	2	6	17	16	12	6	1

- i. State the modal class (1 mark)
 ii. Calculate the median mass (3 marks)

QUESTION TWO (20 MARKS)

- a) Students in Machakos University posted the following grades after their continuous assessment test; 34.61, 34.57, 34.40, 34.63, 34.63, 34.51, 34.49, 34.61, 34.52, 34.55, 34.58, 34.53, 34.44, 34.48 and 34.40.
 i. Calculate the mean mark (2 marks)
 ii. Calculate the standard deviation (4 marks)
- b) A car rental company charges 30dollars a day and 15cents a mile for renting a car. Helen rents a car for two days, and her bill comes to 108 dollars. How many miles did she drive? (4 marks)
- c) A carnival has two plans for tickets:
 Plan A:5 dollars as entrance fee and 25 cents for each ride.
 Plan B:2 dollars as entrance fee and 50cents for each ride.
 How many rides would you have to take for Plan A to be less expensive than Plan B? (6 marks)
- d) Find an equation of the line through the point (5,2) that is parallel to the line $4x+6y+5=0$. (4 marks)

QUESTION THREE (20 MARKS)

- a) With the help of exponents, simplify the following algebraic expressions:
 i. $(2a^3b^4)^{\frac{3}{2}}$ (3 marks)

ii. $3\sqrt{X^4}$ (2 marks)

iii. $\left(\frac{2X^{3/4}}{y^{1/3}}\right)^3 \left(\frac{y^4}{X^{-1/2}}\right)$ (4 marks)

b) Evaluate the following definite integrals.

i. $\int_2^3 (2x - 1)^3 dx$ (3 marks)

ii. $\int_0^1 \frac{dx}{(3x+1)^4}$ (4 marks)

c) If the profit in thousands of dollars, based on both cost and potential sales for manufacturing military helicopters is given by the formula $p(n) = 360 + 17n - 3n^2$. Find the number of helicopters that maximize the profit by completing the square. (4 marks)

QUESTION FOUR (20 MARKS)

- a) Under ideal conditions a certain bacteria population doubles every three hours. Initially there are 1000 bacteria in a colony.
- Find a model for the bacteria population after t hours. (3 marks)
 - How many bacteria are in the colony after 15 hours? (5 marks)
 - After how many hours will the bacteria count reach 100,000? (7 marks)
- b) Find an equation of the line through the point (5,2) that is parallel to the line $4x+6y+5=0$. (5 marks)

QUESTION FIVE (20 MARKS)

- a) A factory produces two agricultural pesticides, A and B. For every barrel of pesticide A, the factory emits 0:25 kg of carbon monoxide (CO) and 0:60 kg of sulfur dioxide (SO₂). For every barrel of pesticide B, the factory emits 0:50 kg of CO and 0:20 kg of SO₂. Pollution laws restrict the factory's output of CO to a maximum of 75 kg per day and its output of SO₂ to a maximum of 90 kg per day.
- Find a system of inequalities that describes the number of barrels of each pesticide the factory can produce per day and still satisfy the pollution laws. Graph the feasible region. (8 marks)
 - Would it be legal for the factory to produce 100 barrels of pesticide A and 80 barrels of pesticide B per day? (2 marks)
 - Would it be legal for the factory to produce 60 barrels of pesticide A and 160 barrels of pesticide B per day? (2 marks)

b) Solve the following equations and state how many solutions they have.

i. $\frac{3}{x} - \frac{2}{x-3} = -\frac{12}{x^2-9}$ (4 marks)

ii. $2x = 1 - \sqrt{2-x}$ (4 marks)

