



MACHAKOS UNIVERSITY

University Examinations for 2021/2022

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: 28/1/2022

TIME: 8:30 – 10:30 AM

INSTRUCTIONS: Answer any **THREE** questions

Answer Question ONE and any other TWO questions.

QUESTION ONE (COMPULSORY) (30 MARKS)

- a) Evaluate $\frac{9^{\frac{1}{3}} \times 27^{\frac{-1}{2}}}{3^{\frac{-1}{6}} \times 3^{\frac{-2}{3}}}$ (3 marks)
- b) Rationalize the denominator of $\frac{3-\sqrt{5}}{1+3\sqrt{5}}$ (3 marks)
- c) Solve the equation $\log_2 1 + \log_4 \frac{1}{2} = \log_9 x$ (4 marks)
- d) Find the range of values of k for which the equation $x^2 - kx + (k + 3) = 0$ has real roots. (5 marks)
- e) Compute the inverse of the following matrix $A = \begin{pmatrix} 4 & 0 & 1 \\ 2 & 2 & 0 \\ 3 & 1 & 1 \end{pmatrix}$ (5 marks)
- f) (i) Solve for τ and μ given that $\tau(3,4) + \mu(1,-1) = (1,2)$ (3 marks)
(ii) Find the cross product of $(i + 2j + k) \times (j + 3k)$ (3 marks)
- g) Work out the derivative of $y = \frac{7x-2}{4x^2+4}$ (4 marks)

QUESTION TWO (20 MARKS)

- a) Differentiate with respect to x the following functions;
(i) $f(x) = (1 - 5x^2)(6x^2 - 4x + 1)$ (3 marks)
(ii) $y = (3x + 4)^4$ (3 marks)
(iii) $g(x) = \frac{2x^2+1}{x^2-1}$ (4 marks)
- b) Find the turning points and the point of inflection on the curve
 $y = x^5 - 5x^4 + 5x^3 - 1$ (10 marks)

QUESTION THREE (20 MARKS)

- a) Evaluate
- (i) $\int_1^3 (3x^2 + 3)dx$ (4 marks)
- (ii) $\int xe^x dx$ (4 marks)
- b) Find the following integral by making the substitution suggested.
- $\int 2x\sqrt{1+x^2}dx, u = 1+x^2$ (4 marks)
- c) Calculate the area bounded by the parabola $y = 6 - x - x^2$ and the x-axis (8 marks)

QUESTION FOUR (20 MARKS)

- a) Solve the following systems of equations using Cramer's rule
- $$\begin{aligned} -2x_1 + 3x_2 - x_3 &= 1, \\ x_1 + 2x_2 - x_3 &= 4, \\ -2x_1 - x_2 + x_3 &= -3 \end{aligned}$$
- (10 marks)
- b) Determine the values of x for which the determinant of A is zero
- $$A = \begin{pmatrix} x-2 & 4 & 3 \\ 1 & x+1 & -2 \\ 0 & 0 & x-4 \end{pmatrix}$$
- (5 marks)
- c) Work out the following
- (i) $3A + 4B - 2C$, given that $A = \begin{pmatrix} 2 & -5 & 1 \\ 3 & 0 & -4 \end{pmatrix}$, $B = \begin{pmatrix} 1 & -2 & -3 \\ 0 & -1 & 5 \end{pmatrix}$ and
- $$C = \begin{pmatrix} 0 & 1 & -2 \\ 1 & -1 & -1 \end{pmatrix}$$
- (3 marks)
- (ii) AB , given that $A = \begin{pmatrix} 2 & -1 \\ 1 & 0 \\ -3 & 4 \end{pmatrix}$ and $B = \begin{pmatrix} 1 & -2 & -5 \\ 3 & 4 & 0 \end{pmatrix}$ (2 marks)

QUESTION FIVE (20 MARKS)

- a) If $p = 2i + j - k$ and $q = i - 3j + 2k$ determine
- (i) $p \cdot q$ (2 marks)
- (ii) $|p| + |q|$ (3 marks)
- b) Find the moment and magnitude of the moment of a force of $(i + 2j - 3k)$ newton about point B having coordinates $(0,1,1)$ when the forces acts on a line through A whose coordinates are $(1,3,4)$ (10 marks)
- c) Graph the feasible region described by the following inequalities
- $$0 \leq x \leq 400, 0 \leq y \leq 300, x + y \leq 600$$
- (5 marks)