



MACHAKOS UNIVERSITY

University Examinations 2020/2021 Academic Year

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF MATHEMATICS AND STATISTICS

FIRST YEAR SPECIAL/SUPPLEMENTARY EXAMINATION FOR

BACHELOR OF SCIENCE (AGRICULTURAL EDUCATION AND EXTENSION)

ENS 137: MATHEMATICS FOR ENVIRONMENT

DATE: 9/8/2021

TIME: 11.00-1.00 PM

INSTRUCTIONS:

Answer Question One and Any Other Two Questions

QUESTION ONE 30 MARKS (COMPULSORY)

- a) Find the median of 7,3,2,9,8,5,1,4,6. (2 marks)
- b) Find the inner product and the lengths of $\vec{a} = [1,2,3]$ and $\vec{a} = [0,-2,1]$ as well as the angle between them. (3 marks)

- c) Find the functions of which the following are the derived functions

$$\frac{5}{x^2} - \frac{6}{x^3} + \frac{6}{x^4} \quad (3 \text{ marks})$$

- d) Solve the following pairs of equations simultaneously

$$6h = 2k + 9$$

$$3h + 4k = 12$$

(4 marks)

- e) A die was cast 55 times and the outcomes recorded in the distribution

No. on die	1	2	3	4	5	6
No. of times shown	5	7	13	15	10	5

Calculate, on average, the number that showed up and the mode.

(5 marks)

- f) Using the remainder theorem to solve the equation $2x^3 - 2x^2 - 7x + 6 = 0$.

(5 marks)

- g) A bird laid a certain number of eggs in a nest, and a collector took away two-thirds of them. The bird laid some more, and another took two-thirds of them. If the bird laid 12 eggs altogether and collectors took 10 altogether, how many eggs were laid to begin with?

(8 marks)

QUESTION TWO (20 MARKS)

- a) Find the components and the length of the vector $\vec{a}$ with initial point $P(6, 2, -1)$ and terminal point $Q(7, -1, 2)$ (2 marks)
- b) The velocity of a moving particle after t seconds is $v \text{ ms}^{-1}$, where $v = 30 - t^2$. find the acceleration of the particle after 1 second. (3 marks)
- c) The number of faults occurring on a production line in a nine-week period are as shown below. Determine the median and quartile values for the data: 30 27 25 24 27 37 31 27 35 (5 marks)
- d) Find the term that must be added to the expressions to make it perfect square $t^2 + 16t$ (5 marks)
- e) Explain why $\int x^n$ is not possible for $n = -1$. (5 marks)

QUESTION THREE (20 MARKS)

- a) In a single toss of two dice, calculate the probability that the numbers that show up
- Give a total of 3 (2 marks)
 - Give a total of 10 (2 marks)
 - Are the same (2 marks)
- b) Calculate the gradient of the curve $y = x^3 - 5x + 3$ at the point $x = 3$ (3 marks)
- c) If $\log_b M = 3$ and $\log_b P = 4$, determine $\log_b \frac{M^{1/3} P^{1/4}}{\sqrt{(M^2 P^3)}}$ (5 marks)

- d) The probability of a component failing in one year due to excessive temperature is $\frac{1}{20}$, due to excessive vibration is $\frac{1}{25}$ and due to excessive humidity is $\frac{1}{50}$. Determine the probabilities that during a one-year period a component:
- Fails due to excessive vibration
 - Fails due to excessive vibration or excessive humidity, and
 - Will not fail because of both excessive temperature and excessive humidity.
- (6 marks)

QUESTION FOUR (20 MARKS)

- a) In a single toss of a fair die calculate the probability that what show up is
- An even number (2 marks)
 - At least 5 (2 marks)
 - At most 4 (2 marks)
- b) Find the functions of which the following are the derived functions.
- $$\frac{5}{x^2} - \frac{6}{x^3} - \frac{6}{x^4}$$
- (4 marks)
- c) A rectangle is 3 times as long as it is wide, and its perimeter is 56cm. find its length and width (5 marks)
- d) If $x = \log_9 5$ and $y = \log_3 5$ find y in terms of x (5 marks)

QUESTION FIVE (20 MARKS)

- a) Find the differential coefficient of the following functions with respect to x
- $$-y = 2x^3 - 3x^2$$
- (3 marks)
- b) The velocity of a moving particle after t seconds is $v \text{ ms}^{-1}$, where $v = 30 - t^2$. Find the acceleration of the particle after 2 second. (4 marks)

- c) The gradient of a curve at any point is $5 - 6x$. Find the equation of the curve if it passes through the point $(1, 2)$ (5 marks)
- d) Use the factor theorem to factorize $x^3 + 4x^2 + x - 6$ and hence solve the cubic equation $x^3 + 4x^2 + x - 6 = 0$. (8 marks)