



TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF APPLIED AND HEALTH SCIENCES

DEPARTMENT OF MATHEMATICS AND PHYSICS

UNIVERSITY EXAMINATION FOR:

**BACHELOR OF SCIENCE IN INDUSTRIAL MICROBIOLOGY
& TECHNOLOGY**

AMA 4216: MATHEMATICS FOR BIOLOGISTS PAPER 11

END OF SEMESTER EXAMINATION

SERIES: FIRST SEMESTER YEAR ONE

TIME: 2 HOURS

DATE: APRIL 2016

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of FIVE questions. Attempt **QUESTION ONE** and any other TWO.

Do not write on the question paper.

QUESTION ONE (30 MARKS)

a) Differentiate from first principles, $f(x) = 4x^2 + 1$ (4marks)

b) Differentiate the following with respect to x:

(i) $y = (4 + x)(x - 1)$ (2 marks)

(ii) $y = 2 \cos 3t$ (3 marks)

(iii) $y = \frac{2x}{x^2 + 1}$ (3 marks)

c) Evaluate $\int \frac{2}{3e^{4t}} dx$ (3marks)

- d) A product is sold in packets whose masses are normally distributed with a mean of 1.42kg and a standard deviation of 0.025kg.
- (i) Find the probability that the mass of a packet selected at random lies between 1.37 and 1.45 kg. (5 marks)
- (ii) Estimate the number of packets in an output of 5000, whose mass is less than 1.35 kg. (4 marks)

- d) When medicine is administered, reaction (measured in change of blood pressure or temperature) can be modelled by

$$R = m^2 \left(\frac{c}{2} - \frac{m}{3} \right)$$

where c is a positive constant and m is the amount of medicine absorbed into the blood. The sensitivity to the medication is defined to be the rate of change of reaction R with respect to the amount of medicine absorbed in the blood.

- (i) Find the sensitivity (2marks)
- (ii) Find the instantaneous rate of change of sensitivity with respect to the amount of medicine absorbed in the blood. (1mark)
- (iii) Which order derivative of reaction gives the rate of change of sensitivity? (1mark)

QUESTION TWO (20 MARKS)

- a) Determine the equation of the tangent to the curve $y = 3x^2 + 2$, at the point $x = (4, 2)$. (4 marks)
- b) Determine the relative maxima and minima of the function; $y = x^3 - 3x + 5$ by determining the sign of the second derivative. (7marks)
- c) Find dy/dx implicitly if $3x^2 + y^2 - 5x + y = 2$ (6 marks)
- d) Given $x = 5\theta - 1$ and $y = 2\theta - 1$, determine dy/dx in terms of θ (3 marks)

QUESTION THREE (20MARKS)

- a) Evaluate the following integrals;
- (i) $\int \frac{(1+n)^2}{\sqrt{n}} dn$ (4 marks)
- (ii) $\int_1^9 \sqrt{x} + \frac{1}{\sqrt{x}}$ (5 marks)
- (iii) $\int x\sqrt{1-x} dx$ (5 marks)
- b) Calculate an approximate value for $\sqrt{16.2}$ (6 marks)

QUESTION FOUR (20 MARKS)

- a) A batch of 1500 lemonade bottles has an average content of 753ml and the standard deviation of the contents is 1.8ml. if the volumes of the contents are normally distributed , find
- (i) probability of a bottle likely to contain less than 750 ml (3 marks)
 - (ii) number of bottles likely to contain between 751 and 754 ml (4marks)
 - (iii) number of bottles likely to contain more than 757ml (4 marks)
 - (iv) probability of a bottle likely to contain between 750 and 757 ml (3 marks)
- b) A consumer products company is formulating a new shampoo and is interested in foam height (in ml). Foam height is approximately normally distributed and has a standard deviation of 20ml. the company wishes to test;

$$H_0 : \mu = 175ml \text{ Vs}$$

$$H_1 : \mu > 175ml$$

Using $n=10$ and $\bar{x}=190ml$ and at 5% level of significance.

What conclusions would you reach?

(6marks)

QUESTION FIVE (20 MARKS)

- a) Find the equation of the normal to the curve $y = 3x^2 - x + 1$ at $x=1$. (5 marks)
- b) Given $y = 2xe^{-3x}$ show that $\frac{d^2y}{dx^2} + 6\frac{dy}{dx} + 9y = 0$ (7 marks)
- c) A bacteria population is growing at a rate equal to 10% of its population each day. Its initial size is 10,000 organisms. How many bacteria are present after 10 days and after 30 days. (8 marks)