THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

(A Constituent College of JKUAT)

(A Centre of Excellence)

Faculty of Applied & Health Sciences

DEPARTMENT OF MATHEMATICS & PHYSICS

UNIVERSITY EXAMINATION FOR:

BACHELOR OF TECHNOLOGY IN MICROBIOLOGY & BIOTECHNOLOGY

(BTMB)

SMA 2250: MATHEMATICS FOR BIOLOGISTS

END OF SEMESTER EXAMINATION

SERIES: DECEMBER 2012

TIME: 2 HOURS

Instructions to Candidates:

You should have the following for this examination

- *Answer Booklet*

This paper consist of **FIVE** questions

Answer question **ONE (COMPULSORY)** and any other **TWO** questions

Maximum marks for each part of a question are as shown

This paper consists of **THREE** printed pages

Question One (Compulsory)

a) Evaluate the following limits:

(i) $\lim_{x\to} \frac{2}{3}x^3 + 3x - 3$ **(2 marks)**

(ii) $\lim_{x \to} \frac{x^3 - 27}{x - 3}$ **(3 marks)**

b) Differentiate $y = \cos x$ from first principles. **(4 marks)**

c) By taking $\frac{dy}{dx} \approx \frac{dy}{dx}$ for small charges in x, find an approximation for $\sin 61^o$ correct to 3 decimal places, given that $\sin 60^o = \frac{\sqrt{3}}{2}, \sqrt{3} = 1.732$ and $\cos 60^o = 0.5$ **(4 marks)**

d) Evaluate: $\int_0^{\pi/2} \cos^3 \ x dx$ **(4 marks)**

e) The diameters of bolts manufactured by a company are normally distributed with mean 2.5cm and standard deviation 0.2cm. A bolt is considered defective if its diameter is less than or equal to 2cm, or greater than or equal to 2.8cm. Find the number of defective bolts out of a lot of 400 bolts. **(4 marks)**

f) Differentiate: $y = \ln \left| \frac{x^4}{(3x^2 + 2)^2} \right|$ **(3 marks)**

g) Ali has a 250 metre long barbed wire to fence his rectangular tree nursery. He intends to fit 10 levels of wire altogether. One boundary of the fenced field will be an existing wall and will therefore not need to be fenced.

(i) What will be the length of one level? **(1 mark)**

(ii) What should be the dimensions of the nursery if he must obtain the maximum possible area? **(5 marks)**

Question Two

a) A rectangle page is to contain 24 square centimeters of print. The margins at the top and bottom of the page are each 1.5cm wide. The margins on each side are 1cm. What should the dimensions of the page be so that the least amount of paper is used? **(9 marks)**

b) Calculate the area between curves $y = -1.5x$ and $y = x^2 - 1$ **(6 marks)**

c) Given that $x = \cos^2 \theta$ and $y = \cos^2 \theta$, find $\frac{dy}{dx}$ **(5 marks)**

Question Three

a) Find the probability of getting between 3 and 6 heads inclusive in 10 tosses of a fair coin by using:

(i) The binomial distribution. **(4 marks)**

(ii) The normal approximation to the binomial distributor. **(4 marks)**

b) In Mendel's experiment with peas be observed 315 round yellow, and 32 wrinkled and green. According to his theory of heredity the numbers, the numbers should be in the proportion 9:3:3:1 ls there any evidence to doubt his theory at 0.01 level of significance. **(7 marks)**

c) The mean lifetime of a sample of 100 fluorescent life bulbs produced by a company is computed to be 1570 hours with a standard deviation of 120 hours. If μ is the mean lifetime of all the bulbs produced by the company, test the hypothesis $\mu = 1600$ hours against the alternative hypothesis $\mu \neq 1600$ hours using a level of significance of 0.05. **(5 marks)**

Question Four

a) State the conditions that a continuous function $f(x)$, must satisfy at a point x = a. **(3 marks)**

b) A function $f(x)$ is defined as follows:

$$f(x)\begin{cases} x+1 & if \quad x<1 \\ 2 & if \quad 1<x\leq 3 \\ 1 & if \quad x>3 \end{cases}$$

(i) Sketch the function on the Cartesian plane **(4 marks)**

(ii) Find the following limits where possible:

a) $\lim_{x\to 1} f(x)$

b) $\lim_{x\to 3} f(x)$ **(2 marks)**

c) Evaluate the following limits:

(i) $\lim_{x\to 2} \frac{(3x-4)^{-1}-2^{-1}}{x-2}$ **(4 marks)**

(ii) $\lim_{x\to 0}\left(\frac{1-\cos x}{x^2}\right)$ **(5 marks)**

Question Five

a) Sand is poured onto a horizontal floor at the rate of 4cm^3 per second and forms, a pile in the shape of a cone whose height remains three quarters of the radius throughout. Calculate the rate at which the radius is changing when the radius is 4cm. **(5 marks)**

b) Sketch the curve $y = x^4 - 4x^3 + 4x^2$, indicating clearly the x – intercepts and the critical points. **(6 marks)**

c) Find the equations of the tangent and normal to the curve $x^3 + x^2 y - y^3 + 7 = 0$ at the point (2, 3). **(5 marks)**

d) Differentiate $\tan y = 5^x$ **(4 marks)**