



MACHAKOS UNIVERSITY

University Examinations 2016/2017

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF MATHEMATICS AND STATISTICS

FIRST YEAR SECOND SEMESTER EXAMINATIONS FOR DEGREE IN

BACHELOR OF SCIENCE IN BIOLOGY

SMA 101: MATHEMATICS FOR SCIENCE II

DATE: 31/5/2017

TIME: 2:00 – 4:00 PM

INSTRUCTIONS:

Answer question ONE which is compulsory and any other TWO

SECTION A

QUESTION ONE (COMPULSORY) (30 MARKS)

- (a) Given that $f(x) = x^2 + 1$ and $g(x) = x + 2$ are functions from a set of real numbers to the set of real numbers. Determine $f + g$ and fg . (4 marks)
- (b) State with a reason whether the function $f(x) = 3x + 4$ from set of integers to integers is one to one. (3 marks)
- (c) Determine whether the function $f(x) = x + 1$ from set of integers to integers are onto. (3 marks)
- (d) Show that the functions f and g are inverse of each other by showing that $f(g(x))=x$ where
$$f(x) = x^3 - 8 \text{ and } g(x) = \sqrt[3]{x - 8}$$
 (3 marks)
- (e) Given that $y = 2e^{3x} \cos 4x$, determine $\frac{dy}{dx}$ (5 marks)
- (f) Determine $\int \left(\frac{3x^4 - 2x}{5x}\right) dx$ (4 marks)

(g) Given that $(\theta) = \frac{2\theta^2 - 3\sqrt{\theta^3} + \sqrt[4]{\theta^5}}{\theta}$, evaluate the value of $f^1(\theta)$ when $\theta = 1$ (4 marks)

(i) Determine $\int_0^{\frac{\pi}{2}} 5\sin 2x dx$ (4 marks)

SECTION B: ANSWER QUESTION ONE AND ANY OTHER TWO QUESTIONS

QUESTION TWO (20 MARKS)

(a) Differentiate the following functions

(i) $y = \frac{xe^{2x}}{\sin 2x}$ (5 marks)

(ii) $y = 3 \cot(3x^2 + 1)$ (5 marks)

(b) Given $y = 3x^3 - 2\sqrt{x} + 5\sqrt[3]{x^4}$, determine $\frac{dy}{dx}$ and evaluate when $x=1$ (10 marks)

QUESTION THREE (20 MARKS)

(a) Evaluate $\int_1^4 \left(\frac{t+1}{\sqrt{t}}\right) dt$, taking the positive roots only. (10 marks)

(b) A ball is thrown vertically upwards from the ground level and its height after t seconds is $(15.4t - 4.9t^2)m$. Determine the greatest height it reaches, and time it takes to get there. (10 marks)

QUESTION FOUR (20 MARKS)

(a) An object moves along the y -axis (marked in metres) so that its position at x (in seconds) is $f(x) = x^3 - 6x^2 + 9x$

(i) Determine the instantaneous velocity function V . (2 marks)

(ii) Determine the velocity at $x=2$ and $x=5$ seconds. (4 marks)

(iii) Determine the time(s) when the velocity is 0. (4 marks)

(b) Determine the turning values of y on the graph $y=f(x)$ where

$f(x) = 5 + 24x - 9x^2 - 2x^3$. (10 marks)

QUESTION FIVE (20 MARKS)

(a) Determine the area between the graph of $f(x) = x^2 - 2x$ and the x -axis over the indicated intervals

(i) (1,2) (5 marks)

(ii) (-1,1) (5 marks)

(b) Solve completely the following differential equations:

$2 \frac{dr}{dx} + \sin(2x) = 0$ and $r = 2$ when $x = \frac{\pi}{2}$. (5 marks)

(c) Determine the equation of the curve which passes through the point (1,3) and satisfies the differential equation, $x \left(\frac{dy}{dx} + 1\right) = x^3 - 2y$ (5 marks)