University of Swaziland

Supplementary Examinations 2008

Dip. Env. Health I, Dip. Env. Health IV

Title of Paper : Calculus for Health Sciences
Course Number : HSM115
Time Allowed : Two (2) hours
Instructions :

1. This paper consists of SIX questions.
2. Each question is worth 25%.
3. Answer ANY FOUR questions.
4. Show all your working.

THIS PAPER SHOULD NOT BE OPENED UNTIL PERMISSION HAS BEEN GIVEN BY THE INVIGILATOR.

337

Question 1

(a) Find y' and simplify, given

(i) $y = 6x^{3/2} - 4x^{-1/2} + \pi$ [3 marks]

(ii) $y = 5\ln x - 2e^{-2x}$. [3 marks]

(b) Integrate

(i) $\int_0^2 (3 - 2x + 4x^3)\mathrm{d}x$ [5 marks]

(ii) $\int_1^4 \left(3\sqrt{x} - \frac{2}{x}\right)\mathrm{d}x$ [7 marks]

(iii) $\int \frac{3x}{1+x^2}\mathrm{d}x$. [7 marks]

Question 2

(a) Differentiate

(i) $y = (x+2)(2x-3)$ [3 marks]

(ii) $y = (x-1)e^{-x}$. [6 marks]

(iii) $y = \ln\left(4 + x^2\right)^{-\frac{3}{2}}$ [8 marks]

(b) Evaluate

(i) $\lim_{x\to 1}\left(\frac{1-2x^2}{2x^2 - x + 1}\right)$ [3 marks]

(ii) $\int_0^{45^0} \cos 2x\mathrm{d}x$ [5 marks]

Question 3

(a) The number of harmful bacteria in the bloodstream of a patient is given by

$$C(t) = 4 - 4t + t^2,$$

where t is the number of hours after taking a dose of medication and $C(t)$ is the number of bacteria in millions.

(i) When is the bacteria population increasing? Decreasing? [5 marks]

(ii) When is the bacteria population at a minimum? What is the population at this point? [3 marks]

(iii) Sketch the graph of $C(t)$. [7 marks]

(b) Integrate

$$\int_{-1}^{2} \left(3x^2 - \frac{6}{x^2}\right) \mathrm{d}x. \qquad \text{[10 marks]}$$

Question 4

(a) The population of a city is 50,000 in the year 2000, and increases at the rate

$$P'(t) = 200e^{0.05t},$$

where $P(t)$ is the population t years from the year 2000.

(i) Find the population in the year 2008. [9 marks]

(ii) What is the total change in population between 2005 and 2008? [6 marks]

(b) Differentiate and simplify

$$y = \frac{2x+1}{3x+2}. \qquad \text{[10 marks]}$$

Question 5

(a) Differentiate

$$y = \left(5 + 3x^2\right)^{40}. \qquad \text{[8 marks]}$$

(b) Find the area of the region bounded by the curves $y = x^2$ and $y = 15 - 2x$. [17 marks]

Question 6

(a) Use integration by parts to evaluate

$$\int xe^{2x}\mathrm{d}x. \qquad \text{[8 marks]}$$

(b) Find the indicated derivative

(i) $y = \cos 3x, \quad y''$ [4 marks]

(ii) $y = 2x - \frac{1}{2x}, \quad y'''$ [6 marks]

(iii) $y = 5e^{2x+1}, \quad y^{iv}$ [7 marks]