
University of Swaziland



Final Examination May 2009

Dip. Env. Health I, BSc. 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.

Question 1

(a) Evaluate

(i) $\lim_{t \rightarrow 2} \frac{4 + t^2}{4 - t^2}$ [4 marks]

(ii) $\lim_{x \rightarrow 0} \frac{1 + \cos x - \tan x}{1 - \sin x}$ [3 marks]

(b) Differentiate

(i) $H(v) = \frac{v^4 - 2v^2 + 8}{v^3}$ [4 marks]

(ii) $F(s) = \frac{2s + 3}{3s + 2}$ [7 marks]

(c) Integrate

$$\int x \ln x \, dx. \quad [7 \text{ marks}]$$

Question 2

(a) Differentiate

(i) $h(\xi) = 3\xi^2 - \frac{1}{2\xi^2} + 8$ [3 marks]

(ii) $F(x) = \pi^2 + \ln x^2 - \left(\frac{2}{e^x}\right)^2$ [5 marks]

(b) Use the limit definition to find $f'(x)$ given

$$f(x) = 2 - 3x^2. \quad [8 \text{ marks}]$$

(c) Evaluate

$$\int \frac{3x \, dx}{(x^2 + 3)^2}. \quad [9 \text{ marks}]$$

Question 3

(a) For the function

$$y = x^3 - 27x + 9,$$

find

i. the intervals in which the graph is increasing/decreasing [3 marks]

ii. intervals in which the graph is concave up/down [3 marks]

iii. stationary points and classify them [3 marks]
inflexion points [3 marks]

Hence make a sketch of the graph of y . [5 marks]

(b) Integrate

i. $\int \left(\frac{3}{x} - \frac{3}{x^2} - 6e^{-3x} \right) dx$ [4 marks]

ii. $\int_{-2}^2 t^2 \left(t^2 - \frac{2}{t^4} \right) dt$ [4 marks]

Question 4

(a) Integrate

i. $\int_{-1}^1 (x^2 - 2x + 3\sqrt{x}) dx$ [4 marks]

ii. $\int (3 - 2x)^2 dx$ [4 marks]

(b) A farmer needs to construct a rectangular holding for his livestock. On one of the sides, he needs to use heavy-duty fence which costs E 50 per metre. Regular

fencing, to be used on the other sides costs E 30 per metre. If his budget for the job is E 24,000.00, find the dimensions of the largest holding he can construct.

[17 marks]

Question 5

(a) Find the indicated derivatives:

i. $R(\theta) = \ln(\cos \theta), \quad R'$ [4 marks]

ii. $H(\varphi) = \varphi \cos 2\varphi, \quad H^{iv}$ [8 marks]

(b) Evaluate

$$\lim_{t \rightarrow \infty} \frac{t^2 + t - 6}{20000 - t - 2t^2}.$$

[3 marks]

(c) Find the exact value of the area enclosed by the curves $y = x^2$ and $y = 4 - x^2$. [10 marks]

Question 6

(a) Differentiate and simplify

i. $G(\lambda) = \lambda \cos \lambda - \sin \lambda + 2$ [4 marks]

ii. $y = \frac{e^x}{e^x + e^{-x}}$ [5 marks]

(b) Integrate

$$\int x^2 e^{-2x} dx$$
 [8 marks]

(c) Use partial fractions to integrate

$$\int \frac{dx}{x^2 - 4}.$$

[8 marks]
