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# University of Swaziland



## Final Examination May 2012

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### Diploma in Environmental Health Sciences I

**Title of Paper** : Calculus for Health Sciences

**Course Number** : EHM107

**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.

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**Question 1**

(a) Evaluate

(i)  $\lim_{t \rightarrow 1} \frac{t^2 - 1}{t + 1}$  [4 marks]

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

(b) Differentiate

(i)  $H(v) = \frac{v^5 - 2v^3 + 3}{v^2}$  [4 marks]

(ii)  $F(u) = \frac{u}{u - 1}$  [7 marks]

(c) Integrate

$$\int_1^e \frac{x + 2}{x} dx. \quad [7 \text{ marks}]$$

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**Question 2**

(a) Differentiate

(i)  $H(x) = 3x^3 - \frac{1}{3x^3} - 7$  [4 marks]

(ii)  $F(x) = \ln \pi + \tan x - e^{-2x}$  [4 marks]

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

$$f(x) = 2x - 5x^2. \quad [8 \text{ marks}]$$

(c) Evaluate

$$\int \frac{6x}{\sqrt{x^2 + 2}} dx. \quad [9 \text{ marks}]$$

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**Question 3**

(a) For the function

$$y = x^3 + 3x^2 - 9x + 2,$$

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]
- iv. inflexion points [3 marks]

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

(b) Integrate

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

ii.  $\int_{-2}^2 t \left( t^3 - \frac{2}{t^3} \right) dt$  [4 marks]

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**Question 4**

(a) Integrate

i.  $\int_0^1 (3x^2 - 4x + 6\sqrt{x}) dx$  [4 marks]

ii.  $\int (x + 3)^2 dx$  [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]

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**Question 5**

(a) Find the indicated derivatives:

i.  $R(x) = \ln(x^2 + 1)$ ,  $R'$  [2 marks]

ii.  $H(v) = (v - 1)e^{2v}$ ,  $H'''$  [8 marks]

(b) Evaluate

$$\lim_{x \rightarrow \infty} \frac{2x^2 + 3x - 6}{5 - 4x - x^2}.$$

[5 marks]

(c) Find the area of the region enclosed by the curves

$y = x^2$  and  $y = 2x + 8$ . [10 marks]

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**Question 6**

(a) Differentiate and simplify

i.  $G(\lambda) = \lambda e^\lambda - e^\lambda + 2$  [3 marks]

ii.  $y = \frac{\sin x}{1 + \cos x}$  [6 marks]

(b) Integrate

$$\int x^2 \sin x \, dx$$
 [8 marks]

(c) Use partial fractions to integrate

$$\int \frac{x + 2}{x^2 - x - 6} \, dx.$$

[8 marks]

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