

**UNIVERSITY OF SWAZILAND**  
**Faculty of Health Sciences**  
**DEGREE IN ENVIRONMENTAL HEALTH**  
**MAIN EXAMINATION PAPER 2013**

<b>TITLE OF PAPER</b>	<b>:</b>	<b>CLCULUS FOR HEALTH SCIENCES</b>
<b>COURSE CODE</b>	<b>:</b>	<b>EHM 107</b>
<b>DURATION</b>	<b>:</b>	<b>2 HOURS</b>
<b>MARKS</b>	<b>:</b>	<b>100 MARK</b>
<b>INSTRUCTIONS</b>	<b>:</b>	<b>READ THE QUESTIONS &amp; INSTRUCTIONS CAREFULLY</b>
	<b>:</b>	<b>ANSWER ANY FOUR QUESTIONS</b>
	<b>:</b>	<b>EACH QUESTION CARRIES 25 MARKS</b>
	<b>:</b>	<b>WRITE NEATLY &amp; CLEARLY</b>
	<b>:</b>	<b>NO PAPER SHOULD BE BROUGHT INTO NOR OUT OF THE EXAMINATION ROOM</b>
	<b>:</b>	<b>BEGIN EACH QUESTION ON A SEPARATE SHEET OF PAPER</b>

**DO NOT OPEN THIS QUESTION PAPER UNTIL PERMISSION IS GRANTED BY THE INVIGILATOR**

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**Question 1**

(a) Evaluate

(i)  $\lim_{x \rightarrow 1} \frac{x^2 - x}{x^2 - 1}$  [6 marks]

(ii)  $\lim_{x \rightarrow \infty} \frac{x^2 - x}{x^2 - 1}$  [6 marks]

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

$$f(x) = 2x - x^2. \quad [13 \text{ marks}]$$

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**Question 2**

(a) Differentiate

(i)  $y = 2^{-x}$  [5 marks]

(ii)  $F(x) = (1 + 4x)^{15}$  [5 marks]

(iii)  $H(x) = \ln(\sec x + \tan x)$  [5 marks]

(b) Integrate

$$\int 24x^2 e^{-x} dx \quad [10 \text{ marks}].$$

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**Question 3**

(a) Find  $y'''$  for the function  $y = e^{-2x}$ . [6 marks]

(b) Evaluate find

(i)  $\int \left( 4x + \frac{1}{x} - \frac{6}{x^2} \right) dx$  [3 marks]

(ii)  $\int (1 + e^x - \cos x) dx$  [4 marks]

(iii)  $\int_1^9 \left( 6X^{\frac{1}{2}} - X^{-\frac{1}{2}} \right) dX$  [6 marks]

(iv)  $\int \frac{x}{x+2} dx$  [6 marks]

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**Question 4**

(a) Differentiate

(i)  $y = \ln x - \cos 2x + e^{-4x} - \frac{5}{x^2}$  [4 marks]

(ii)  $y = \frac{x^2}{2+x^2}$  [7 marks]

(b) A bottling company has assigned you to design a *closed* cylindrical container with a capacity of  $16\pi$  cubic centimetres.

(i) Show that its external surface area  $S$  is given by

$$S(r) = 2\pi r^2 + \frac{32\pi}{r}$$

where  $r$  is the radius. [5 marks]

(ii) Find the value of  $r$  for which the surface area is minimum. [7 marks]

- (iii) Hence find the dimensions of the cylinder that utilizes the least amount of material. [2 marks]
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**Question 5**

(a) Evaluate

(i)  $\int (1 - 2x^2)^2 dx$  [4 marks]

(ii)  $\int \frac{12x dx}{\sqrt{4x^2 + 1}}$  [7 marks]

(b) Find the *exact* area of the region enclosed by the curves  $y = x^2 - 2$  and  $y = 2 - x^2$ . [16 marks]

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**Question 6**

(a) Find  $y^{iv}$  for the function  $y = 80\sqrt{x} - \frac{1}{x}$ . [6 marks]

(b) Consider the function

$$f(x) = x^3 - 12x + 2.$$

Locate the stationary points of  $f(x)$  and classify them. [9 marks]

(c) Use partial fractions to evaluate

$$\int \frac{x}{(x+1)(x-2)} dx. \quad [10 marks]$$

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