
University of Eswatini



Resit Examination – 2020/21

BSc in Env. Health I

Title of Paper : Algebra for Health Sciences

Course Number : EHS101

Time Allowed : Two (2) hours

Instructions:

1. This paper consists of 2 sections.
2. Answer ALL questions in Section A.
3. Answer ANY 2 questions in Section B.
4. Show all your working.
5. Begin each question on a new page.

Section A
Answer ALL Questions in this section

A.1 a. Without using a calculator, showing ALL your steps, find the value of

$$\frac{\log 45 - \log 5}{\log 3}. \quad [4 \text{ marks}]$$

b. Consider the straight line segment from $A(-2, 3)$ to $B(4, -5)$.

i. Find the coordinates of the midpoint of AB [2 marks]

ii. Find the equation of the perpendicular bisector of AB [6 marks]

c. Given the matrices

$$A = \begin{pmatrix} 2 & -3 & 1 \\ 1 & 5 & 0 \\ -4 & 1 & 3 \end{pmatrix}, \quad B = \begin{pmatrix} 3 & 0 \\ -1 & 2 \\ 4 & 1 \end{pmatrix},$$

evaluate

i. $2A^T + 4B$

ii. $B^T A$

iii. $|A|$

[12 marks]

d. Find the value of the sum

$$\sum_{n=0}^{200} (7n + 2). \quad [6 \text{ marks}]$$

e. Use *synthetic division* to find the quotient and remainder of

$$\frac{x^2 - x^3 + 3x + 7}{x - 3}. \quad [6 \text{ marks}]$$

g. Solve for x given

i. $\log_2(2x - 7) = 0$ [3 marks]

ii. $3^{x-2} = 73$ (correct to 2 d.p.) [4 marks]

h. Given the vectors

$$A = -5\hat{i} + \hat{j} - 4\hat{k}, \quad B = \begin{pmatrix} 3 \\ -1 \\ 4 \end{pmatrix},$$

find

i. $|3A - 2B|$ [4 marks]

ii. $A \cdot B$ [3 marks]

Section B**Answer ANY 2 Questions in this section**

B.2 a. Use Cramer's rule to solve the simultaneous system

$$\begin{aligned}x - 2y + z &= 3 \\ 3y - 2z &= 0 \\ 2x - z &= -2.\end{aligned}$$

[15 marks]

b. Find the angle between the vectors

$$A = \hat{i} + 4\hat{j} + 6\hat{k}, \quad B = \begin{pmatrix} 7 \\ -3 \\ 2 \end{pmatrix}.$$

[10 marks]

B.3 a. Consider the quadratic function

$$y = 20x - 4x^2.$$

- i. Find the coordinates of the roots [3 marks]
- ii. Find the coordinates of the vertex [3 marks]
- iii. Find the coordinates of the y -intercept [1 marks]
- iv. Make a sketch of the graph of y [4 marks]

b. The profit P (in Emalangen) of a company is given by

$$P(x) = 75x - 0.03x^2 - 5400,$$

where x is the number of units sold per month.

- i. Find the profit if the monthly sales stand at 500 units [2 marks]
- ii. Find the maximum profit and the number of units required to achieve this. [4 marks]

c. For the triangle with vertices $A(-5, 6)$, $B(7, 1)$ and $C(-1, -5)$, find

- i. the interior angle \hat{C} . [3 marks]
 - ii. the *exact* area of the triangle [5 marks]
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B.4 a. Find the value(s) of x such that the sequence

$$x + 2, x + 3, 2x^2 + 1$$

is an *arithmetic progression*.

[4 marks]

b. The number of seats in the first 4 rows of a sitting section of a stadium are given below.

Row	1	2	3	4
Number of Seats	27	31	35	39

If the number of seats continue to increase by 4 between consecutive rows and the sitting section has a total of 48 rows, find

i. the number of seats in row 25

[2 marks]

ii. the row with 171 seats

[3 marks]

iii. the *total* number of seats in the section

[5 marks]

c. In the binomial expansion of

$$\left(x^2 + \frac{1}{x}\right)^{24},$$

find

i. the first 4 terms.

[7 marks]

ii. the 15th term

[4 marks]

B.5 a. Using the remainder theorem, the rational root theorem and synthetic division, factorise the polynomial

$$P(x) = x^3 - 4x^2 + x + 6.$$

Hence, find all the roots of $P(x)$.

[10 marks]

b. Simplify

$$2\log(100x) - 3\log(10x^2) + 4\log x.$$

[5 marks]

c. After acquiring a new farm, a farmer buys a herd of 50 cattle. If the relative growth rate of the herd is 25% per year and the carrying capacity of the farm is 400, then the number of cattle is modelled by the *logistic equation*

$$P(t) = \frac{400}{1 + 7e^{-0.25t}}$$

where t is the number of years after the initial introduction. Find

a. the number of cattle after 4 years

[3 marks]

b. how long it takes for the cattle to reach 360.

[7 marks]