
University of Swaziland



Supplementary Examination, July 2013

BSc Env. Health Sc. I

Title of Paper : Algebra for Health Sciences

Course Number : EHM106

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) Find the value(s) of x such that the following sequence is an AP

$$(x + 2), (x + 3), (2x^2 + 1). \quad [7 \text{ marks}]$$

(b) Work out and express your answer in the form $a + ib$

i. $(2 + i)^2(3 - 4i)$ [6 marks]

ii. $\frac{5}{1 - 2i} + \frac{13i}{2 - 3i}$ [6 marks]

(c) Find the centre and radius of the circle described by the equation

$$x^2 + y^2 - 14y + 40 = 0. \quad [6 \text{ marks}]$$

Question 2

(a) Expand and simplify term by term

$$\left(2x + \frac{1}{x}\right)^4 \quad [9 \text{ marks}]$$

(b) Use de Moivre's theorem to expand

$$(1 - i\sqrt{3})^6,$$

expressing your answer in the form $a + ib$. [8 marks]

(c) A ball fall from a height of 20 metres. If the maximum height attained decreases by 4% each time, fin the total distance travelled by the ball in coming to rest. [8 marks]

Question 3

(a) Solve for x

i. $8^{1-2x} = \frac{1}{256}$ [4 marks]

ii. $\log_2(3x + 7) = 4$ [3 marks]

iii. $\log_6(x + 4) - \log_6(x - 1) = 1$ [6 marks]

(b) Given the matrices

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

work out (where possible)

i. $A + A^T$ [3 marks]

ii. AC [3 marks]

iii. CA [3 marks]

iv. $C^T A$ [3 marks]

Question 4

(a) Express as a single logarithm with coefficient 1, and simplify

$$\log_a 1 + \log_a a^2 + 2 \log_2 a^4 - 3 \log_2 a^2. \quad [9 \text{ marks}]$$

(b) Solve the system

$$x + 2y + 3z = 0$$

$$2x + 2z = -1$$

$$2x + y = 3$$

using Cramer's rule.

[16 marks]

Question 5

(a) Given that $\cos A = -\frac{3}{5}$ and A lies in QII , find the exact values of

i. $\cos 2A$ [5 marks]

ii. $\tan 2A$ [5 marks]

Hence state the quadrant in which the angle $2A$ lies. [2 marks]

(b) Find the 13th term in the binomial expansion of

$$\left(x - \frac{y}{x}\right)^{15}. \quad [5 \text{ marks}]$$

(c) The population of a city grows according to

$$P(t) = 45,000e^{0.03t}$$

where t is the number of years from year 2000. Find

i. the population of the city in year 2010; [3 marks]

ii. the date when the population will be double that in 2000. [5 marks]

Question 6

(a) Find the value of

a. $\sum_{n=0}^{70} (3n + 2)$ [4 marks]

b. $\sum_{n=0}^{\infty} 15\left(\frac{1}{2}\right)^n$ [3 marks]

(b) Prove

$$(1 + \tan^2 \theta)(1 - \sin^2 \theta) = 1. \quad [9 \text{ marks}]$$

(c) Find a solution set of

$$2 \sin \theta \cos \theta + \sin \theta = 0$$

in the interval $-180^\circ \leq \theta \leq 180^\circ$. [9 marks]

EHM106: Algebra for Health Sciences

- **Polynomials.** Long division and synthetic division of polynomials . Factor and remainder theorems. Rational roots of polynomials.
- **Exponential and logarithmic functions.** Exponents, radicals and the logarithm. Solving exponential equations and logarithmic equations. Applications
- **Trigonometry.** Trigonometric ratios and fundamental trigonometric identities. Solving trigonometric equations.
- **Binomial expansions.** Binomial theorem of expansions and its applications.
- **Progressions.** Arithmetic and Geometric Progressions and their applications.
- **Matrices.** Properties of Matrices. Addition, Subtraction and Multiplication of matrices. Transpose and Determinants. Solutions of equation systems using Cramer's rule.
- **Coordinate Geometry.** Properties and equations of straight lines and circles.
- **Complex numbers.** Algebra of complex numbers. Polar representation of complex numbers. Solving quadratic equations with complex roots.

*Reading 17
- References - F*