

SENIOR FIVE PRINCIPAL MATHEMATICS

PURE MATHEMATICS

END OF TERM I 2026

DURATION: 3 HOURS

INSTRUCTIONS.

This paper has two sections; A and B

Section A (Conception knowledge) compulsory and each question carries 5 scores

SECTION B (Application) (Scenario items)

Respond to any four items/questions and all items carry equal scores.

Section A (40 scores)

1. Prove that $\frac{1-\cos\theta}{\sin\theta} = \frac{1}{\operatorname{cosec}\theta + \cot\theta}$
2. Expand $\sqrt{\frac{1+2x}{1-2x}}$ up to the third term.
3. Determine the nature of the roots of the equation: $x^2 - 4x + 4 = 0$
4. Determine the equation of the tangent to the curve $y^3 + y^2 - x^4 = 1$ at the point (1,1).
5. Show that $2\log 4 + \frac{1}{2}\log 25 - \log 20 = 2\log 2$.
6. Solve for x in the equation $4^{2x} - 4^{x+1} + 4 = 0$

7. Solve the simultaneous equations;

$$x - 2y - 2z = 0$$

$$2x + 3y + z = 1$$

$$3x - y - 3z = 3$$

8. Without using mathematical tables or calculator, find the value of

$$\frac{(\sqrt{5}+2)^2 - (\sqrt{5}-2)^2}{8\sqrt{5}}$$

SECTION B (Attempt any 4 questions)(60 scores)

QUESTION.9: BINOMIAL THEOREM

A construction company in Kampala is designing a curved metallic path arch for a modern gate. The stress (for per unit area) along the arch is modeled by the expression $(1 + 0.002x)^8$ where x is the distance (in meters) from the base.

To ensure safety and minimizing material costs, engineers must approximate and analyze this expression for small values of x . (i.e $x < 5$)

Task.

- Use binomial theorem to expand $(1 + 0.02x)^8$ up to the term in x^3 and hence find the value of $(1.04)^8$.
- Explain what the co-efficient of x^2 represents in the context of stress variation along the arch.
- Using the first four terms of the expansion, determine the maximum value of x for which the approximation is accurate to 2 decimal places.

c) Find the general term in the expansion of $\left(2x - \frac{1}{x}\right)^6$ and hence determine the term independent of x .

QUESTION 10: SERIES (A.P and G.P)

A company gives a monthly transport allowance to its intern. The first intern received UGX 100,000 and each subsequent intern receives UGX 5,000 more than the previous one. There are 20 interns in total.

Task

a). Calculate the total amount of the money paid to all interns in a month.

b). If instead, the transport allowance follows a geometric sequence where the second intern receives UGX 90,000 and the fourth receives UGX 121,500.

i). Find the common ratio

ii). Calculate the total allowance for the first 6 interns.

QUESTION 11; INDICES, SURDS AND LOGARITHMS

In a science experiment conducted by a teacher with 5.5 students, the intensity of light (I) decreases with the square of the distance (d) from the source such that $I = \frac{100}{d^2}$. A student records that intensity at distance 2m is 25 lux.

Task:

a) Express the formula using indices.

b) Find the intensity at 5m.

c) A student models the data with the logarithmic function $\log I = a \log d + b$. Find the values of a and b .

d) Use your values from (c) to estimate the intensity when $d=4\text{m}$.

QUESTION 12: ROOTS OF QUADRATIC EQUATIONS.

a) A rectangular garden has an area of 60m^2 . Its length is 2m more than its width.

Task. Form a quadratic equation to represent the situation and Solve it.

b) At a secondary school in Wakiso district, an ICT club is designing a simple signal processing program to control sound waves during school events. The system models two signal frequencies using the equation $x^2 - 5x + 6 = 0$. The roots of the equation are α and β , representing the base frequencies of two sound signals.

To improve the sound quality, the system generates enhanced signals whose frequencies are proportional to the cubes of the original frequencies.

Task: Help the ICT club members to form an equation for the newly generated base frequencies and hence explain briefly how transforming roots can affect signal behavior in real-life systems.

QUESTION 13: (LINEAR EQUATIONS)

A wholesale distributor in Kampala supplies three products to different schools; exercise books, pens and mathematical sets.

The pricing and supply structure varies depending on agreements with different schools.

School A buys only exercise books; the total cost is UGX 48,000 and each book cost UGX 1,600.

School B purchases exercise books and pens. The supplier records;

- 5 books and 3 pens cost UGX 13,900
- 3 books and 2 pens cost UGX 8,600

School C purchases all the three items. The following records are obtained and the secretary is asked to make a report

- 2 books, 1 pen and 1 mathematical set cost UGX 8,800
- 3 books, 2 pens and 1 mathematical set cost UGX 13,400
- 1 book, 3 pens and 2 mathematical sets cost UGX 11,200

Task.

a) Determine the number of books bought by school A and the amount of money at which school B bought a pen and an exercise book.

b) Using Gaussian's Elimination method (row-reduction to Echlon), Help the Secretary of school C to have a detailed report showing the cost per item.

c) Sir Elite teaches in school C and he wants to buy 10 books, 5 pens and 2 mathematical sets. He has a budget of UGX 50,000 however he doesn't know whether it is sufficient. He has asked for your help.

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