

**THE O - LEVEL ANNUAL MATHEMATICS SEMINAR**  
**HELD AT**  
**STMARIA GORETTI SENIOR SECONDARY SCHOOL KATENDE**  
**ON SATURDAY 27<sup>TH</sup> SEPTEMBER 2025**



**BY**  
**THE MATHEMATICS DEPARTMENT**

***We welcome you all and wish you a fruit fill discussion***

## Theme One: Numbers

**1<sup>st</sup> EOC:** Learner appreciates and uses computational skills to solve problems in real-life situations.

1. Number bases
2. Working with integers
3. Fractions, percentages and decimals
4. Ratios and proportions
5. Numerical concepts 1 and 2
  - (a) Indices
  - (b) Surds

### Item 1.

Ruth's uncle has started a farm near your school and all the documents attached to this farm are kept in a deposit box with a seal containing a secret number 123 in base nine. He has been informed that the actual pin is in base four and he is finding it difficult to obtain it so that he can access the documents.

The school fees for term two has been changed because of mocks but his earlier plan was to pay the fees in three installments with 60% as the first installment at the beginning of the term, two thirds of the remaining amount by visitation day and the rest of the school fees amounting to Shs 160,000 towards the end of the term. He wants to determine the actual amount he will pay for the first installment.

Because of her poor health, Ruth's uncle visits her after every 24 days and he also sells off the produce from his farm every after 16 days. He brought Ruth back to school for term two on 6<sup>th</sup> May, 2025 after selling the produce from his farm. He wants to determine the actual day when he will visit both his farm and Ruth's school.

He wants introduce animals on the farm. He has been told by his farm manager that the ratio of sheep to goats must be **2: 5** while that of goats to cows must be **3: 1** and that the space on the farm can accommodate 390 animals. Each lamb can be bought at shs 180,000, each kid at shs 120,000 while each calf at shs 200,000. He wants to determine the total amount he will use to buy the animals.

### Task:

- (a) Assist Ruth's uncle obtain the exact password to access his farm's documents.
- (b) Determine the actual amount he will pay for the first installment.
- (c) What is the actual day when he will visit both his farm and Ruth's school?
- (d) Find the total amount he will use to buy the animals.

## Item 2.

Your school has a population of 400 students and it has been observed that the population increases by 10% every year. The head teacher is planning to construct a new classroom block after 4 years if the number of students in the school exceeds 700. He is not sure if it is right to construct the classroom.

The initial budget by the engineer requested for 252 bags of cement, 210kg of iron nails and 294 iron bars. He plans to transport the items using the school pick up in trips such that each trip carries the same quantities of cement, iron nails and iron bars with no item left at the hardware. Each trip the pickup makes costs shs 45,000. The bursar wants to write a receipt of the total expenditure on the transportation of these items.

The school also wants to tile the rectangular floor of a newly constructed art room of length and width in the form  $(2\sqrt{5} + \sqrt{8})m$  and  $(2\sqrt{5} - \sqrt{8})m$  respectively. Each box of tiles they plans to buy, can cover an area of  $1.5m^2$ . Each box is sold at Shs. 48,000. The school needs help to determine how many boxes of tiles they will need, how much it will cost to buy.

### Task:

- (a) By calculation determine if it is wise for the head teacher to construct the new classroom.
- (b) Guide the school bursar on the actual amount to write on the receipt.
- (c) How much will it cost the school to buy the boxes they will need to cover the total area of the floor?

## Theme Two: Patterns and algebra

2<sup>nd</sup> EOC: Learner appreciates and uses analysis to solve problems in real-life situations.

- |                                  |                                   |
|----------------------------------|-----------------------------------|
| 1. Sequences and patterns        | 8. Simultaneous equations         |
| 2. Equations of lines and curves | 9. Quadratic equations            |
| 3. Algebra 1 and 2               | 10. Composite functions           |
| 4. Mapping and relations         | 11. Equations and Inequalities    |
| 5. Vectors and translation       | 12. Linear programming            |
| 6. Inequalities and regions      | 13. Direct and inverse proportion |
| 7. Equation of a straight line   |                                   |

### Item 3.

Two boys Roy and Gary were sent at a shop in the center dealing in eggs and sugar, Roy bought 4 trays of eggs and 3kg of sugar and paid Shs 58,000 while Gary who is his neighbor was given Shs 40,000 and bought 2 trays of eggs and 4kg of sugar and his balance was only shs1,000. None of these boys was given a receipt yet Sam who is also their neighbor wants to send his daughter 5 trays of eggs and 2kg of sugar. He wants to establish the actual amount of money to give her daughter.

At the same shop, they also sell cartons of juice and cartoons of water. The number of cartoons of water sold per day are always less than twice the number of cartoons of juice sold. Each carton of water is sold at Shs 5,000 and that of juice is at Shs 4,000 and they always make sales of a minimum of Shs 200,000 per day. The number of cartoons of water sold are at least 25. There is a profit of Shs 700 on each carton of water and Shs 600 on each carton of juice. The profits made per day does not exceed Shs 42,000.

#### Task:

- (a) Establish the actual amount of money to give her daughter.
- (b) Determine the number of cartoons of each drink that should be sold to maximize the profit.

### Item 4.

Chris has always been making his mandazi under an umbrella. This time he plans to weld a metallic structure with a length of 6 ft more than the width. He has a ground area of only 91square feet available to place this structure. He wants to determine the exact length and width of the structure.

Reaching the shop, he gets an order of 200 mandazi. He needs to know how many kilograms of wheat he needs to buy to fulfill the order. Previously he baked 48 mandazi using 2kg of wheat and 168 mandazi using 7kg of wheat.

#### Task:

- (a) Help Chris to determine the exact length and width of the structure.
- (b)
  - (i) According to his previous records, create a mathematical relationship between number of mandazi produced and amount of wheat used.
  - (ii) Use the relationship to help him determine the amount of wheat he should buy.

### Item 5.

A wholesaler wants to offload some bags of sugar from the container. He has two men Fred and Dan. When Fred works alone he takes 30 minutes and when Dan works alone, he takes 20 minutes. He wants this task done in less than 15 minutes.

The wholesaler's profit function is represented by the function  $f(x) = 100x^2 + 10$ , where  $x$  is the number of crates sold and the profit is in shillings. The number of crates sold is expected to increase according to the function  $g(x) = 2x + 5$ , where  $x$  represents the number of days since the start of the promotional campaign.

The wholesaler plans to paint the windows for his new structure and he has approached a welder. To paint the windows, the welder charges a basic commitment fee of shs 33,000 and then charges shs 21,000 per window. He wants to determine the number of windows that can be for painted with shs 180,000 that the client has given him.

### Task

- (a) Work out the exact time the two men will take and find if they will be able to work with in the required time frame.
- (b)
  - (i) Find the composite function  $fg(x)$  that represents the profit as a function of the number of days since the promotional campaign began.
  - (ii) Calculate the profit 5 days after the campaign starts.
- (c) How many windows can be painted with the available fee.

### Theme Number Three: Data and Probability

*3<sup>rd</sup> EOC: Learner appreciates and uses logical reasoning to solve problems in real-life situations*

1. Graphs
2. Set theory
3. Data collection and display and presentation
4. Matrices
5. Probability
6. Matrix transformations

### Item 6.

As a requirement for the NLSC, learners in a certain institution have to opt for either Agriculture, Performing Arts or Chinese as a language. Out of the 120 S.1 learners who joined the school this year, 40 opted to do Performing Arts, the number of learners who

opted to do Chinese is twice the number of those who opted to do Agriculture. The head teacher agreed to purchase new Chinese text books if the probability of a learner taking Chinese is greater than 50%. In the first month, some learners were still finding out which subject they can take and some ended up studying more than one subject. 10 learners studied all the three subjects, 25 studied Agriculture and Performing Arts, 10 studied only Performing Arts while 12 studied only Agriculture and Chinese.

The school wishes to reward **one** of the learners who have opted for all the three subjects, and to get to this learner, they have decided to play a game. In the game;

They have put 4 red marbles and 7 green marbles in a box. A learner is to pick two marbles at random, one after the other without replacement from this box. If one picks marbles of different colors, he/she **wins**. The learner would like to know their chances of winning but have found it difficult.

**Task:**

- (a) Present the information on a Venn diagram.
- (b) Find by calculation if the head teacher will buy more Chinese text books?
- (c) What is the number of learners who opted for the required subjects?
- (d) What is the chance that a learner who plays the game will win?

**Item 7.**

Maize farmers in a certain village have also decided to form a producer cooperative society if the average produce is less than 50 bags and they are also calling for government help through their leaders. Leaders have accepted to help them with either fertilizers, seedlings or ready market.

Farmers with less than 25 bags are to be given fertilizers. Farmers with more than 25 bags but less than 55 bags are to be given seedlings and those farmers with more than 55 bags are to be provided with ready market.

They also want to determine the number of bags produced by 75% of the farmers.

A sample of 40 farmers was interviewed after harvesting and their produce (in number of bags) were recorded as follows.

11	38	14	60	71	48	52	21	28	17
45	59	45	38	65	68	35	56	43	47
25	42	59	62	79	21	52	65	48	34
22	34	51	18	49	43	54	64	27	38

**Task:**

- (a) Summarize the produce above by grouping them in a frequency table with 7 classes.
- (b) Show by calculation if the farmers form a producer cooperative society or not?
- (c) Determine the number of farmers that will be provided with:
  - (i) Fertilizers
  - (ii) Seedlings
  - (iii) Ready market.
- (d) Determine the number of bags produced by 75% of the farmers.

**Item 8.**

Your relative sells Juice in three sizes of glasses of 250ml, 300ml and 400ml. Each glass is sold at Shs.2000, Shs.3000, and Shs.5000 respectively.

On each glass of 250ml, 300ml and 400ml, she earns profits Shs. 500, Shs. 1,000 and Shs. 2,000 respectively.

**Below are the number of glasses of each size that were sold in week one for the three different types of juice:**

Water melon: 10 glasses of 250ml, 15 glasses of 300ml, and 12glasses of 400ml.

Passion: 15glasses of 250ml, 20 glasses of 300ml and 30 glasses of 400ml.

Beat root: 5 glasses of 250ml, 4glasses of 300ml and 2glasses of 400ml

**Below are the numbers of glasses of each size sold in week two:**

Water melon: 20 glasses of 250ml, 30 glasses of 300ml and 24 glasses of 400ml.

Passion juice: 30 glasses of 250ml, 40 glasses of 300ml and 60 glasses of 400ml.

Beat root: 10 glasses of 250ml, 8 glasses of 300ml and 4 glasses of 400ml.

She needs help to determine the cost of each type of juice sold and hence determine the total percentage profits earned from all the glasses of juice sold.

She is to use the percentage to determine whether the business is improving or not given that in the previous 2 weeks, the total the percentage profit was 40%.

**Task:**

- (a) Arrange the quantities of juice sold within the two weeks in rows and columns in two respective brackets.
- (b) Arrange the profits earned and selling prices of each type of juice in columns in two respective brackets.

(c) Using the arrangements above:

- (i) Determine the total quantities of juice sold within the two weeks while maintaining the rows and columns.
- (ii) Determine the total profits earned from each type of juice.
- (iii) Determine the total selling prices of each type of commodity.

(d) Determine the total cost price of each type of Juice.

(e) Determine the total percentage profits earned in the two weeks.

(f) Is the business improving or not? (Justify your answer)

### Item 9

Kampala is 120km from Masaka. Tom is broker who left Kampala for Masaka at 8:15 am riding a motorcycle at 20km/h. Two hours later he stopped for breakfast that took him  $1\frac{1}{2}$  hours before resuming his journey at the same speed.

At 10:30am, Alice who wants to buy left Masaka for Kampala in a vehicle travelling non-stop at a speed of 40km/h. they agreed to meet no later than midday to finalize the land and sign documents.

Upon arrival, Mukasa collects soil samples at various depths and records the sand content percentage in the table below:

Soil depth (x)	35	65	55	25	45	75	20	90	51	60
Percentage of sand (y)	86	70	84	92	79	68	96	58	86	77

Mukasa needs to create an appropriate graph to visualize the relationship between depth and sand content, and determine the soil depth for a sand percentage corresponding to 75%.

### Task.

- (a)
  - (i) Using a graph show if they were able to meet before the agreed time.
  - (ii) Determine who had moved a longer distance by the time they met.
- (b)
  - (i) Draw a scatter diagram showing the relationship between soil depth and sand percentage.
  - (ii) Comment on the relationship between soil depth and sand percentage.
  - (iii) Determine the soil depth for a sand percentage corresponding to 75%.

## Theme Four: Geometry and Measures

### 4<sup>th</sup> EOC: Learner appreciates and uses spatial reasoning to solve real life situations

1. Geometric construction skills
2. Bearings
3. General and angle properties of geometric figures
4. Reflection
5. Business mathematics
6. Time and time tables
7. Similarities and enlargement
8. Circles
9. Rotation
10. Length and area properties of two dimensional geometrical figures
11. Nets, areas, and volumes of solids
12. Trigonometry 1 and 2
13. Circle properties
14. Vectors
15. Loci
16. Lines and planes in three dimension

### Part II

*Answer only one item from this part*

#### Item 10.

Collin wants to invest shs12,000,000 in a hardware business. He wants to use his savings which is 45% of what he needs and plans to get a loan for the remaining amount. He has approached a money lender who lends at a 10% per annum simple interest rate for 3 years. The lender's condition is that his interest and principal must be paid in equal monthly installments.

He wants to hire a manager for the hardware and pay him Ugx 650,000 which includes a transport allowance of Ugx 60,000 and a lunch allowance of Ugx 45,000 all given monthly. Additionally, he will offer a family allowance for only two of his three children aged 3 years, 7 years and 12 years accordingly. A child below 5 years gets Ugx 10,000, a child between 5 and 10 years gets Ugx 12,000 and one above 10 years gets Ugx 15,000.

The taxable income is subjected to taxation according to the tax structure below.

Taxable income (Ugx)	Tax Rate (%)
1–150,000	Free
150,001–320,000	9.0
Above 320,000	16.0

The manger has been earning a net pay of Ugx 500,000 from his previous job. He is finding it difficult to decide on whether to take up the new job offer or not.

**Task:**

- (a) What is the total amount of money Collin will pay the money lender monthly?
- (b) How much will be deducted monthly by government as tax.
- (c) Do you advise the manger to take up this new job offer or not?

**Item 11.**

You are attending a friend's birthday party in Town C. You drove from Town A at 2:00pm northeast 10km to Town B, then 24km W45<sup>0</sup>N to Town C, arriving at 2:45pm.

After the party, you learn the direct road but not sure how much it will cost you to re-fuel your car that consumes 0.08 litres of fuel per kilometre given that each litre costs Shs. 5800.

You bought the car at Ugx. 45 million. Due to its usage, the car's value depreciated at a rate of 20% per year. You plan to sell the car after 3 years.

You find a buyer that has just come from abroad but wants to pay USD 8,500 but you are not sure whether it will be a loss or profit.

**Note:**

- **1 USD = 0.92 EUR**
- **1 EUR = 4,000 UGX**

**Task:**

- (a) What is the average speed at which you drove the journey from town A to town C?
- (b) How much will it cost you to refuel the car using the direct route?
- (c) What will be the value of the car after 3 years?
- (d) Will you make a profit or loss after selling the car the buyer mentioned above?

### Item 12.

A certain metal and fabrication workshop has been contracted by a school to make a whole closed cylindrical metallic water tank of diameter 1.4ft and height 2.8m. The tank is made up of metallic pieces of dimensions 8ft by 4ft only each sold at Shs. 80,000.

They want to paint the outside part of the curved surface only excluding the other parts with paint which is sold in either jerrycans or cylindrical tins. A sealed jerrycan which costs Shs. 23,000 can paint  $300\text{ft}^2$  and a sealed tin which costs Shs. 14,000 can paint  $200\text{ft}^2$ . Given that  $1\text{m} = 3.3\text{ft}$ .

#### Task:

- (a)
  - (i) Determine the number of pieces of material required to make the tank.
  - (ii) How much money is used to buy the required pieces of material.
- (b) Should they use paint in Jerry cans or tins? Justify your answer.

### Item 13.

Your school is to buy stools to be used in the science laboratory. The stools are to be with a round wooden top. It has been decided that the top should be of radius 0.2m. At his workshop, the carpenter who has been contracted to make the stools has pieces of timber which he had cut into triangular shapes. These pieces have two sides which are 30cm and 35cm and they intersect at an angle of  $60^\circ$ . The carpenter needs to find out whether he can cut these pieces of timber to make the tops of the stools required by the school.

The head teacher wants to borrow Shs. 2,870,000 from a bank to pay the carpenter at a compound interest rate of 10% per annum for a period of 2 years. The head teacher is supposed to repay the total amount of the money in equal monthly installments within the loan period. He does not know how much he will pay per month.

The head teacher also bought a bucket which is in shape of a frustum with an open end of diameter 30cm and a bottom diameter of 20cm. The bucket, which is 42cm deep, is to be used to fill an empty cylindrical tank of diameter 1.8m and Height 1.2m. He wants to find out the number of buckets required to fill the water tank.

He wants to pay a certain gentleman UGX 1000 per bucket to fetch water from the water tap using the bucket and fill the tank.

**Task:**

- (a) (i) By geometric construction, advise the carpenter whether the required size of the stool top can be made from the available triangular pieces of timber.
- (ii) Give a reason for your answer above.
- (b) Determine how much the head teacher will pay per installment?
- (c) Assist the head teacher to determine the number of buckets the gentleman will fetch and hence the amount of money he will pay.

**Item 14.**

The university owns a triangular piece of land in a particular community, and people have been encroaching on it. The land measures 650 meters by 720 meters, with an angle of 75 degrees between these sides. To address this problem and clearly define the boundaries, the university council has constructed a circular fence that touches each vertex of the triangular land. The fence's labor cost is 10 US dollars per meter, and the construction materials amounted to UGX. 10, 567,800. Use exchange rate \$1= UGX.3750.

One of the neighbors decides to sell his plot of land at UGX.14, 000,000 to the university. The university management asked for a discount of 20% of the amount. If the man accepts and sells, the blocker wants 5% commission on the amount sold. The LC1 also requested for UGX.350, 000 to sign the agreements. He is not sure of the amount he will remain with after paying all the blocker and LC1 in case he accepts to give a discount.

- (a) What is the area of the piece of land owned by university?
- (b) With an aid of an accurate diagram;
- (i) Estimate the total cost of constructing the fence.
- (ii) Did the university take over land that belongs to other people? Justify your response.
- (c) How much will he remain with after paying all the blocker and LC1 in case he accepts to give a discount.

*Thank you all for coming may God Bless You*

