



## THE UGANDA INTER SCHOOL VIRTUAL OLEVEL MATHEMATICS SEMINAR 2024.

Saturday 29<sup>th</sup> June 2024 (9:00 a.m)

### INSTRUCTIONS TO STUDENTS AND TEACHERS:

Dear students and teachers we would like to welcome you to participate in the forthcoming Mathematics seminar for senior four students. This is in preparation for the forthcoming final exams(UNEB) and the Mock Examinations. **This is a free seminar and no one should charge you any fees.**The process to be followed by both the teachers and students is suggested below:

1. Teachers share the Seminar questions with their students and ask for volunteers to discuss any of the questions. Questions should be pinned up and learners write down all the questions in their books.
2. Teachers talk to the school administrators to allow the children participate as presenters in the seminar on Saturday **29th June from 09:00am - 2:00 pm**. Other students will just be participants.
3. The student together with the teachers select atleast two best done presentations and the students to represent the school.The solutions and pictures/videos should be uploaded on padlet.<https://bit.ly/S4MATHSEMINAR2023>
4. Hold a mock presentation where all your discussants present to the rest of the class.After that release the rest of the class and record your best presenter in a very quiet environment but with good light.Record each part of the question separately .
5. The teacher could now train the student on how to present on zoom as far as sharing a screen and using the whiteboard. Alternatively the students' presentation will be loaded on the computer screen and they explain to us their solution.

### SEMINAR DETAILS

S.4 virtual Mathematics seminar 2024.

Time: 29th June 2024, 09:00 AM

Join Zoom Meeting

<https://zoom.us/j/98772764215?pwd=L1lhbjE2U1A3VHcwVWVzd0NtSlpBUT09>

Meeting ID:987 7276 4215

Passcode: HeLP2024

Item	Element of Construct	Topics
Item one	Numbers	<ol style="list-style-type: none"> <li>1. Number bases</li> <li>2. Working with Integers</li> <li>3. Rectangular Cartesian Coordinates in 2- Dimensions</li> <li>4. Fractions, percentages and decimals</li> <li>5. Numerical concepts 1 and 2               <ol style="list-style-type: none"> <li>(a) Indices</li> <li>(b) Surds</li> </ol> </li> <li>6. Ratios and Proportions</li> </ol>
Item two	Patterns and Algebra	<ol style="list-style-type: none"> <li>1. Sequence and patterns</li> <li>2. Equation of lines and curves</li> <li>3. Algebra 1 and 2</li> <li>4. Mappings and relations</li> <li>5. Vectors and translation</li> <li>6. Inequalities and regions</li> <li>7. Equation of a straight line</li> <li>8. Simultaneous equations</li> <li>9. Quadratic equations</li> <li>10. Composite functions</li> <li>11. Equations and inequalities</li> <li>12. Linear programming</li> <li>13. Loci</li> </ol>
Item three and four	Data and Probability	<ol style="list-style-type: none"> <li>1. Data collection/display and presentation</li> <li>2. Graphs</li> <li>3. Set theory</li> <li>4. Matrices</li> <li>5. Probability</li> </ol>
Item five and six	Geometry and Measures	<ol style="list-style-type: none"> <li>1. Geometric Constructions Skills</li> <li>2. Bearings</li> <li>3. General and angle properties of geometric figures</li> <li>4. Reflection</li> <li>5. Business mathematics</li> <li>6. Time and time tables</li> <li>7. Similarities and enlargement</li> <li>8. Circles</li> <li>9. Rotation</li> <li>10. Length and area properties of two-dimensional geometrical figures.</li> <li>11. Nets, areas and volumes of solids</li> <li>12. Trigonometry</li> <li>13. Vectors</li> <li>14. Matrix transformations</li> <li>15. Circle properties</li> <li>16. Lines and planes in three dimensions</li> </ol>

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## NUMBERS

1. During their baking lesson , the students were given a recipe for 10 scones using the following ingredients:

- 80g butter
- 350g self-raising flour
- 30g sugar
- 2 eggs

However the student has the following ingredient and is preparing for the exhibition due to take place at school and wishes to bake 25 scones for the exhibition because he expects parents and visitors to support his entrepreneurial venture.

- 100g butter
- 1kg self-raising flour
- 50g sugar
- 4 eggs

**Task:**

- (a) Determine if the student has enough of each ingredient to bake 25 scones based on the recipe.
- (b) Determine how much more of each ingredient the student needs to buy.
- (c) If the prices of the ingredients are as follows:
- Butter: 5,000 shillings per 100g
  - Self-raising flour: 6,000 shillings per kg
  - Sugar: 1,000 shillings per 50g
  - Eggs: 500 shillings per egg

Calculate the total cost for the additional ingredients needed.

- (d) Determine how much the student should sell each scone .Electricity and other expenses are provided free by the school.
2. Your aunt is planning to enroll you in a boarding school for your O-level education. She has a budget of Shs 5,000,000 for your school expenses. To visit the school, she decides to take a boda-boda. The boda-boda travels 3 km west from your home to the main road, then 4 km south to reach the school. However, you later realize there's a shortcut path that leads directly from your home to the school. Upon reaching the school, your aunt learns that the school fees are Shs 3,000,000, boarding fees are Shs 1,500,000, and the cost of school supplies is Shs 500,000. Fortunately, the school offers a scholarship program. Students with excellent primary school leaving exam results receive a 50% discount on school fees, a Shs 200,000 reduction in boarding fees, and a Shs 150,000 voucher for school supplies. You are

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eligible for this scholarship based on your outstanding performance. The school also offers two payment options for school fees:

- Option 1: Two Installments - Pay two-fifths of the school fees at the beginning of the term and the remaining balance before the midterm exams.
- Option 2: Four Installments - Pay equal amounts at the beginning of the term, before midterm exams, after midterm, and before final exams.

**Task:**

- (a) What is the distance from your home to the school using the direct path?
- (b)
  - i. Considering the scholarship, calculate the total amount your aunt will pay for your school expenses.
  - ii. Can your aunt afford the school expenses based on her budget?
- (c)
  - i. For those paying the full school fees amount, calculate the amount paid per installment for each payment option.
  - ii. Which payment option would you recommend and why?

## PATTERNS AND ALGEBRA

3. Your uncle owns a small bakery and plans to bake two types of loaves of bread: whole wheat bread and white bread. Due to the bakery's oven capacity, your uncle can bake at most 15 loaves of bread in a day. He wants to bake at least 3 loaves of whole wheat bread. Additionally, he wants to bake more whole wheat bread than white bread because it is more popular among his customers. The selling prices are as follows:

Whole wheat bread is sold at Shs 6500 per loaf.

White bread is sold at Shs 5000 per loaf.

To cover his costs and make a profit, your uncle needs to earn more than Shs 30,000 from the sales each day.

**Task:**

- (a) Write mathematical statements that show the relation between the whole wheat bread and white bread.
- (b) Show the feasible region of the relation on the Cartesian plane.
- (c) How many loaves of each type should your uncle bake in order to make the maximum profit?
- (d) What is the minimum number of loaves he can bake and still make a profit?

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4. The company manager is organizing a party for her colleagues. The cost of renting a local hall is UGX 2,000,000 for the evening. She then has to budget for food, which will cost approximately UGX 20,000 per person. The manager needs to ensure that the total cost of the evening stays within her budget. The manager has a maximum budget of UGX 5,000,000

**Task:**

- (a) Write down a formula connecting the total cost of the evening with the number of people attending .
  - (b) Find the total cost for the evening if 25 people attend.
  - (c) Find the greatest number of people she is able to invite.
  - (d) In the end, only 16 people will attend. Calculate how much each person should be charged so that the manager covers her costs.
5. Your friend is shopping at a supermarket in Kampala during a clearance sale. He wants to buy a calculator that originally costs 120,000 UGX. The store has reduced the price of all calculators by 35% for the sale. Additionally, today there is an extra markdown of 40% applied to the sale price of all calculators.

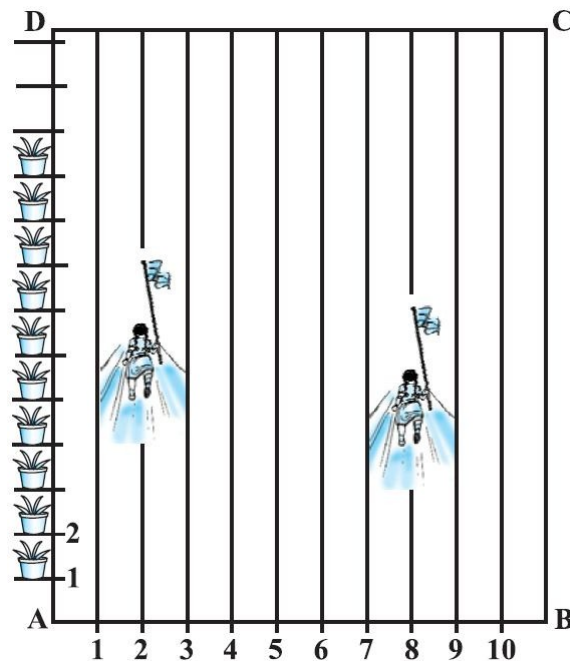
**Task:**

- (a) Develop a function that calculates the sale price of the calculator today, where  $x$  is the original price of the calculator.
  - (b) Using the function from (a), determine the final price your friend will pay for the calculator.
6. A manufacturer considers that men and women workers are equally efficient and so he pays them at the same rate. He has 30 units of male workers and 17 units of female workers and capital respectively, which he uses to produce two types of goods, A and B. To produce one unit of A, 2 workers and 3 units of capital are required, while 3 workers and 1 unit of capital are required to produce one unit of B. Goods A and B are priced at UGX 100,000 and UGX 120,000 per unit respectively.

**Task:**

- (a) Write mathematical statements that show the relation between the units of goods A and B produced
- (b) Show the feasible region of the relation on the Cartesian plane
- (c) How should he use his resources to maximize the total revenue?
- (d) Do you agree with this view of the manufacturer that men and women workers are equally efficient and so should be paid at the same rate?

7. In preparation for the annual sports day that takes place in second term of every year , your school has marked lines with ash powder at intervals of 1 meter on a rectangular sports field ABCD. The field is 100 meters long (AD) and 50 meters wide (AB). To make the event more exciting, the school has set up a challenge where students need to post flags at specific locations on the field.



- 100 flower pots are placed at 1-meter intervals along the length AD.
- Two different lines (second and eighth) running parallel to AD are specifically used for this challenge.
- One student runs  $\frac{1}{4}^{th}$  the length of the field along the 2nd meter line and posts a green flag.
- Another student runs  $\frac{1}{5}^{th}$  the length of the field along the 8th meter line and posts a red flag.

Taking one corner of the field (point A) as the origin, with the x-axis along the width (AB) and the y-axis along the length (AD), answer the following questions:

**Task:**

- Find the coordinates of the green flag.
- Find the coordinates of the red flag.
- Find the distance between the two flags.
- If a blue flag is to be placed exactly halfway between the green and red flags, where should it be placed?
- Draw the locus of points that are equidistant from both the green and red flags and find its equation.

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8. A cooperative society of farmers has 50 hectares of land to grow two crops A and B. The profits from crops A and B per hectare are estimated as Shs 10,500,000 and Shs 9,000,000 respectively. To control weeds, a liquid herbicide has to be used for crops A and B at the rate of 20 litres and 10 litres per hectare, respectively. Further not more than 800 litres of herbicide should be used in order to protect fish and wildlife using a pond which collects drainage from this land. Keeping in mind that the protection of fish and other wildlife is more important than earning profit respectively.

**Task:**

- (a) Write mathematical statements that show the relation between the hectare of land to be allocated to crop A and B respectively
- (b) Show the feasible region of the relation on the Cartesian plane
- (c) How much land should be allocated to each crop so as to maximize the total profit?
- (d) Do you agree with the message that the protection of wildlife is utmost necessary to preserve the balance in environment?

## DATA AND PROBABILITY

9. In a school survey, 200 students were asked about their internet usage habits. They were asked to choose from three activities: Social Media (like Facebook and TikTok), Academic Work (such as research and homework), and Playing Games. The results showed that 165 students use the internet for Social Media, 130 use it for Academic Work, and 100 use it for Playing Games. Among them, 70 students use it for both Social Media and Academic Work only, 60 use it for both Social Media and Playing Games, and 50 use it for both Playing Games and Academic Work. Additionally, no students exclusively use the internet for playing games. Now, the school needs to decide whether to set rules if more than 60% of students spend their internet time on Social Media.

**Task:**

- (a) Calculate how many students use the internet for at least one of these activities.
  - (b) Determine how many students don't use the internet at all.
  - (c) Estimate the percentage of students who use the internet solely for Academic Work.
  - (d) Based on the findings, advise the school on whether to implement rules or not.
10. A certain company in Kampala is analyzing the optimal departure time for its 40 employees to ensure they reach home by 6:00 PM, minimizing their commute time and avoiding peak traffic congestion. The company conducts a survey to track the times employees typically arrive home after work, measured in minutes past 5:00 PM.

15	20	25	30	35	40	45	50	55	60
65	70	75	20	25	30	35	40	45	50
55	60	65	70	75	80	25	30	35	40
45	50	55	60	65	70	75	80	30	35

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**Task:**

- (a) Based on calculations using the collected data, suggest an optimal departure time for employees to begin their commute home.
  - (b) Following advice to allow employees to leave work when at least 50% of them have already arrived home, determine the optimal departure time.
  - (c) As the company management, which of the two suggested departure times from (a) and (b) would you choose to ensure employees reach home by 7:00 PM, and why?
11. A baker is preparing for a local community event. She needs to bake several types of cakes, however she has to ensure she has the correct quantities of ingredients for each. Below are the types of cakes she plans to bake and their required quantities of ingredients:
- Chocolate Cake: Requires 3 cups of flour, 2 cups of sugar, 4 eggs, and 1 cup of mixed ingredients per cake.
  - Vanilla Cake: Requires 4 cups of flour, 3 cups of sugar, 3 eggs, and 2 cups of mixed ingredients per cake.
  - Red Velvet Cake: Requires 5 cups of flour, 2 cups of sugar, and 1 cup of mixed ingredients per cake.
  - Lemon Cake: Requires 2 cups of flour, 2 cups of sugar, 3 eggs, and 1 cup of mixed ingredients per cake.

The baker has been asked to bake a total of 10 Chocolate Cakes, 8 Vanilla Cakes, 6 Red Velvet Cakes, and 5 Lemon Cakes.

**Task:**

- (a) Form a matrix to show the quantities of ingredients required for each type of cake.
  - (b) She wants to calculate the total quantity of each ingredient she will need for the event. Help the baker using your knowledge of matrix multiplication.
  - (c) If each kilogram of flour goes for UGX 8000, each kilogram of sugar goes for UGX 5000, and each egg goes for UGX 300, and a cup of mixed ingredients goes for UGX 6000. Find out how much she will spend on making the cakes considering that each cup with the ingredient weighs 250grammes.
12. A layer chicken farmer decided to weigh a sample of 800 eggs on his farm and classify them according to their mass (m grams) to optimize the packing process. The frequency distribution of the egg masses is as follows:

Mass in grams	Number of eggs
40 – 44	36
45 – 49	142
50 – 54	286
55 – 59	238
60 – 64	76
65 – 69	22



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The farmer's plan is to pack eggs in given weights.

**Task:**

- (a) Determine the median mass of an egg from the given frequency distribution to understand the central tendency of the egg weights.
  - (b) What would be the percentage of eggs which would be classified as large(over 62 grams)
  - (c) The farmer plans to pack eggs that weigh over 62 grams, with each pack containing 12 eggs. If each pack costs UGX 12,000, calculate the total revenue the farmer will earn from selling all the large eggs and compare the revenue earned from selling the same eggs to a middle man who he is buying at UGX 9000.What advice will you offer to the farmer.
13. In preparation for the upcoming national voter registration drive in Uganda, the Electoral Commission needs to determine the optimal opening time for registration centers across various districts. This decision aims to facilitate maximum voter registration and ensure efficient processing of the data of the citizens eager to participate in the upcoming elections. Here are the arrival times of citizens at a sample voter registration center in minutes past the scheduled opening time (8:00 AM):

11	66	21	88	33	67	41	45	47	41
27	62	32	43	31	34	66	20	21	36
26	75	80	45	12	44	58	48	42	38
56	63	68	24	21	65	68	63	72	38

**Task:**

- (a) Based on calculations using the collected data, suggest an opening time for voter registration centers.
- (b) Following advice to open registration centers when at least 50% of expected citizens have arrived, determine the opening time.
- (c) As the Electoral Commission of Uganda, which of the two suggested opening times from (a) and (b) would you choose, and why?

## GEOMETRY AND MEASURES

14. Your relative, is planning to start a small bakery business and seeks your advice on financial matters related to her venture. She plans to invest a total of \$10,000 into the business and wants to understand the financial implications of different financing options. She has approached two money lenders and she is asking for your input before she takes on the decision.

**Lender 1 :** Your relative ,wants to borrow UGX 50,000,000 from a local bank to purchase baking equipment. The bank offers her two different repayment plans:

- Option 1: Simple Interest - The loan is offered at an annual interest rate of 20% and to be paid after 2 years.

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- Option 2: Compound Interest - The loan is offered at an annual interest rate of 4% and is to be paid after 2 years

**Lender 2:** Your relative is considering a hire purchase agreement with a bakery equipment supplier. The total cost of the equipment is \$5,000, and the hire purchase agreement specifies a down payment of \$1,000 followed by monthly payments of \$400 for 24 months. The supplier will consider a constant dollar rate at  $1\$ = \text{UGX}3,800$

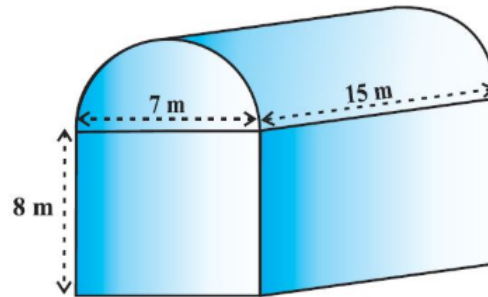
**Task:**

- (a) Calculate the total repayment amount for each financial option over the loan term and compare them to determine which option would be more cost-effective for your relative bakery business.
  - (b) Analyze the monthly cash flow implications for your relative, under each financing option, considering her ability to manage operational expenses alongside loan repayments.
  - (c) Based on your calculations and analysis in (a) and (b), provide your relative, with a recommendation on which financial option would be optimal for her bakery business, taking into account both total repayment amount and monthly cash flow considerations.
15. A group of tourists has just arrived at Entebbe International Airport in Uganda for a safari adventure. They are interested in reaching the source of the Nile in Jinja. The touring company has approximated the distance from Entebbe to Jinja to be about 94 km, which should take around 3 hours without traffic, assuming an average speed of 30 km/h for the whole journey. Here are the directions they are following:
- From Entebbe Airport, travel north for 35 kilometers to reach Kampala, the capital city.
  - From Kampala, head east on the Jinja highway. As they approached Mukono, approximately 25 km from Kampala, the guide was alerted by a friend coming from Jinja to change the route and use the Kayunga road due to an accident in Mabira. The driver changed the route at Mukono and went in the northeast direction to Kayunga, approximately 45 km away.
  - From Kayunga, they headed to Jinja on a bearing of  $130^\circ$ , which took them 1 hour and 44 minutes as they enjoyed the scenery along the roadside.

**Task**

- (a) Describe the direction from Jinja to Entebbe.
- (b) How far is it from Mukono to Jinja using the direct route instead of the Kayunga route?
- (c) How long does the journey from Entebbe to Kampala take?
- (d) If each liter of fuel costs UGX 4900 and the car van consumes 1 liter per 10 km, how much fuel and money would they have saved if there was no accident in Mabira?
- (e) How much extra time did they spend on the road due to the detour, and what recommendations would you make to avoid such delays in the future?

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16. Your neighbor runs an industry in a shed that is in the shape of a cuboid surmounted by a half-cylinder. The dimensions of the cuboid base are 15 m by 7 m, and the height is 8 m.

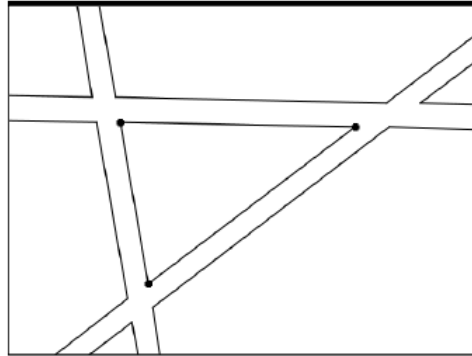


Your neighbor wants to install air conditioning units in the shed. The installation company offers two types of units: Type X and Type Y. Each Type X unit costs \$2,500 and each Type Y unit costs \$3,200. The Type X unit covers  $100m^3$  of air, while the Type Y unit covers  $150m^3$  of air. For bulk purchases, the company offers a 5% discount on the total cost for every 10 Type X units purchased and a 7% discount on the total cost for every 8 Type Y units purchased. The neighbor plans to buy enough units to cover the entire volume of the shed. He intends to borrow money from a bank to buy the air conditioning units but is unsure of the amount needed.

**Task:**

- (a) Find the volume of the air that the shed can hold.
- (b) If the industry requires machinery which would occupy a total space of  $300m^3$  and there are 20 workers each of whom would occupy 0.08 space on an average, how much air would be in the shed when it is working?
- (c) Calculate the number of air conditioning units required for both Type X and Type Y units based on the usable air volume.
- (d) Estimate the total cost and the amount of money your neighbor needs to borrow for purchasing the required air conditioning units for both Type X and Type Y.
- (e) Advise your neighbor , with reasons, on the type of air conditioning units to buy.

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17. The Parks Department in a Ugandan village has acquired a new sprinkler system to water their flower equilateral triangular lawn, which is essential for maintaining the village greenery. The equilateral triangular lawn, with each side measuring 10 meters, is surrounded by pathways, and the sprinkler needs to be strategically placed to ensure effective coverage without wasting water on the pathways.



**Diagram not on scale**

**Task:**

- Explain whether or not you think all of the lawn in the triangle can be watered with a circular sprinkler
- Determine the best location inside the equilateral triangular lawn where the sprinkler should be positioned to maximize the watering coverage while avoiding the pathways.
- Estimate the area of the lawn that will not receive water effectively once the sprinkler is optimally placed.