

THE UGANDA INTER SCHOOL VIRTUAL OLEVEL MATHEMATICS SEMINAR 2024.

Saturday 29*th* 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 nal 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 dis- cuss 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=L1lhbjE2UlA3VHcwVWVzd0NtSlpBUT09](https://zoom.us/j/98772764215?pwd=L1lhbjE2UlA3VHcwVWVzd0NtSlpBUT09%20) Meeting ID:987 7276 4215

Passcode: HeLP2024

S.4 Virtual Seminar*⃝*c 2024 1

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| --- | --- | --- |
| Item | Element of Construct | Topics |
| Item one | Numbers | 1. Number bases 2. Working with Integers 3. Rectangular Cartesian Coordinates in 2- Di- mensions 4. Fractions,percentages and decimals 5. Numerical concepts 1 and 2    1. Indices    2. Surds 6. Ratios and Proportions |
| Item two | Patterns and Algebra | 1. Sequence and patterns 2. Equation of lines and curves 3. Algebra 1 and 2 4. Mappings and relations 5. Vectors and translation 6. Inequalities and regions 7. Equation of a straight line 8. Simultaneous equations 9. Quadratic equations 10. Composite functions 11. Equations and inequalities 12. Linear programming 13. Loci |
| Item three and four | Data and Probability | 1. Data collection/display and presentation 2. Graphs 3. Set theory 4. Matrices 5. Probability |
| Item ve and six | Geometry and Measures | 1. Geometric Constructions Skills 2. Bearings 3. General and angle properties of geometric   gures   1. Re ection 2. Business mathematics 3. Time and time tables 4. Similarities and enlargement 5. Circles 6. Rotation 7. Length and area properties of two- dimensional geometrical gures. 8. Nets, areas and volumes of solids 9. Trigonometry 10. Vectors 11. Matrix transformations 12. Circle properties 13. Lines and planes in three dimensions |

2 S.4 Virtual Seminar*⃝*c 2024

# NUMBERS

1. During their baking lesson , the students were given a recipe for 10 scones using the following ingredients:
   * 80g butter
   * 350g self-raising our
   * 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 venuture.

* + 100g butter
  + 1kg self-raising our
  + 50g sugar
  + 4 eggs Task:

1. Determine if the student has enough of each ingredient to bake 25 scones based on the recipe.
2. Determine how much more of each ingredient the student needs to buy.
3. If the prices of the ingredients are as follows:
   * Butter: 5,000 shillings per 100g
   * Self-raising our: 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.

1. 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 o ers 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

S.4 Virtual Seminar*⃝*c 2024 3

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

* + Option 1: Two Installments - Pay two- fths 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 nal exams.

Task:

1. What is the distance from your home to the school using the direct path?
2. i. Considering the scholarship, calculate the total amount your aunt will pay for your school expenses.
   1. Can your aunt a ord the school expenses based on her budget?
3. i. For those paying the full school fees amount, calculate the amount paid per in- stallment for each payment option.
   1. Which payment option would you recommend and why?

# PATTERNS AND ALGEBRA

1. 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 pro t, your uncle needs to earn more than Shs 30,000 from the sales each day.

Task:

1. Write mathematical statements that show the relation between the whole wheat bread and white bread.
2. Show the feasible region of the relation on the Cartesian plane.
3. How many loaves of each type should your uncle bake in order to make the maximum pro t?
4. What is the minimum number of loaves he can bake and still make a pro t?

4 S.4 Virtual Seminar*⃝*c 2024

1. 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:

1. Write down a formula connecting the total cost of the evening with the number of people attending .
2. Find the total cost for the evening if 25 people attend.
3. Find the greatest number of people she is able to invite.
4. 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:

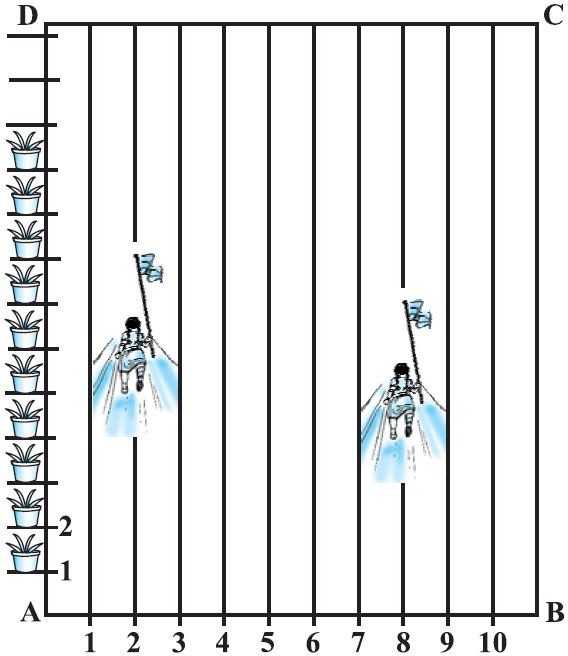
1. Develop a function that calculates the sale price of the calculator today, where x is the original price of the calculator.
2. Using the function from (a), determine the nal price your friend will pay for the calculator.
3. A manufacturer considers that men and women workers are equally e cient and 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:

1. Write mathematical statements that show the relation between the units of goods A and B produced
2. Show the feasible region of the relation on the Cartesian plane
3. How should he use his resources to maximize the total revenue?
4. Do you agree with this view of the manufacturer that men and women workers are equally e cient and so should be paid at the same rate?

S.4 Virtual Seminar*⃝*c 2024 5

1. 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 eld ABCD. The eld 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 ags at speci c locations on the eld.



* + 100 ower pots are placed at 1-meter intervals along the length AD.
  + Two di erent lines (second and eighth) running parallel to AD are speci cally used for this challenge.
  + One student runs 1 *th* the length of the eld along the 2nd meter line and posts a green

4

ag.

* + Another student runs 1 *th* the length of the eld along the 8th meter line and posts a

5

red ag.

Taking one corner of the eld (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:

1. Find the coordinates of the green ag.
2. Find the coordinates of the red ag.
3. Find the distance between the two ags.
4. If a blue ag is to be placed exactly halfway between the green and red ags, where should it be placed?
5. Draw the locus of points that are equidistant from both the green and red ags and

nd it is equation.

6 S.4 Virtual Seminar*⃝*c 2024

1. A cooperative society of farmers has 50 hectares of land to grow two crops A and B. The pro ts 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 sh and wildlife using a pond which collects drainage from this land. Keeping in mind that the protection of sh and other wildlife is more important than earning pro t respectively.

Task:

1. Write mathematical statements that show the relation between the hectare of land to be allocated to crop A and B respectively
2. Show the feasible region of the relation on the Cartesian plane
3. How much land should be allocated to each crop so as to maximize the total pro t?
4. Do you agree with the message that the protection of wildlife is utmost necessary to preserve the balance in environment?

# DATA AND PROBABILITY

1. 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:

1. Calculate how many students use the internet for at least one of these activities.
2. Determine how many students don't use the internet at all.
3. Estimate the percentage of students who use the internet solely for Academic Work.
4. Based on the ndings, advise the school on whether to implement rules or not.
5. 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 tra c 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 |

S.4 Virtual Seminar*⃝*c 2024 7

Task:

1. Based on calculations using the collected data, suggest an optimal departure time for employees to begin their commute home.
2. Following advice to allow employees to leave work when at least 50% of them have already arrived home, determine the optimal departure time.
3. 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?
4. 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 our, 2 cups of sugar, 4 eggs, and 1 cup of mixed ingredients per cake.
   * Vanilla Cake: Requires 4 cups of our, 3 cups of sugar, 3 eggs, and 2 cups of mixed ingredients per cake.
   * Red Velvet Cake: Requires 5 cups of our, 2 cups of sugar, and 1 cup of mixed ingredients per cake.
   * Lemon Cake: Requires 2 cups of our, 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:

1. Form a matrix to show the quantities of ingredients required for each type of cake.
2. 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.
3. If each kilogram of our 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.
4. 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 |

8 S.4 Virtual Seminar*⃝*c 2024

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

1. Determine the median mass of an egg from the given frequency distribution to under- stand the central tendency of the egg weights.
2. What would be the percentage of eggs which would be classi ed as large(over 62 grams)
3. 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 o er to the farmer.
4. 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 e cient 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 |
| Task: | 56 | 63 | 68 | 24 | 21 | 65 | 68 | 63 | 72 | 38 |

1. Based on calculations using the collected data, suggest an opening time for voter reg- istration centers.
2. Following advice to open registration centers when at least 50% of expected citizens have arrived, determine the opening time.
3. 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

1. Your relative, is planning to start a small bakery business and seeks your advice on nancial matters related to her venture. She plans to invest a total of $10*,* 000 into the business and wants to understand the nancial implications of di erent nancing 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 o ers her two di erent repayment plans:

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

S.4 Virtual Seminar*⃝*c 2024 9

* + Option 2: Compound Interest - The loan is o ered 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 speci es a down payment of $1*,* 000 followed by monthly payments of $400 for 24 months.The supplier will consider a constant dollar rate at 1$ = *UGX*3*,* 800

Task:

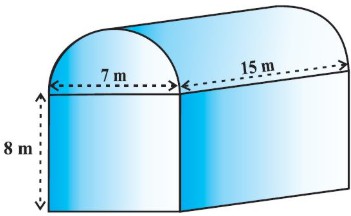
1. Calculate the total repayment amount for each nancial option over the loan term and compare them to determine which option would be more cost-e ective for your relative bakery business.
2. Analyze the monthly cash ow implications for your relative, under each nancing option, considering her ability to manage operational expenses alongside loan repay- ments.
3. Based on your calculations and analysis in (a) and (b), provide your relative, with a recommendation on which nancial option would be optimal for her bakery business, taking into account both total repayment amount and monthly cash ow considerations.
4. 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 tra c, 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, approx- imately 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 1300, which took them 1 hour and 44 minutes as they enjoyed the scenery along the roadside.

Task

1. Describe the direction from Jinja to Entebbe.
2. How far is it from Mukono to Jinja using the direct route instead of the Kayunga route?
3. How long does the journey from Entebbe to Kampala take?
4. 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?
5. How much extra time did they spend on the road due to the detour, and what recom- mendations would you make to avoid such delays in the future?

10 S.4 Virtual Seminar*⃝*c 2024

1. 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 o ers 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 100*m*3 of air, while the Type Y unit covers 150*m*3 of air. For bulk purchases, the company o ers 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:

1. Find the volume of the air that the shed can hold.
2. If the industry requires machinery which would occupy a total space of 300*m*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?
3. Calculate the number of air conditioning units required for both Type X and Type Y units based on the usable air volume.
4. 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.
5. Advise your neighbor , with reasons, on the type of air conditioning units to buy.

S.4 Virtual Seminar*⃝*c 2024 11

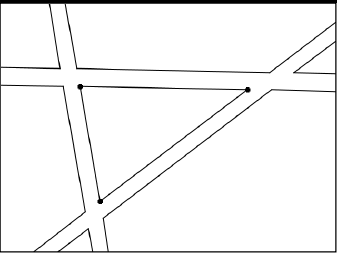
1. The Parks Department in a Ugandan village has acquired a new sprinkler system to water their ower equilateral triangular lawn , which is essential for maintaining the village green- ery. The equilateral triangular lawn, with each side measuring 10 meters, is surrounded by pathways, and the sprinkler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

Diagram not on scale

Task:

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

12 S.4 Virtual Seminar*⃝*c 2024