

S.4 MATHEMATICS FORMAT 456/1

Section A comprises of two compulsory items and **Section B** comprises of Part I and Part II each having two questions and a learner answers one question from part

CONSTRUCT: appreciates and uses computational skills, analysis, spatial and logical reasoning in making decisions to solve problems in real-life situations.

Item	Element of construct	Topics covered
SECTION A: compulsory		
Item one	Numbers Learner appreciates and uses computational skills to solve problems in real-life situations.	1. Number bases
		2. Working with integers
		3. Rectangular Cartesian Coordinates in 2-Dimensions
		4. Fractions, percentages and decimals
		5. Numerical concepts 1 and 2 (a) Indices (b) Surds
		6. Ratios and proportions
Item Two	Patterns and algebra Learner appreciates and uses analysis to solve problems in real-life situations	1. Sequences and patterns
		2. Equations of lines and curves
		3. Algebra 1 and 2
		4. Mapping 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
SECTION B		
PART I (choose one question)		

Items 3 and 4	DATA AND PROBABILITY	1. Data collection and presentation
		2. Graphs
	Learner appreciates and uses logical reasoning to solve problems in real-life situations	3. Set theory
		4. Data collection and display and presentation
		5. Matrices
		6. Probability
PART II (choose one question)		
Items 5 and 6	GEOMETRY AND MEASURES	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. Vectors
		14. Matrix transformation
		15. Circle properties
		16. Lines and planes in three dimensions

NUMBERS

ITEM ONE

Suzan a married woman has recently got a job where she will earn two million eight hundred eighty

five thousand shillings only, her friend has advised her to spend wisely in the following way, use ¹ of

5

her salary as her contribution towards monthly groceries, **30%** for her parents' upkeep, **Shs.400,000** for her own personal use and invest the rest. As a supportive wife she has agreed with her husband that they will be sharing the grocery cost and that she will contribute **2** parts while he contributes **3** parts, she wants to know how much each of them will contribute towards the monthly grocery shopping.

TASK

- Show Suzan the actual amounts she will have to spend as she has been advised.
- How much will they spend on monthly grocery shopping?

ITEM TWO

A camping site attracts visitors among which include children, men and women. On a certain day, the manager of the site recorded the attendance as ratios. **Men : Women = 5:4** and **Women : Children**

= 3 : 7. In total **224** children visited the camping site that day. However, the manager was not sure of the number of men and women who visited the site that day.

In 2024, the cost of a ticket to the campsite for children was at half price that for adults and that a ticket for adults cost **UGX30,000**. In order to attract more customers, the manager instructed the attendants to set the ticket charges for 2025 such that their cost is less by **20%**. However, the attendants were not sure of the exact costs to set for 2025.

Task:

- (a) Help the manager to find the total number of men and women who visited the camping site that day.
- (b) Determine the amount of money collected by the camping site on that day.
- (c) Determine the cost for the tickets for children and in 2025.

PATTERNS AND ALGEBRA

ITEM THREE

After occupying his new house with his entire family, a man was told that the cost of water used will be equal to the sum of a constant service fee of **shs.3500** and the cost of the number of units used per month. In the first month he paid **shs.15500** for **4** units used and in the second month he was sent a bill of **shs.33500** for the **10** units used. He wants to determine the cost of each unit for proper budgeting.

To reduce on the money he spends on water every month the man decided to dig a well of **11** metres where he will place a water pump, he has been told that the cost of digging the well will be as follows **shs.20,000** for the first meter, **shs.21,500** for the second meter, **shs.23,000** for the third meter and so on ,the cost kept increasing in that way for every meter. The man has saved **shs.350,000** for the job so he needs to determine the cost of digging the last meter and the total cost of digging the well.

Task:

- (a) Develop a mathematical relationship that will help the man determine the cost of each unit of water.
- (b) (i) Using your mathematical skills help the man to determine the cost of digging the last meter.
(ii) Will the money he has saved be enough for digging the well?

ITEM FOUR

An engineer was contracted by a certain hotel to design a new parking lot. On reaching the hotel, the engineer picked up measurements for two straight lines perpendicular to each other. For the first line, he picked two points which he recorded as **(2, -4)** and **(-6, 9)** and for the second line he picked up only one point and recorded it as **(-4, 6)**.

The new parking lot is to be rectangular in shape, with its breadth **3 m** less than its length. Its area is to be **4** square meters more than the area of the old parking lot whose shape is in form of an isosceles triangle of height **12 m** with its base as the breadth of the rectangular parking lot.

the infection at school clinic falls.

ITEM TEN

A farmer in a certain village has visited a statistician to help him analyze his production per year of the crop he produced so that he can decide whether to change to a new seed variety, he plans to buy a new seed variety if the commonest mass-produced falls below **55 kg**. He stored his valuable information about the grain production in his house, Unfortunately, part of his information was destroyed by rats due to poor storage, luckily enough a certain page with this table was spared as shown below;

Mass (kg)	9.5-19.5	19.5-29.5	29.5-39.5	39.5-49.5	49.5-59.5	59.5-69.5	69.5-79.7	79.5-89.5	89.5-99.5
Number of bags	50	115	210	315	410	485	550		600

Task

Help the farmer to;

- Retrieve the original information about his production in a frequency distribution table, and determine the mean production per year. (b)
- Determine the commonest mass of grains he produced last season so as to plan well for the next season.
- Will the farmer change to a new seed variety?

ITEM ELEVEN

Candidates who wish to get admitted to University through Mature Age entry scheme were given an aptitude test. The scores obtained in the aptitude test are given below.

7	4	3	5	4	6	7	7	8	3
2	3	6	7	7	8	5	9	2	1
5	4	7	5	2	7	5	7	8	7
2	7	4	2	9	2	7	2	7	3
3	5	6	5	4	4	3	5	2	8
2	2	2	5	2	7	7	7	2	1
2	5	3	6	6	3	4	3	5	8
7	3	7	4	2	2	7	7	2	8
5	2	3	6	7	5	6	3	3	7
5	5	0	7	0	2	7	6	8	6

The University want;

The data to be presented in a suitable table for all candidates using equal classes of width **10**. Starting with a class of **20–29**.

To know the score obtained by half of the candidates who sat the test.

The number of candidates whose score exceeded **54.5** and they want to know whether their percentage is below **50%** so as to give a remedial test.

Task:

- Represent the above information on a suitable table for easy interpretation.

He normally receives a monthly salary of 300,000 Ugandan shillings with no additional allowances. However, the company will start deducting taxes from his pay every month, and he needs to determine his new take-home pay. The company will follow the tax brackets shown below:

Monthly taxable income (Ugx.)	Rate (%)
0–100,000	0
100,001–200,000	5
200,001–300,000	10

He needs to deliver the gift box to the customer and charges a delivery fee based on the amount of fuel used. His motorcycle uses 0.035 liters of fuel per kilometer, and he travels at an average speed of 20 meters per second. With fuel priced at 5,000 Ugandan shillings per liter, he wants to calculate the delivery fee. According to the customer, the journey will take 45 minutes.

TASK:

- Help Moses develop a sketch outlining the specifications he needs.
- What is the new salary Moses will be receiving monthly?
- How much will Moses charge the customer for delivery?

ITEM 18

Jane has a room that she plans to use as a hair salon. She has a wall paper of 4.7m^2 . The wall she plans to cover with the paper is 240 cm by 300 cm. She knows the wall paper she has is not enough. So she needs your advice on how much more she should buy. A roll of 10 m^2 of wall paper is sold at UGX 32,000. She also plans to use three employees and pay each of her employees a gross monthly salary of UGX 350,000. The gross monthly salary includes a non- taxable transport allowance of UGX 90,000. However, before she pays them, she has to deduct income tax as a requirement by the tax authority. The tax bands are shown the table below.

Monthly taxable income (shillings)	Tax rate (%)
0-100,000	0
100,001-200,000	5
200,001-300,000	15

Jane is having difficulty in using the tax bands. Task:

- How many more square meters of wall paper should Jane buy?
- How much will she pay for the extra wall paper?
- What is the total amount of income tax Jane will deduct from her employees?
- How much will she pay each of the employees as net salary?

ITEM 5:

Alice is supposed to pay 4 500 000 shillings per year to the university. This amount is divided in the ratio of 4:3:3 for her fees, accommodation and meals respectively. She is supposed to pay 60% of the fees in the first installment, pay $\frac{1}{3}$ of the remainder of the fees in second installment and the rest of the fees in the third installment.

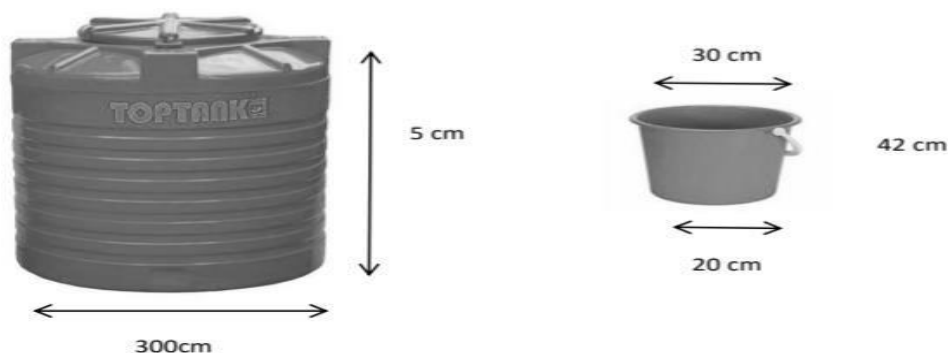
Alice is supposed to get the money for fees from a mobile money agent using a 4-digit code. For safety reasons, her father gave her the code written as 234 in base ten and Alice has to convert this code to base six to get the actual code.

Task

- a) How much will Alice pay for fees in the last installment?
- b) How much money will Alice pay for accommodation?
- c) Help Alice to determine the actual code for withdrawing the money from the mobile money agent.

ITEM 6:

James has been sent to a certain region to find out whether it is necessary to set up a new office for processing National Identity cards, Driving permits and passports, if the probability of a person having only one document is less than 50%. A well-known hotel in central Uganda, which provides services at an international level, is facing a water supply issue. They have been informed that the water will run out three weeks before it is replenished. The manager has access to a nearby borehole, from which water must be collected using a bucket. The bucket has a top diameter of 30 cm, a bottom diameter of 20 cm, and a height of 42 cm. The collected water is stored in a cylindrical tank that needs to be filled. The tank has a diameter of 300 cm and is 5 cm high. If 1 litre of water is shs 2,000 and each bucket carried is shs 500.



Ntungamo Hs	2	2	2
Nyakasura	3	2	1
Kyogera	0	2	4

	Win	Draw	Loss
Fort Portal	1	2	3
Ntungamo Hs	2	1	3
Nyakasura	2	3	1
Kyogera	1	4	1

The tournament followed a standard points system: three points for a victory, one point for a draw, and zero points for a defeat. Additionally, the four teams shared a prize pot of UGX 24,000,000, allocated proportionally to their points tally.

TASK

- a) (i) Assist the games teachers in plotting the buses' routes on a graph, enabling a more helpful evaluation of their journey.
- (ii) Provide the games teachers with the information needed to determine each school's transportation expenditure.
- (iii) Ascertain the first bus to arrive in Kampala and the time gap between its arrival and the subsequent bus.
- b) Ascertain the winning and last teams and amount given to each team that participated in the tournament.

ITEM 15.

A non-governmental organization aims to teach French, German, and English to lower primary school children in its community schools.

The organization intends to offer language instruction in French, German, and English to students in their schools. They plan to offer permanent positions to candidates who can teach all three languages, while those who can teach one or two languages will be hired on a contract basis. To fill these positions, they are soliciting applications from qualified teachers. Out of the applications received, 29 candidates can teach French, with 7 able to teach French only and 22 able to teach French plus one or both of the other languages. 27 candidates can teach German, with 9 able to teach German only and 18 able to teach German plus one or both of the other languages. 30 candidates can teach English, with 11 able to teach English only and 19 able to teach English plus one or both of the other languages. The organization will only consider candidates who are proficient in at least two languages for oral interviews. Your friend has been tasked with identifying the eligible candidate. And

ITEM 20

Esther, a S.3 student in your school has her father and mother working overseas. Her father visits her after every two terms, while her mother visits her every after four terms. Both parents last visited her in third term of her S.2. This term the school fees was increased to one million fifty thousand shillings. Because she is part of the school dance spot team, the school pays sixty percent of the school fees. The rest of the fees are paid by her father and mother in the ratio of 5:2 respectively. Her father has spared U~~g~~sh. 365000. to cater for her school fees and her pocket money.

Task:

- (a) Help Esther know when she will be visited by both her father and mother.
- (b) Assist Esther find how much she will receive from her father as pocket Money.

ITEM 21

The headteacher of Jinja Modern SS is thinking of how he can boost the mathematics department of your school. He can either add another teacher or buy more books or both. He has decided that he will do both if the average performance of this year's performance for the 50 students is lower than that of the previous which was 64. He asked the department to give a test and these were the student's marks.

86	30	26	64	87	47	49	26	43	25
45	38	44	56	59	52	76	27	89	46
90	57	73	48	58	89	51	32	56	88
66	62	52	67	69	68	49	92	66	95
54	74	32	39	35	36	69	50	71	92

He also visited the library and found out that previous candidates used three books for their revision; Longhorn, Baroque or Math Clinic. From the Librarian's records it is clear that those who did not use any books failed the subjects greatly. Out of the 50 candidates this year 13 used Longhorn, 20 used Baroque and 17 used Math Clinic. 9 used Longhorn and Math Clinic, 3 used Longhorn and Baroque while 8 used Baroque and Math Clinic only. The records show that 2 used all the three books. He observed that he should replace one book type of the three with Fountain Publisher since no student read it only alone.

charging each single room at Ugx.200,000 and each double room at Ugx. 400,000. So he needs to decide on how many rooms of each category he should construct to match his specifications and at the same time maximize income.

TASK

- a) (i) Form mathematical inequalities and expressions describing his situation.
- (ii) Suggest to him the space of single rooms and double rooms he can construct in and justify your suggestion.

THEME 3: DATA AND PROBABILITY

ITEM THREE:

Your guardian operates a catering company. He gave you a list of major ingredients he will need to cook beans and beef at the two occasions he was called at such that you help him account for how much he will need in total for both.

OCCASION ONE:

BEEF: 1 bucket of tomatoes, 2 bunches of onions and 2 liters of cooking oil.

BEANS: $\frac{1}{2}$ bucket of tomatoes, 1 bunch of onions, and 1 liter of cooking oil.

OCCASION TWO:

BEANS: $\frac{1}{2}$ bucket of tomatoes, 1 bunch of onions, and 1 litre of cooking oil

BEEF: $1\frac{1}{2}$ bucket of tomatoes, 3 bunches of onions and 2 litres of cooking oil.

UNIT PRICES:

A bucket of tomatoes is Ugx.10,000, a bunch of onions Ugx.5,000 and a liter of cooking oil at Ugx.7,000.

TASK:

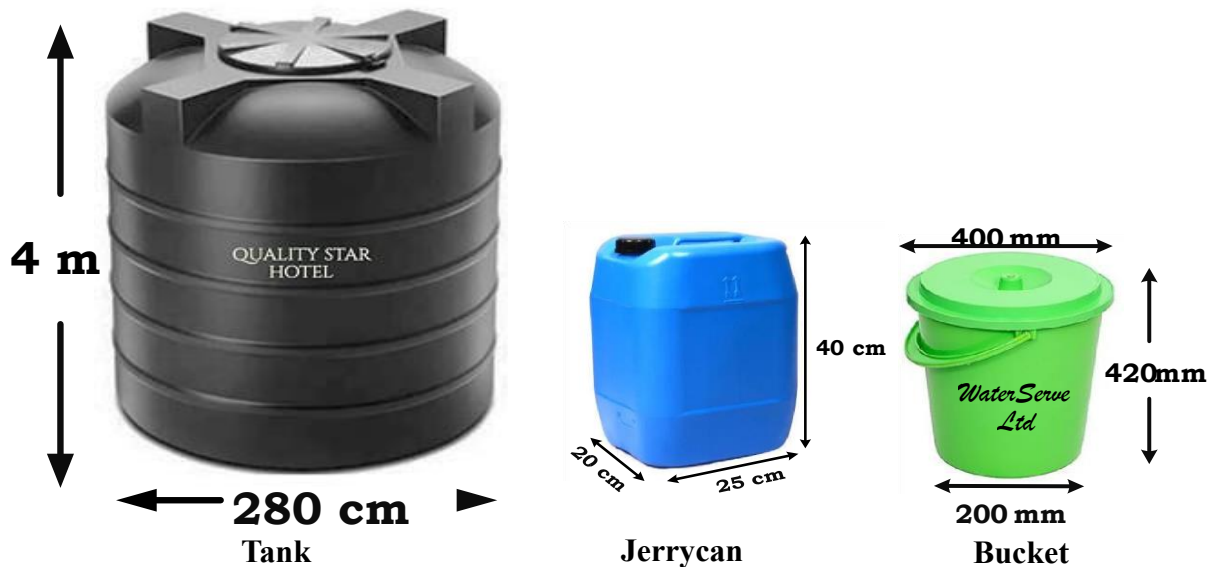
- a) What are the total quantities of each ingredient he will need for beef and beans respectively for both occasions combined?
- b) How much money will he need for both beef and beans respectively for both occasions combined?
- c) (i) If the total amount on the budget for both occasions is Ugx. 400,000. what percentage of that amount will go on ingredients?
(ii) According to the percentage, should he cut the budget for ingredients or not? Justify your answer.

- Assuming they were to buy the items before going to school, using the matrices help the father to determine how much he would give to each child.
- By use of matrices determine how much each child paid to the canteen attendant in order to acquire the items.
- Help the children determine how much each shared as pocket money after buying the items from the school canteen.

THEME 4: GEOMETRY AND MEASURES

ITEM 10

Quality Star Hotel is faced with a problem of water supply. The owner has instructed the Hotel Manager to contract **Water Serve Ltd** a water fetching company in the locality to fill the newly bought water tank at the Hotel within a period of not more than two weeks using an effective and efficient water fetching system. **Water Serve Ltd** has two **systems A** and **B** of fetching water. In system A, water is fetched using Jerrycans and system B that uses Buckets as shown below.



The Hotel tank has a base of diameter 280 cm and height of 4 m and the jerrycans are of dimensions of 20 cm by 25 cm by 40 cm while the buckets each has diameters of 400 mm and 200 mm respectively. In a day, Water Serve Ltd can only fetch 120 Jerrycans of water under system A or 100 Buckets when uses system B. The cost of water from the Commercial Reservoir is **shs 5/=** per litre. (**1 litre = 1000 cm³**). The transport charge per Jerrycan is **shs 300/=**

late. She decided to collect data about arrival time of the workers so as to make necessary adjustment in the starting time of the morning briefings. The data collected of the arrival time in minutes from the start of the briefing was as follows.

15 23 33 20 40 39 22 37 53 30
 32 28 47 54 34 21 58 37 26 42
 52 49 11 16 32 28 32 55 24 38
 46 36 46 27 52 41 27 38 59 33
 58 29 38 31 44 18 21 47 25 39
 24 47 49 51 34 48 19 55 44 35

Task:

- (a) With a reason based on the calculation from the data above, suggest the appropriate time when the morning briefings should always start.
- (b) Determine the maximum time of arrival for the first 50% of the workers.

Item 15	(a) Data sorted. Median = 30th value. Suggest new briefing start based on median arrival time. (b) 50% of 60 = 30th value in sorted list = 33 mins $\Rightarrow$ latest arrival of first half.
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ITEM 16.

A sports club surveyed 150 of its members on whether they participate in Athletics (A), Basketball (B), or Cricket (C). The survey revealed that 65 participate in Athletics, 55 in Basketball, and 50 in Cricket. 20 members participate in Athletics and Basketball, 15 participate in Basketball and Cricket, and 10 participate in Athletics and Cricket. It was also found that 5 members participate in all three sports, and 20 members do not participate in any of these three sports.

Task:

- (a) Represent this information on a diagram.
- (b) Determine the number of members who participate in:
 - (i) Athletics only.
 - (ii) Exactly two of the three sports.
- (c) If a member is chosen at random from the surveyed group, what is the probability that the member participates in:
 - (i) Basketball or Cricket.
 - (ii) At least one of the three sports.
- (d) Given that a randomly selected member participates in Athletics, what is the probability that they also participate in Basketball?

Item 16	(a) Venn diagram of $A = 65$, $B = 55$, $C = 50$. Overlaps $A \cap B = 20$, $B \cap C = 15$, $A \cap C = 10$, all three = 5. (b)(i) $A \text{ only} = 65 - 20 - 10 + 5 = 40$. (ii) Exactly two = $20 + 15 + 10 - 3 \times 5 = 15$. (c)(i) $B \cup C = 55 + 50 - 15 = 90 \Rightarrow P = 90/150 = 0.6$. (ii) At least one = $130/150 = 0.867$. (d) $P(B A) = 20/65 \approx 0.308$.
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ITEM 17.

Paul and Tom are playing a game, they have a bag containing **4 Green (G)** balls and **6 Yellow (Y)** balls. The total number of balls in the bag is 10. The rules of the game are; A person reaches into the bag, pull out one ball, and without putting it back, he would immediately reach in again and pull out a second ball. To win this challenge you should have the same colour by not going beyond the second trial.

Task:

- Illustrate this sequence of events on a probability tree diagram.
- What is the probability that a person win on the second trial?
- Find the probability that the ball selected on the second trial from a bag is green, given that the ball selected at first from the same bag is yellow.

Item 17	(a) Tree diagram: 1st: G (4/10), Y (6/10); 2nd: G/Y depends on first. (b) $P(\text{win on 2nd}) = P(G \text{ then } Y) + P(Y \text{ then } G) = 4/10 \times 6/9 + 6/10 \times 4/9 = 48/90 = 0.533$. (c) $P(G_2 Y_1) = 4/9$.
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ITEM 18.

Sarah is planning a journey from Town A to Town C, passing through Town B. The journey from A to B is 120 km, and from B to C is 80 km. She considers two travel options:

Option 1 (Car): Drive from A to B at a constant speed of 60 km/h, take a 30-minute break at B, and then drive from B to C at a constant speed of 80 km/h.

Option 2 (Bus): The bus travels directly from A to C. Its journey is represented on a distance-time graph starting at A (0 km) at time 0, reaching B (120 km) after 2.5 hours, waiting 15 minutes, then reaching C (200 km) after a total of 4 hours.

Task:

- If she is to consider Option 1 (Car), help her find:
 - The time she is going to take travel from A to B.
 - The time she is going to take to travel from B to C.
 - Determine total time taken for the entire journey, including the break.
- On the same axes, come up with distance-time graphs representing both

Sarah's car journey (Option 1) and the bus journey (Option 2) from Town A.

(c) Using your graph:

(i) Determine the time(s) when the car and the bus are at the same distance from Town A.

(ii) Estimate the distance from Town A when the car overtakes the bus.

Item 18	(a)(i) $A \text{ to } B: 120/60 = 2h$, (ii) $B \text{ to } C: 80/80 = 1h$, (iii) $Total = 3.5h$. (b) Plot both journeys on distance-time graph. (c) Find point of intersection for equal distance and overtaking.
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ITEM 19.

A small retail company in Kampala, Uganda, sells three products: coffee, tea, and snacks. The company has two branches, one in downtown Kampala and the other in Ntinda. In a given week the downtown branch sold 100 cups of coffee, 50 cups of tea and 200 snacks, the Ntinda in the same week sold 80 cups of coffee, 70 cups of tea and 150 snacks. If a cup of coffee costs Ugx 2,000, a cup of tea costs Ugx 1,000 and a packet of snack costs Ugx 500. The company manager wants to carryout financial computation to assess the performance of the two branches.

Task:

(a) Help the manager to represent the sales data as a matrix.

(b) Determine total sales for each product in both branches.

(c) Suppose the company wants to adjust its sales strategy based on a which is a transpose of the sales matrix. What would be the total sales for each product across both branches?

Item 19	(a) Sales matrix: $[[100, 50, 200], [80, 70, 150]]$ (b) Product totals: Coffee = 180, Tea = 120, Snacks = 350. (c) Transpose matrix and calculate revenue.
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ITEM 20.

Ms. Evelyn, the school counselor, wanted to organize some engaging after-school clubs but first needed to understand the students' interests. She surveyed 100 students, asking if they liked Mathematics (M), Physics (P), or Chemistry (C). The results were a bit complex: 55 students ticked Mathematics, 40 liked Physics, and 30 were keen on Chemistry. Overlapping interests included 20 for Math and Physics, 15 for Math and Chemistry, and 10 for Physics and Chemistry. A small group of 5 enthusiastic students liked all three. Ms. Evelyn needed a clear picture of these preferences to make informed decisions about the clubs.

Task:

(a) Illustrate the survey results showing the relationship between the students' subject preferences and their overlaps.

ITEM 28.

A community needed a large water storage solution, so they decided to install a cylindrical tank with a radius of 3.5 meters and a height of 6 meters. To protect it from the elements and make it look presentable, they planned to paint its entire outer surface, but understandably, not the part resting on the ground (the base). They found out the paint costs UGX 15,000 for every square meter it covers. They also wondered just how much water the tank could hold when full.

Task:

- (a) Calculate the external surface area of the cylindrical tank that needs to be painted, excluding the base.
- (b) Determine the total cost required to purchase the paint for the tank's exterior.
- (c) If 1 liter of water occupies a volume of 0.001m^3 , calculate the maximum volume of water (capacity) the tank can hold.

Item 28	(a) $\text{Surface} = 2\pi rh + \pi r^2 \text{ (top only)} = 2\pi \times 3.5 \times 6 + \pi \times 3.5^2$. (b) $\text{Total cost} = \text{area} \times 15,000 \text{ UGX}$. (c) $\text{Volume} = \pi r^2 h \Rightarrow \text{convert to litres: } \text{m}^3 \times 1000$.
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ITEM 29.

A graphic designer was working on a new logo based on a simple triangle with corners at $P(2, 1)$, $Q(5, 1)$, and $R(2, 5)$ on a digital grid. As part of the design process, she first created a mirrored version of the triangle by reflecting it across the y-axis, resulting in a new triangle $P' Q' R'$. Then, to explore variations, she took this new triangle $P'Q'R'$ and rotated it 90° counter clockwise around the center of the grid (the origin) to get the final shape $P'' Q'' R''$. She needed to know the precise locations of the corners of the transformed triangles and understand the overall effect of the two steps combined.

Task:

- (a) Determine the exact coordinates of the vertices of triangle $P' Q' R'$ after the reflection.
- (b) Find the precise coordinates of the vertices of triangle $P'' Q'' R''$ after rotating triangle $P' Q' R'$.
- (c) Analyze the relationship between the original triangle $P Q R$ and the final triangle $P'' Q'' R''$. Describe a single geometric transformation that would map triangle PQR directly onto triangle $P'' Q'' R''$.

Item 29	(a) $\text{Reflect across y-axis: } (x, y) \rightarrow (-x, y)$. (b) $\text{Rotate } 90^\circ \text{ CCW: } (x, y) \rightarrow (-y, x)$. (c) $\text{Combined} = \text{rotation of } 90^\circ \text{ around origin}$.
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(ii) Save after buying the seedlings.

(c) How much is needed to plant all the seedlings?

3(a)	Area on the map is 8.5cm^2 From the scale 1: 1500, 1 cm on the map represents 1500cm on ground 1cm represents 1500cm 1cm^2 on a map represents 1500^2cm^2 on ground 8.5cm^2 represents on $8.5 \times 1500^2\text{cm}^2$ $1\text{m} = 100\text{cm}$ $1\text{cm} = \frac{1}{100}\text{m}$ $1\text{cm}^2 = \frac{1}{100^2}\text{m}^2$ $8.5 \times 1500^2\text{cm}^2 = \frac{8.5 \times 1500^2}{100^2}\text{m}^2$
	$= 1912.5\text{m}^2$ $\therefore$ The actual area is 1912.5m^2 Since the actual area is less than 2000m^2, then he is going to plant cocoa.
(b)(i)	Number of 50m^2 in $1912.5\text{m}^2 = \frac{1912.5}{50}$ $= 38.25$ Amount spent to buy the whole land $= 8,000,000 \times 38.25$ $= \text{shs } 306,000,000$ $\therefore$ He spent to buy the whole land $= \text{shs } 306,000,000$
(ii)	Number of seedlings needed $= \frac{1912.5}{2.5}$ $= 765$ Amount spent to buy seedlings $= 765 \times 900$ $= \text{shs } 688,500$ Amount saved $= 750,000 - 688,500$ $= \text{shs } 61,500$
(c)	$\therefore$ The amount saved after buying seedlings is shs 61,500 Let the amount required to plant the seedling be x Amount needed to plant the seedling is $\frac{1}{8}x = 61,500$ $x = 8 \times 61500$ $x = 492,000$ $\therefore$ The amount needed to plant the seedlings is shs 492,000

ITEM 33

In a certain farm, the manager recorded the produce for two consecutive weeks as follows. Week one, 12 cows produced 100 liters of milk and in the second week when 3 more cows were brought, they recorded 125 litres of milk. The management would like to add more cows on the farm such that the produce can be 250 litres in the 3rd week, but is not sure of how many cows to add and they seek for your advice. In the same farm, they produce two types of crops beans and maize. In order to maximize produce, they need to plant at most 3 hectares of beans and a maximum of 2 more hectares of maize than

Task:

- (a) How can you use your mathematical skills to determine the mean number of customers that ordered for the dish in the 40 days.
- (b) Using a suitable graph determine the highest number customers that could have ordered for the dish on any one day of the period stated.

Part II

Answer one item from this part.

Item 5

A surveyor 1.5 m high standing 100metres away on the left of the base of the lighthouse, wants to determine the height of the lighthouse. He used the surveyors tool and measured the angle of elevation of the house as 35° . He then went up the lighthouse to a window 10 meters below the top of the house and looked down at a boat on the bank at the opposite side and measured the angle of depression of the boat as 28° . He also wants to know the distance between the him and the boat.

He observed the boat sailing out to sea from bank **A** in a direction of 075° for 800m towards point **B**. It then changed course and moved in a direction of 285° for 500m until it stopped before reaching point **C**.

Tasks:

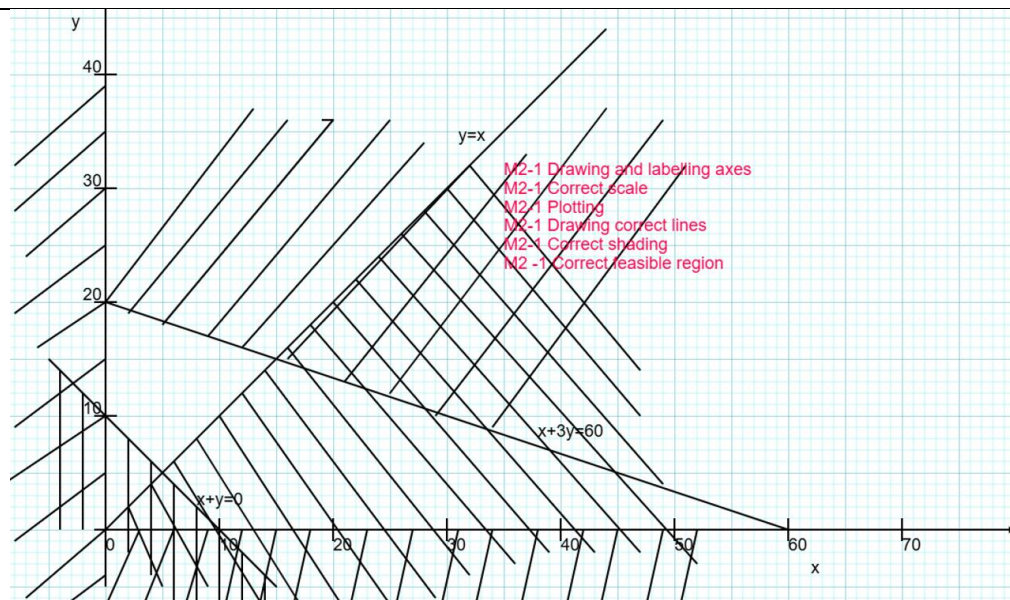
- (a) Help the surveyor determine the height of the light house and the distance between the surveyor and the first position of the boat.
- (b) Help the surveyor determine the distance the boat will cover to if it were to move directly from **A** to point **C**.

Item 6

A tent-making company has got an order from a client who wants a square-based tent with sides 12m and its vertical poles to stand at a height of 5m. Its roof is to be of the form of a right pyramid with its vertex standing 8m above the ground. Onyango was asked to determine the least amount of canvas material that would be needed to cover the roof and the three sides of the tent.

The tent costs shs1,300,000 but the company offers a discount of 3% if one pays cash but the client was not sure of the actual amount to pay.

Item 2



let the number of bags be x
let the number of pairs of shoes be y

$$40,000x + 120,000y \leq 2,400,000$$

$$x + 3y \leq 60$$

$$x + y \geq 10$$

$$x \leq y$$

$$x \geq 0$$

$$y \geq 0$$

equations of line

$$x + 3y = 60$$

$$x + y = 10$$

$$x = y$$

$$x = 0$$

$$y = 0$$

cordinates

$$x + 3y = 60$$

$$\text{when } x = 0, y = 20$$

$$\text{when } y = 0, x = 60$$

$$x + y = 10$$

$$\text{when } x = 0, y = 10$$

$$\text{when } y = 0, x = 10$$

$$x = y \rightarrow (1,1)(2,2)(20,20)$$

using $3000x + 9000y$

$$(15,15) \rightarrow 3000 \times 15 + 9000 \times 15 = 180,000$$

$$(0,20) \rightarrow 3000 \times 0 + 9000 \times 20 = 180,000$$

$$(0,15) \rightarrow 3000 \times 10 + 9000 \times 15 = 165,000$$

he can either make 15 bags and 15 pair of shoes for a maximum of Shs 180,000

OR He can either make 0 bags and 20 pairs of shoes for a maximum of shs 180,000

A venn diagram for the data

$F - 1$
Formation of variables

$F - 1$

$F - 1$

$F - 1$
Formation of correct inequalities

$F - 1$

$F - 1$
Formation of equation of lines

$M2 - 1$
Manipulating to get correct points to plot

$F - 1$
Formation of expression

$AP2 - 1$
For reading coordinates
 $AP2 - 1$
For testing coordinates

$AP2 - 1$
For choosing an optional coordinate

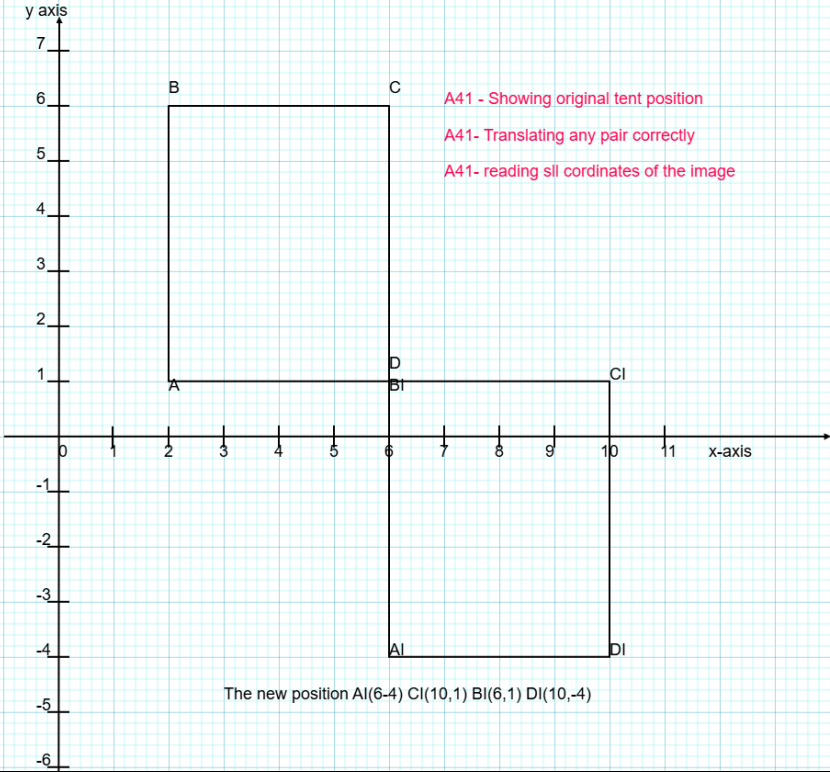
$AP2 - 1$
For maximizing profits

Item 3

$P - 1$
For title

$P - 1$
For running sets with correct set notation

			$\sum f$ = 40			$\sum fx$ = 5990	A3 – 1 sum of fx
	Mean number of customers = $\frac{\sum fx}{\sum f} = \frac{5990}{40}$ 149.75 ≈ 159 the mean number of customers that ordered the dish were 150 ON GRAPH therefore the highest number of customers that could have ordered for the dish was 154						A3 – 1 Inserting values correctly A3 – 1 For correct values of mean IN For response IN For response
THE HISTOGRAM FOR THE DATA A3 -For labelling axes A3 - For correct bars A3 -For locating the mode A3 -For reading mode MODE=154							

	$= 160.8m^2$ $\text{Total surface area} = 180 + 160.8$ $340.8m^2$ <i>the least amount of canvas material needs is</i> $340.8m^2$	
(b)	$\text{original cost} = \text{shs } 1,300,000$ $\text{discount} = 3\%$ $= \frac{3}{100} \times 1,300,000$ $= \text{Shs } 39,000$ $= 1,300,000 - 39,000$ $1,261,000$ <i>the client paid Shs 1,261,000 in cash</i>	<i>A4 – 1</i> <i>M4 – 1</i> <i>A4 – 1</i> <i>M4 – 1</i> <i>AP4 – 1</i>
	 The new position A1(6-4) C1(10,1) B1(6,1) D1(10,-4)	

END

(+256780413120)

LEARNING AREA; ELEMENT OF CONSTRUCT

ONE(NUMBERS)

ITEM ONE

Mukyawe and Gladys bought an acre of land in Jinja district at shs 7,000,000 on 01/06/2025 where they contributed 4,000,000 and 3,000,000 respectively. They portioned it into 8 plots and sold each plot at shs. 1,500,000. On each plot, the dealer (A person who brings the buyer) is given shs. 90,000, the LC1 chairperson is given 10% of the selling price and each witness is given 20,000. They only allow five witnesses to sign on the land agreement. Mukyawe and Gladys shared 7% of the actual excess money after selling all the plots in the ratio of their money contribution. They agreed to buy land again on the day they will both be off duty. Mr. Mukyawe is always off duty after every 4 days and Madam Gladys is off duty after every 7 days.

Task;

- (a) How much did Mukyawe and Gladys get from the excess money?
- (b) How much money will they use to buy land on the day they will meet again?
- (c) When will they buy land?

ITEM TWO

Your guardian had shs. 4,500,000 on his bank account. At the start of the term, he instructed your elder brother to withdraw 70% of the amount to cater for your school fees and cover other school needs. He gave him a PIN as 9,7 in base ten but each digit corresponds to some digits in base five which your brother couldn't identify correctly.

The ATM machine allows a maximum of 2,000,000 per transaction and it charges shs. 1,200 per withdrawal irrespective of the amount. Your brother ensured that he minimizes the withdraw charges as he withdraws. Later, after bringing the money, your guardian called your brother again to go and withdraw the remaining amount from the account. From that, he was to keep shs. 500,000 at home and then share the rest among himself, your sister and young brother in the ratio of 5:3:2 respectively.

The account's minimum balance (what must remain on the account) is shs. 10,000. Your guardian, used the money to buy pieces of clothes which measure $120m^2$, $150m^2$ and $210m^2$ respectively and he wishes to cut them into small pieces of the same size to make table clothes.

Task:

- (a) Help your brother to determine the;
 - (i) actual PIN
 - (ii) amount to be received by him, your sister and your young brother.
- (b) Determine the size of each table cloth and the number of table clothes he can get from the pieces he bought.

ITEM THREE

Your guardian who is in Kampala would like to set up a farm in your village. However, he has no land but you have identified the land that he can buy but he is so busy to the extent that he cannot come to see the available land. The area of the available land was indicated on the map which has a scale reading as

1: 1,500. The land occupies an area of $8.5m^2$ on that map. He said that if the actual area of land

- (b) Determine the possible number of motorcycles of each type that the factory owner should buy in order to achieve his target and hence find the amount saved.

ITEM SIX

Your friend owns a rectangular piece of land of which he wants to construct a house with a rectangular cross section leaving a path 2m around the house base. The path occupies an area of 76 m^2 and he also wants the dimensions of his house floor to differ by 3m.

He also owns a soft drink depot where he sells Crates of soda and boxes of juice. Tom bought 4 crates of soda and three boxes of juice and paid Shs 110,700. Tom's brother bought 3 crates of soda and 4 boxes of juice and paid Shs 122,400 but he is not contented about the money he paid claiming that he bought almost similar items as Tom but he has paid much money.

Task:

- a) (i) Determine the size of the floor base of your friend's house.
(ii) How big is your friend's piece of land?
- b) (i) Help Tom's brother to be contented with the payment he made.
(ii) How much would Ann pay if she buys 2 crates of soda and 2 boxes of water from the same depot?

LEARNING AREA; ELEMENT OF CONSTRUCT THREE (DATA & PROBABILITY) ITEM SEVEN

Your mathematics teacher has introduced a new rewarding system based on students' performance in the mathematics assessments. Your teacher has asked you to analyze the scores (in %) of the S2 students which were obtained in the recent mathematics assessment and recorded as given below in order to identify and submit the number of students who qualify for various awards.

28	94	35	78	70	56	57
58	76	60	77	62	84	66
67	61	98	70	96	64	73
74	41	75	62	54	80	83
88	69	90	47	64	70	75

Basing on the new rewarding system, students who score above 85% will receive shs 20,000 each, those who score between 80% and 85% inclusive will receive UGX 10,000 as a contribution towards their pocket. Those who score below 40% will receive written warnings. Additionally, the school administration has also decided to award those subject teachers whose subject average score is above 70% and if above 50% of your students in the class have scores below 60, you will be requested to be having mandatory weekly tests in order to better the grades.

Task.

- a) Will your mathematics teacher qualify for an award or not? Justify your answer.
- b) How many students qualify for each category of awards?
- c) Will your mathematics teacher be requested to have mandatory weekly tests or not? Justify your answer.

After finalizing the deal with the farmer in Lyantonde, he needs to return directly to his home in Kampala to prepare for the trip to Jinja.

In Lyantonde, he successfully negotiated the price for **600 pineapples**. The farmer's initial price was **UGX 5,000 per pineapple**. Because the entrepreneur is buying in bulk, the farmer offers a **7% discount** on the total bill. Additionally, the farmer gives a further **3% discount** for any customer paying in cash, which the entrepreneur does.

For the juice, he needs to buy large mixing containers. He purchases **3 cylindrical drums** of one size and **2 cylindrical drums** of another.

- The **smaller drum** has a base radius of **40 cm** and a height of **80 cm**.
- The **larger drum** has a base radius of **70 cm** and a height of **120 cm**.
He plans to fill these drums completely with juice to serve the festival guests.

TASKS:

- (a) Determine the shortest distance and the bearing the entrepreneur must follow to travel directly from Lyantonde back to his home in Kampala.
- (b) Calculate the total amount of money the entrepreneur paid for the **600 pineapples** after all applicable discounts.
- (c) If he fills all the drums he bought completely, what is the **total volume of juice** (in litres) he can prepare for the festival? (Use $\pi = \frac{22}{7}$ and note: 1 litre = 1000 cm³)

Item 3.

The chairperson of a rural community development association in Jinja has secured a grant to build a modern community learning center. The building's design is unique; the main hall is to be constructed in the shape of a regular octagon to maximize space and aesthetics. The local contractor has provided the cost based on the tiling of the floor. He explains that the area of each of the congruent isosceles triangles formed by drawing lines from the center of the octagon to its vertices will cost **UGX 15,000,000** to tile with high-quality ceramic material.

To facilitate the construction, the association needs to buy a sturdy pickup truck to ferry materials like cement, iron sheets, and timber from Jinja town to the site. They visit a local dealership and find a suitable Toyota Hilux.

- The **cash price** of the Hilux is **UGX 180,000,000**.
- As an alternative to cash, the dealership offers a hire-purchase option:
 - A **30% deposit** of the cash price is required.
 - The balance can be paid in **24 equal monthly installments** of **UGX 6,500,000**.

Item 39

A city park in Jinja features three interconnected geometric structures. The first is a large right pyramid with a square base of side 15 m. The slant edges of the pyramid are each 20 m long, and the vertex is directly above the centre of the base. At a height of 6 m above the base, a horizontal observation platform is to be built that cuts through the pyramid, creating a smaller similar pyramid above the platform and a frustum below. The second structure is a cylindrical fountain with a diameter of 8 m and a height of 2.5 m, surrounded by a conical spray dome that, when activated, forms an inverted cone of water with a base diameter of 10 m and a slant height of 7 m measured from the fountain's rim to the apex above. The third structure is a rectangular prism-shaped exhibition hall measuring 20 m by 12 m by 8 m high, with a flat roof on which a hemispherical glass dome of radius 4 m is mounted.

TASKS:

(a) For the square pyramid:

- (i) Calculate the vertical height of the entire pyramid.
- (ii) Determine the angle between a triangular face and the base plane.
- (iii) Find the dimensions of the square observation platform at 6 m above the base.
- (iv) Calculate the angle between a slant edge and the base plane.

(b) *For the fountain with conical water spray:*

- (i) Find the vertical height of the inverted water cone.
- (ii) Determine the angle between the slant height of the water cone and the horizontal plane.
- (iii) Calculate the volume of water in the cone when fully formed.

(c) *For the exhibition hall with hemispherical dome:*

- (i) Find the total volume of the hall including the dome.
- (ii) Calculate the external surface area of the dome (excluding the circular base where it meets the roof).
- (iii) Determine the angle between a diagonal of a side wall and the floor plane.

Item 40

A resort is being developed on a hilltop in Kabale, featuring several geometric structures. The main lodge has a roof in the shape of a right pyramid on a regular hexagonal base. Each side of the hexagonal base measures 5 m, and the slant edges from the vertex to each corner of the hexagon are all 12 m long. The vertex is directly above the centre of the hexagon. Adjacent to the lodge is an infinity pool in the shape of a trapezoidal prism. The pool has a depth that varies from 1.2 m at the shallow end to 2.4 m at the deep end, a width of 8 m, and a length of 15 m. The deep end face is vertical and rectangular. Behind the pool stands a cylindrical restaurant with a diameter of 14 m and a height of 6 m, topped with a conical roof. The conical roof has a slant height of 8 m and its base matches the cylinder's diameter. At the very top of the cone, a spherical decorative finial of radius 0.8 m is attached.

TASKS:

- (a) (i) Calculate the apothem (distance from centre to midpoint of a side) of the hexagonal base.
- (ii) Determine the vertical height of the pyramid.
- (iii) Find the angle between a slant edge and the base plane.
- (iv) Calculate the angle between a triangular face and the base plane.
- (b) (i) Find the volume of water the pool can hold when full.
- (ii) Determine the angle between the sloping floor of the pool and the horizontal plane.
- (iii) Calculate the angle between the deep end vertical face and the sloping floor.
- (c) (i) Find the vertical height of the conical roof.
- (ii) Calculate the total volume of the restaurant (cylinder + cone + sphere).
- (iii) Determine the angle between the slant height of the cone and the base plane.

Item 41

A university in Kampala is constructing a science complex consisting of three buildings. The first is a lecture theatre with a roof in the shape of a right pyramid on a rectangular base measuring 30 m by 20 m. The vertex is 10 m vertically above the centre of the base. Inside the theatre, a sloping floor is constructed as an inclined plane from the back wall to the front, rising 4 m vertically over a horizontal distance of 18 m. The second building is a laboratory block shaped like a cube of side 12 m, with a pyramidal roof on top. The pyramidal roof has a square base matching the cube and a vertical height of 4 m. The third structure is an observatory consisting of a cylindrical base of diameter 10 m and height 5 m, surmounted by a hemispherical dome of the same diameter. Inside the dome, a telescope is mounted such that its viewing axis makes an angle of 45° with the vertical.

TASKS:

- (a) (i) Calculate the length of a slant edge from the vertex to a corner of the base.
- (ii) Determine the angle between a slant edge and the base plane.
- (iii) Find the angle between a triangular face and the base plane.
- (iv) Calculate the angle between two adjacent triangular faces along their common slant edge.
- (b) (i) Determine the angle of inclination of the floor relative to the horizontal.
- (ii) If a spotlight is mounted on the ceiling directly above the highest point of the floor, find the angle between the light beam and the floor.
- (c) (i) Find the total height of the building from ground to roof vertex.
- (ii) Calculate the angle between a sloping edge of the roof and the vertical.
- (iii) Determine the angle between a roof face and the horizontal.
- (d) (i) Find the total volume of the observatory (cylinder + hemisphere).
- (ii) If the telescope is pointed at an angle of 45° to the vertical, calculate the angle its axis makes with the horizontal plane.
- (iii) Determine the angle between the telescope axis and a line from the centre of the dome to a point on the rim.

- (b) Calculate the cost of buying 5 litres of each brand without a discount.
- (c) Determine the cost of the bundle deal after applying the 5% discount.

Item 47

A school in Fort Portal orders textbooks from two publishers: Publisher A and Publisher B. The first order consisted of 40 books from Publisher A and 25 books from Publisher B, costing a total of UGX 1,225,000. The second order consisted of 30 books from Publisher A and 35 books from Publisher B, costing a total of UGX 1,275,000. The school needs to know the cost per book from each publisher to plan their annual budget. They also want to compare the prices with a third publisher who offers each book at UGX 32,000 regardless of the type.

TASKS:

- (a) Determine the cost of one book from Publisher A and one book from Publisher B.
- (b) Calculate the total cost if the school orders 50 books from Publisher A and 50 books from Publisher B.
- (c) Find how much the school would save (or spend extra) if they bought the same 100 books from the third publisher instead.

Item 47

An adult education centre in Arua offers two courses: literacy and numeracy. In January, 25 students enrolled in literacy and 30 enrolled in numeracy, generating a total fee revenue of UGX 2,450,000. In February, 20 students enrolled in literacy and 35 enrolled in numeracy, generating UGX 2,550,000. The centre director needs to determine the fee per course to evaluate the pricing strategy. Additionally, the director plans to introduce a combined course for both literacy and numeracy at a 15% discount off the total of the two individual fees.

TASKS:

- (a) Find the fee for the literacy course and the fee for the numeracy course.
- (b) Calculate the total revenue if 40 students enroll in literacy and 40 students enroll in numeracy at the current fees.
- (c) Determine the price of the combined course after applying the 15% discount.

Item 7

Maria and Liam are in the same math club. Maria is examining a red card that displays the numbers 32 and 51 written in base 7. Liam is examining a green card with the same numbers, but they are written in base 9. They are competing to find the smallest positive integer that can divide both numbers on their own card. Liam boasts that he will finish first because he is 4 years younger than Maria.

Tasks:

- a) Determine the correct answer (the least common divisor greater than 1) that Liam will find on his card.
- b) If the product of their ages is 252, how old is Maria?

Item 8

Two archaeologists, Dr. Aris and Dr. Stone, discover ancient tablets. Dr. Aris's tablet has the numbers 15 and 33 inscribed in base 5. Dr. Stone's tablet has the same numerical values, but inscribed in base 6. They each want to find the greatest common divisor of the two numbers on their own tablet. Dr. Aris believes he will solve it faster because he has 6 more years of experience than Dr. Stone.

Tasks:

- a) Find the greatest common divisor that Dr. Stone will calculate.
- b) If the sum of their years of experience is 54, what is Dr. Aris's experience?

Item 9

In a computer science challenge, Chloe and Sam are given different representations of the same data. Chloe's screen shows the hexadecimal numbers 1A and 2B. Sam's screen shows the same numerical values, but in base 12 (using 0-9 and A for 10, B for 11). They must find the least common multiple of the two numbers on their own screen. Chloe, who is 3 years younger than Sam, is confident she will get the answer first.

Tasks:

- a) Determine the least common multiple of the numbers on Chloe's screen (interpreting 1A and 2B as base-16 numbers).
- b) If the average of their ages is 18.5, how old is Sam?

Item 10.

Researchers Ben and Alex are decoding signals. Ben's signal displays the numbers 121 and 244, which are in base 4. Alex's signal displays the same numbers, but in base 5. They are racing to find the smallest number greater than 1 that divides both numbers on their respective signals. Alex claims he will win because he started his research 2 years before Ben.

Tasks:

- a) Plot your partner's location on a graph and compute the area of the exhibition hall.
- b) Calculate the total interest earned after 18 months.

Item 13

A music concert in Gulu has a capacity of 10,000 attendees. You are watching from the sound booth at (3, -2), and your friend is at the merchandise stall at (-2, 4). The performance zone is a rectangular field defined by points (-7, -4), (5, 4), (-7, 4), and (5, -4), with each unit representing 25 metres. Tickets cost UGX 8,000 per person. The cost to light every 5 metres of the perimeter is UGX 25,000, and 20% of the remaining revenue is divided equally among the 12 band members. The rest is placed in a bank account earning 4% simple interest per month.

Tasks:

- a) Graph the positions and find the area of the performance zone.
- b) Determine the total amount in the bank after 30 months.

Item 14

A community charity run in Fort Portal expects 4,500 participants. You are at the registration desk at (0, 5), and a friend is at the water station at (3, -3). The main event area is a rectangular field with corners at (-8, -3), (4, 5), (-8, 5), and (4, -3), where each unit is 12 metres. Each participant pays UGX 2,000. The cost to mark every 6 metres of the track is UGX 18,000, and 15% of the remaining funds is shared equally among the 25 volunteers. The remainder is deposited in a bank account with a 7% simple interest rate per quarter.

Tasks:

- a) Plot the water station and registration desk, then calculate the area of the field.
- b) Find the total interest earned after 3 years.

Item 15

A book fair in Masaka is set to host 7,200 visitors. You are seated at the author signing booth at (-3, 2), and your friend is at the snack bar at (4, -1). The main exhibition space is a rectangle with vertices at (-5, -4), (5, 4), (-5, 4), and (5, -4), with each unit equal to 8 metres. Entry is UGX 1,500 per person. The cost to install banners around every 4 metres of the perimeter is UGX 10,000, and 10% of the remaining money is shared equally among the 30 authors present. The rest is invested in a savings account with a 3% simple interest rate per month.

Tasks:

- a) Draw a graph showing your friend's location and determine the area of the exhibition space.
- b) Calculate the total amount in the bank after 2 years and 6 months.

Item 16

You went to the city library on 5th March 2024 with UGX 80,000, hoping to return with at least UGX 40,000 for grocery shopping. There, you meet a fellow student who tells you she visits the library every 5 days, while you go every 8 days. She mentions that she pays an annual membership fee of UGX 50,000 and then only UGX 5,000 per visit. You, however, pay UGX 12,000 per visit and usually go 4 times a month. After studying, you both decide to grab lunch at a nearby café, each spending UGX 28,500. Your new friend gets an urgent call and leaves before you can exchange contacts.

Tasks:

- a) i) What is the fewest number of days until you meet your friend again?
- ii) On what date will that next meeting occur?
- b) i) Calculate your total monthly library expenses.
- ii) Compare your cost with your friend's and suggest one way you could save money.

Item 17

On 10th April 2024, you visit a community park with UGX 120,000, needing at least UGX 60,000 left for a weekend trip. You meet a jogger who says she jogs at the park every 3 days, while you jog there every 7 days. She tells you she pays a yearly park pass of UGX 40,000 and then UGX 2,000 per visit. You, however, pay UGX 8,000 per visit and jog there 6 times a month. After your run, you both buy smoothies, each costing UGX 18,000. She gets a phone call and rushes off before you exchange numbers.

Tasks:

- a) i) How many days at minimum until you see her again?
- ii) Mark the exact date of your next meeting on a calendar.
- b) i) How much do you spend on park visits per month?
- ii) Compare this with her costs and explain who spends less and why.

Item 18:

You arrive at a swimming pool on 15th May 2024 with UGX 150,000, planning to keep at least UGX 70,000 for a friend's birthday gift. You meet a regular swimmer who says she comes every 6 days, while you come every 10 days. She pays a quarterly membership of UGX 60,000 plus UGX 4,000 per visit. You pay UGX 15,000 per visit and swim 3 times a month. After swimming, you both buy ice cream, each spending UGX 22,500. She receives an urgent message and leaves before you can ask for her contact.

Tasks:

- a) i) What is the shortest time until you meet her again?

ii) Calculate the total cost for the confirmed artists.

Item 26.

You are a builder stacking bricks: 6 bricks in the first stack, 10 in the second, 14 in the third, and so on. You are hosting a construction safety seminar for 300 registered workers, with two-thirds confirmed. The conference room costs UGX 400,000, and each attendee gets safety gear worth UGX 5,000. You leave at 6:00 a.m. to arrive by 9:00 a.m., traveling 5 km by boda boda and 25 km by taxi. The taxi's speed is 10 km/h faster than the boda boda's.

Tasks:

a) i) Form a mathematical relation for the number of bricks in any stack.

ii) How many bricks will be in the 8th stack?

b) i) Write a formula for total money spent based on attendance.

ii) Determine the total cost for the confirmed workers.

Item 27.

You are a chef preparing dishes for a menu: 2 appetizers on the first day, 5 main courses on the second, 8 desserts on the third, and so on. You are organizing a culinary workshop for 240 registered chefs, with five-eighths confirmed. The venue rental is UGX 380,000, and each attendee gets ingredients worth UGX 4,200. You leave home at 7:45 a.m. to arrive at 10:45 a.m., traveling 4 km by boda boda and 18 km by taxi. The taxi's speed is 5 km/h greater than the boda boda's.

Tasks:

a) i) Establish a relation to predict the number of dishes on any day.

ii) If you prepare pasta on the 11th day, how many dishes will there be?

b) i) Formulate an equation linking total cost to the number of attendees.

ii) Compute the total expenditure for the confirmed chefs.

Item 28:

You are a tailor making garments: 7 shirts in the first week, 11 trousers in the second, 15 jackets in the third, and so on. You are hosting a fashion design seminar for 200 registered designers, with three-fifths confirmed. The hall rental is UGX 320,000, and each attendee gets fabric samples worth UGX 2,800. You leave at 6:30 a.m. to arrive at 9:30 a.m., traveling 3 km by boda boda and 14 km by taxi. The taxi's speed is 4 km/h more than the boda boda's.

Tasks:

a) i) Derive a mathematical relation for the number of garments in any week.

ii) How many garments will be made in the 10th week?

b) i) Write a formula for total expenses based on attendance.

ii) Calculate the total cost for the confirmed designers.

Item 29:

You are a painter creating art pieces: 1 painting in the first month, 4 in the second, 7 in the third, and so on. You are organizing an art workshop for 175 registered artists, with four-sevenths confirmed. The studio rental is UGX 280,000, and each attendee gets paint supplies worth UGX 3,500. You leave home at 7:00 a.m. to arrive at 10:00 a.m., traveling 2 km by boda boda and 11 km by taxi. The taxi's speed is 5 km/h faster than the boda boda's.

Tasks:

- a) i) Find a relation to determine the number of paintings in any month.
- ii) How many paintings will be created in the 12th month?
- b) i) Develop a formula for total money spent based on the number of attendees.
- ii) Determine the total cost for the confirmed artists.

Item 30

You are a sound engineer working in a recording studio, tasked with removing background noise from a critical audio clip. The noise distortion can be modeled as a linear transformation given by the matrix $N = \begin{pmatrix} 1 & 2 \\ 0 & 3 \end{pmatrix}$, where the clean audio signal X is transformed into the noisy recording $Y = NX$. After restoring the original audio, you need to encrypt it before sending to a client. You use an encryption matrix $E = \begin{pmatrix} 2 & -1 \\ 3 & 0 \end{pmatrix}$, so the encrypted signal $Z = EX$.

Tasks:

- a) If the original audio signal is represented by $X = \begin{pmatrix} 4 \\ 5 \end{pmatrix}$, find the noisy recording Y .
- b) Determine the encrypted signal Z using the same original signal X .

Item 31:

You are a data analyst at a weather station, correcting distorted temperature readings from a faulty sensor. The distortion follows a linear model $Y = AX$, with $A = \begin{pmatrix} 3 & 1 \\ 2 & 4 \end{pmatrix}$, where X is the true temperature vector and Y is the distorted output. After correction, you must encode the data for secure transmission using an encoding matrix $E = \begin{pmatrix} 1 & 2 \\ 2 & 3 \end{pmatrix}$, giving encoded data $Z = EX$.

Tasks:

- a) Given true temperatures $X = \begin{pmatrix} 10 \\ 20 \end{pmatrix}$, compute the distorted readings Y .
- b) Find the encoded data Z for the same X .

bought at UGX 1,400 and sold at UGX 2,400, 250 juices bought at UGX 1,900 and sold at UGX 3,200, and 350 waters bought at UGX 750 and sold at UGX 1,400. Entebbe has 600 sodas bought at UGX 1,600 and sold at UGX 2,600, 400 juices bought at UGX 2,100 and sold at UGX 3,600, and 500 waters bought at UGX 850 and sold at UGX 1,600. Masaka has 550 sodas bought at UGX 1,450 and sold at UGX 2,450, 350 juices bought at UGX 1,950 and sold at UGX 3,400, and 450 waters bought at UGX 780 and sold at UGX 1,450. Lyantonde has 400 sodas bought at UGX 1,300 and sold at UGX 2,300, 200 juices bought at UGX 1,800 and sold at UGX 3,000, and 300 waters bought at UGX 700 and sold at UGX 1,300.

Tasks:

- a) Create matrices for inventory quantities, buying prices, and selling prices across all supermarkets.
- b) Calculate the total revenue each supermarket would generate if all drinks are sold and identify the supermarket with the highest revenue.

Item 42:

A hardware store chain with outlets in Arua, Lira, Soroti, and Tororo stocks three products: cement, iron sheets, and nails. The Arua outlet has 800 bags of cement bought at UGX 25,000 and sold at UGX 32,000, 500 iron sheets bought at UGX 40,000 and sold at UGX 55,000, and 1,200 boxes of nails bought at UGX 5,000 and sold at UGX 8,000. Lira has 700 cement bags bought at UGX 24,000 and sold at UGX 31,000, 450 iron sheets bought at UGX 38,000 and sold at UGX 52,000, and 1,000 nail boxes bought at UGX 4,800 and sold at UGX 7,500. Soroti has 900 cement bags bought at UGX 26,000 and sold at UGX 33,000, 600 iron sheets bought at UGX 42,000 and sold at UGX 58,000, and 1,500 nail boxes bought at UGX 5,200 and sold at UGX 8,500. Tororo has 750 cement bags bought at UGX 23,000 and sold at UGX 30,000, 400 iron sheets bought at UGX 37,000 and sold at UGX 50,000, and 1,100 nail boxes bought at UGX 4,500 and sold at UGX 7,200.

Tasks:

- a) Use matrices to represent the inventory, cost, and selling price data for all outlets.
- b) Calculate the total profit for each outlet if all stock is sold and rank the outlets by profit.

Item 43:

A electronics retailer has four stores in Kampala, Nairobi, Kigali, and Dar es Salaam, each selling laptops, tablets, and smartphones. Kampala has 150 laptops bought at \$400 and sold at \$600, 200 tablets bought at \$150 and sold at \$250, and 300 smartphones bought at \$200 and sold at \$350. Nairobi has 180 laptops bought at \$380 and sold at \$580, 220 tablets bought at \$140 and sold at \$240, and 350 smartphones bought at \$190 and sold at \$340. Kigali has 120 laptops bought at \$420 and sold at \$620, 180 tablets bought at \$160 and sold at \$260, and 250 smartphones bought at \$210 and sold at \$360. Dar es Salaam has 200 laptops bought at \$390 and sold at \$590, 250 tablets bought at \$145 and sold at \$245, and 400 smartphones bought at \$195 and sold at \$345.

1,800 kg of sugar bought at UGX 3,900 and sold at UGX 5,400, and 1,100 kg of flour bought at UGX 2,400 and sold at UGX 3,900. Mbale has 1,600 kg of rice bought at UGX 3,600 and sold at UGX 5,100, 2,100 kg of sugar bought at UGX 4,100 and sold at UGX 5,600, and 1,300 kg of flour bought at UGX 2,600 and sold at UGX 4,100. Gulu has 1,400 kg of rice bought at UGX 3,450 and sold at UGX 5,050, 1,900 kg of sugar bought at UGX 3,950 and sold at UGX 5,450, and 1,150 kg of flour bought at UGX 2,450 and sold at UGX 3,950.

Tasks:

- a) Create matrices for inventory levels, buying prices, and selling prices across all stores.
- b) Calculate the total value of each item (rice, sugar, flour) across all stores at selling price.

Item 51.

A sports equipment supplier provides three types of gear, footballs, basketballs, and tennis rackets to five sports clubs in Kampala, Wakiso, Mukono, Jinja, and Entebbe. Kampala club has 400 footballs bought at UGX 15,000 and sold at UGX 25,000, 300 basketballs bought at UGX 20,000 and sold at UGX 30,000, and 200 tennis rackets bought at UGX 30,000 and sold at UGX 45,000. Wakiso has 350 footballs bought at UGX 14,000 and sold at UGX 24,000, 250 basketballs bought at UGX 19,000 and sold at UGX 29,000, and 150 tennis rackets bought at UGX 28,000 and sold at UGX 43,000. Mukono has 450 footballs bought at UGX 15,500 and sold at UGX 25,500, 350 basketballs bought at UGX 20,500 and sold at UGX 30,500, and 250 tennis rackets bought at UGX 31,000 and sold at UGX 46,000. Jinja has 380 footballs bought at UGX 14,500 and sold at UGX 24,500, 280 basketballs bought at UGX 19,500 and sold at UGX 29,500, and 180 tennis rackets bought at UGX 29,000 and sold at UGX 44,000. Entebbe has 420 footballs bought at UGX 15,200 and sold at UGX 25,200, 320 basketballs bought at UGX 20,200 and sold at UGX 30,200, and 220 tennis rackets bought at UGX 30,200 and sold at UGX 45,200.

Tasks:

- a) Use matrices to represent the inventory, cost, and selling price data for all clubs.
- b) Calculate the total profit for each club if all gear is sold and identify the club with the highest profit margin.

Item 52:

From the top of a lighthouse 45 m high, a coast guard spots a sailboat and a buoy. The angle of depression to the sailboat is 15° , and the angle of depression to the buoy is 22° . The sailboat is directly in line with the buoy but farther from the lighthouse. On the opposite side of the lighthouse, a cliff rises to a height of 80 m. From the top of the cliff, the angle of depression to the base of the lighthouse is 18° .

Tasks:

- a) Find the distance between the sailboat and the buoy.
- b) i) Determine the horizontal distance from the cliff to the lighthouse.

Tasks:

- a) Calculate the distance between the two pylons.
- b) i) Determine the horizontal distance from the wind turbine to the dam.
ii) If a control room is located 120 m from the dam toward the turbine, find the angle of depression from the top of the turbine to the control room.

Item 60:

From the top of a hotel 55 m high, a guest sees a fountain and a gazebo. The angle of depression to the fountain is 10° , and to the gazebo is 15° . The gazebo is farther from the hotel. On the opposite side, a church spire rises 75 m high. From its top, the angle of depression to the base of the hotel is 21° .

Tasks:

- a) Find the distance between the fountain and the gazebo.
- b) i) Calculate the horizontal distance from the church to the hotel.
ii) If a market stall is located 90 m from the hotel toward the church, find the angle of depression from the top of the church to the stall.

Item 61:

From the top of a silo 20 m high, a farmer sees two tractors in a field. The angle of depression to the first tractor is 7° , and to the second is 12° . The second tractor is farther away. On the far side, a barn stands 40 m high. From its roof, the angle of depression to the base of the silo is 14° .

Tasks:

- a) Determine the distance between the two tractors.
- b) i) Find the horizontal distance from the barn to the silo.
ii) If a haystack is located 60 m from the silo toward the barn, calculate the angle of depression from the top of the barn to the haystack.

Item 62:

From the top of a skyscraper 150 m high, an observer sees two landmarks. The angle of depression to the first landmark is 5° , and to the second is 11° . The second landmark is farther. On the other side, a radio mast stands 180 m tall. From its top, the angle of depression to the base of the skyscraper is 8° .

Tasks:

- a) Calculate the distance between the two landmarks.
- b) i) Determine the horizontal distance from the radio mast to the skyscraper.
ii) If a park is located 200 m from the skyscraper toward the mast, find the angle of depression from the top of the mast to the park.

year. Entry fees are UGX 25,000 for adults and UGX 10,000 for children, with 60% of visitors being adults. The park plans to build a new visitor center costing UGX 3.5 billion, funded by a loan at 7% annual compound interest over 10 years. Additionally, they want to construct a circular observation tower with a diameter of 30 m and a height of 50 m, with a conical roof. The tower's base will be a concrete cylinder, and the roof will be covered with solar panels.

Tasks:

- a) i) Calculate the annual revenue from entry fees for the current year and project it for 5 years, accounting for visitor growth.
- ii) Determine the total loan repayment amount after 10 years.
- b) i) Find the volume of the concrete cylinder (height 50 m, diameter 30 m) and the surface area of the conical roof (slant height 55 m).
- ii) If solar panels cover 80% of the roof area and generate 150 kWh per square meter per year, calculate the annual energy output.

Item 78.

A logistics company operates a fleet of 50 trucks to deliver goods to 12 distribution centers across the country. The distances between the main warehouse and each center are: 120 km, 85 km, 200 km, 150 km, 95 km, 175 km, 110 km, 130 km, 140 km, 160 km, 180 km, and 125 km. Each truck consumes diesel at 3 km per litre, and diesel costs UGX 4,500 per litre. The company wants to minimize fuel costs by optimizing routes. They also plan to purchase 10 new electric trucks at UGX 120 million each, financed by a bank loan at 9% annual compound interest over 5 years. The current trucks have an average age of 6 years and depreciate at 15% per year on a reducing balance.

Tasks:

- a) i) Calculate the total weekly fuel cost if each center receives one delivery per week, assuming trucks return empty (round trip distance).
- ii) Determine the annual fuel cost and the total distance covered annually.
- b) i) Find the total cost of the new electric trucks including interest over the loan period.
- ii) Calculate the current total value of the existing truck fleet after 6 years of depreciation and the value after 2 more years.

Item 79.

A regional hospital is expanding its capacity by adding a new wing with 150 beds. The current hospital has 300 beds, with an average occupancy rate of 85%. Patient arrivals follow a Poisson distribution with a mean of 45 patients per day. The average length of stay is 4 days. The new wing will cost UGX 25 billion to construct, funded by a government grant and a loan of UGX 10 billion at 6% annual compound interest over 12 years. The hospital also plans to install a solar power system on the roof, which has an area of 2,400 m². Solar panels generate 180 W/m² and cost UGX 350,000 per m² installed. The hospital expects to save 30% on electricity bills, currently UGX 120 million per month.

Tasks:

- a) i) Determine the current average number of patients in the hospital and the number of additional patients that can be accommodated with the new wing at the same occupancy rate.
- ii) Calculate the probability that more than 50 patients arrive on a given day (using Poisson distribution).
- b) i) Find the total loan repayment amount after 12 years and the annual installment.
- ii) Calculate the cost of the solar system, the annual electricity savings, and the payback period in years.

Item 80.

A real estate developer plans to build a mixed-use complex with 200 apartments, 50 shops, and a parking garage. The apartments are of three types: 1-bedroom (80 units, 60 m² each), 2-bedroom (90 units, 85 m² each), and 3-bedroom (30 units, 120 m² each). The shops are each 50 m². The land area is 12,000 m², and the building coverage ratio is 60%. Construction costs are UGX 2.8 million per m² for apartments and UGX 2.2 million per m² for shops. The developer secures a loan of UGX 150 billion at 11% annual compound interest, repayable over 15 years. Rental income is projected at UGX 120,000 per m² annually for apartments and UGX 180,000 per m² for shops. Operating expenses are 25% of rental income.

Tasks:

- a) i) Calculate the total built-up area for apartments and shops, and verify if it exceeds the allowable coverage.
- ii) Determine the total construction cost and the annual loan repayment amount.
- b) i) Find the annual net operating income from rentals.
- ii) Calculate the net present value (NPV) of the project over 15 years if the discount rate is 10%, and advise whether the project is viable.

Item 81.

A conservation organization plans to reforest a degraded area of 800 hectares with indigenous trees. The planting schedule follows an arithmetic progression: 20 hectares in the first year, 30 in the second, 40 in the third, and so on. The cost per hectare for planting is UGX 2.5 million, including seedlings and labor. After planting, maintenance costs are UGX 400,000 per hectare per year for the first 5 years. The organization receives a grant of UGX 5 billion and invests the remainder in a fixed deposit at 7% compound interest per annum. The trees are expected to sequester carbon at a rate of 12 tonnes per hectare per year, and carbon credits sell at UGX 45,000 per tonne. The project also includes building a rectangular ranger post measuring 8 m by 6 m with a pyramidal roof of height 3 m.

Tasks:

- a) i) Determine how many years it will take to complete the reforestation and the total planting cost.

250,000, medical shs 180,000, tool allowance shs 120,000, communication shs 90,000, and project allowance shs 200,000. He contributes 9% of his gross salary to a company pension scheme. He pays shs 150,000 for a professional engineering license annually (spread over 12 months) and shs 80,000 for staff welfare. He has a loan repayment of shs 320,000 monthly.

Tasks:

- a) Calculate Eng. Wasswa's monthly taxable income, monthly PAYE, and his monthly net pay in UGX.
- b) If the exchange rate is 1 USD = 3,830 UGX, find his annual net pay in dollars. Also calculate the percentage of his gross income that is deducted for PAYE and pension combined.

Item 122.

Captain Okot is a commercial airline pilot based at Entebbe International Airport. His gross monthly salary is shs 12,500,000. His allowances include: housing shs 1,500,000, transport shs 600,000, medical shs 400,000, flight allowance shs 800,000, per diem shs 350,000, and risk allowance shs 500,000. He contributes 12% of his gross salary to a private pension fund. He pays shs 450,000 monthly for life insurance and shs 280,000 for a health plan. He also has a mortgage repayment of shs 1,200,000 deducted monthly. Using the Uganda tax brackets, compute his net pay.

Tasks:

- a) Determine Captain Okot's monthly taxable income, monthly PAYE, and his monthly net pay in UGX.
- b) Convert his annual net pay to US dollars at 1 USD = 3,820 UGX. Also calculate the effective tax rate and the total deductions as a percentage of gross income.

Item 123.

Ms. Atim is a Senior State Attorney in the Uganda Judiciary. Her gross monthly salary is shs 3,450,000. Her allowances are: housing shs 450,000, transport shs 200,000, medical shs 150,000, commuter allowance shs 100,000, professional allowance shs 120,000, and responsibility allowance shs 180,000. She contributes 8% of her gross salary to the Judiciary Pension Scheme. She pays shs 50,000 to the Uganda Law Society and shs 40,000 for staff welfare. She also has a car loan repayment of shs 250,000 monthly. She receives a monthly court sitting allowance of shs 150,000.

Tasks:

- a) Calculate Ms. Atim's monthly taxable income, monthly PAYE, and her monthly net pay including court sitting allowance.
- b) If she receives a 20% bonus in June, determine her June net pay in dollars at 1 USD = 3,840 UGX. Also find her average monthly net pay for the year.

Item 148.

Patrick departs from his office 41 km on a bearing of 140° to a client. From the client, he changes course to $S70^\circ E$ and moves 39 km to reach his home. He wants to construct a new home office and needs a loan of UGX 22 million at 6.5% interest compounded semi-annually for 8 years. His monthly gross salary is UGX 1,920,000, with allowances: housing and transport 12% of gross, insurance UGX 52,000, family allowance UGX 118,000, and medical UGX 90,000. Tax brackets: 0-90,000 at 6%, 90,001-200,000 at 13%, 200,001-330,000 at 20%, 330,001-450,000 at 30%, 450,001-560,000 at 40%, above 560,000 at 47%.

Tasks:

- a) i) Find the direct distance from Patrick's office to his home.
- ii) If his vehicle uses 0.6 liters per km and fuel costs UGX 4,800 per liter, calculate the fuel cost for the direct route.
- b) i) Compute Patrick's monthly taxable income and net pay.
- ii) Determine the total loan repayment and monthly installment.

Item 149.

Susan travels from her shop 30 km on a bearing of 100° to a wholesaler. From the wholesaler, she proceeds on a bearing of $N60^\circ W$ for 44 km to reach her store. She plans to renovate the store and needs a loan of UGX 16 million at 6% interest compounded monthly for 6 years. Her monthly gross income from business is UGX 1,280,000, with allowances: housing and transport 10% of gross, insurance UGX 39,000, child allowance UGX 90,000, and medical UGX 70,000. Tax brackets: 0-82,000 at 6.5%, 82,001-185,000 at 14%, 185,001-305,000 at 21%, 305,001-425,000 at 31%, 425,001-535,000 at 41%, above 535,000 at 47%.

Tasks:

- a) i) Calculate the direct distance from Susan's shop to her store.
- ii) If her car consumes 0.55 liters per km and petrol costs UGX 4,700 per liter, find the fuel cost for the direct route.
- b) i) Determine Susan's monthly taxable income and net pay.
- ii) Calculate the total loan repayment and monthly installment.

Item 150.

George leaves his farm 37 km on a bearing of 260° to a cooperative. From the cooperative, he goes on a bearing of $S20^\circ W$ for 49 km to reach his home. He wants to build a new barn and needs a loan of UGX 23 million at 7% interest compounded quarterly for 9 years. His monthly gross income from farming is UGX 2,100,000, with allowances: housing and transport 13% of gross, insurance UGX 60,000, family allowance UGX 132,000, and medical UGX 100,000. Tax brackets: 0-93,000 at 6%, 93,001-206,000 at 13%, 206,001-336,000 at 19%, 336,001-466,000 at 29%, 466,001-586,000 at 39%, above 586,000 at 46%.

Tasks:

- a) i) Find the direct distance from George's farm to his home.
- ii) If his vehicle uses 0.65 liters per km and fuel costs UGX 5,000 per liter, calculate the fuel cost for the direct route.
- b) i) Compute George's monthly taxable income and net pay.
- ii) Determine the total loan repayment and monthly installment.

END