GOOD SAMARITAN HIGH SCHOOL
(MATHEMATICS QUESTIONS)
NEW LOWER SECONDARY CURRICULUM ITEMS

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

SECTION A

(Numbers, Patterns and Algebra)

ITEM 1

The new farm manager who started work at Sugar Corporation of Uganda Limited's Lugazi farm on Monday was unable to access the farm store, which held critical records, due to password–protected locks. He reached out to the farm owner, who replied with a message revealing that the password was a two-digit base eleven numeral. The pin had the characteristic that the total of its digits equaled 17, with the first digit being 4 greater than the second.

He gained entry to the store and obtained access to the records, revealing that the farm had a sizable amount of land available for crop cultivation. He intended to allocate 14% of the land for corn, 30% for wheat, and the remainder for soya beans, with a specific focus on planting corn on 42 – acres. Meanwhile, he discovered that his 12 farm workers could cultivate 15 acres every 4 days.

TASK

a) Educate the new manager on the pin's decimal representation.
b) Ascertain the farm's total land area and the remaining acres suitable for soybean growth.
c) Help the farm manager understand how long it will take workers to get the land ready for planting.

ITEM 2

At the beginning of term two, Kumasi secondary school's administration faced a pressing issue: - a shortage of dormitory space for students. To address this sleeping accommodation deficit, the school's management developed a plan to construct new hostels with a rectangular design, where the length is

√3 times the width, resulting in a perimeter of (14+6√3) units. To fund this project, the administration required a 97% collection rate of school fees from students

By the end of the first week of the term, two-thirds of the student body had settled their fees. In the subsequent week, an additional 100 students paid their fees, resulting in a significant increase in the proportion of students who had paid their fees, reaching three-quarters of the total student population.

TASK

a) Guide the school management to ascertain the land area, ensuring a surd form solution with rationalized numerals and simplified radicals.
b) Ascertain the precise number of students in the school.
c) Guide the school administration on whether the construction can be undertaken, with supporting reasons.

ITEM 3

Garden City Shopping Mall in Kampala is experiencing a massive turnout of customers, leading to a critical shortage of parking spaces. To address this challenge, the mall's management has planned an innovative solution: - a triangular rooftop parking design, exclusively designed for compact cars, each spanning an area of 0.2 square units, to cater for the growing demand of space. The parking area is bounded by the following constraints; $x + y < 3$, $x - y + 3 \geq 0$, and $y + 1 \geq 0$. To capitalize on the high demand for parking, the mall plans to impose a parking fee of Shs 2500 per vehicle, with calculations indicating that on peak days, the cars will occupy a total area of 12.4 square units, yielding a significant income source.

TASK

a) (i) Create a graphical representation on paper to help Garden City management accurately visualize and understand the layout and boundaries of the new parking design.
   (ii) Assist the management in identifying the accurate coordinates and size of the new parking area in square units.
   (ii) Will the new design accommodate the expected maximum number of vehicles? If so, determine the maximum number of cars that can be accommodated in the new parking area at full capacity.
b) Forecast the mall's daily highest revenue on a peak day.

ITEM 4

Mr. Richard received an envelope contained a piece of paper with the number 31, which needed to be converted to a ternary numeral system (**base three**) to unlock the secret code to gain access to his office strongbox. But, to their dismay, **none** of the family members recalled how to perform the conversion, and they turned to you for assistance.

Upon opening the safe, they discovered a staggering **349 million** shillings and **a will** outlining the distribution of the wealth. The will stipulated that the wife was to receive 40% of the total, the eldest son was to receive one-third of the remaining amount, and the two younger children were to share the balance in a 2:3 ratio according to their birth order. To ensure a fair and impartial distribution, your expertise was sought once again to calculate the exact share for each beneficiary, preventing any potential disputes or biases.

TASK;

a) Show how you helped your cousins unlock the safe, showing each step clearly
b) Show, with step-by-step calculations, how you helped the family allocate the funds among its members, and share your thoughts on the distribution's fairness.

ITEM 5

The Uganda Women's Finance and Credit Trust has arranged a group outing for its members, using two vehicles; a bus and a van. with 171 participants having paid the required fees, a total of UGX 400,000 has been allocated for transportation costs. Your sister, who is responsible for managing the transportation, needs your mathematical expertise to optimize the vehicle hire strategy. She wants to minimize transportation costs while ensuring the van, which is faster and can carry 19 people at UGX 50,000 per trip, makes more trips than the bus, which can carry 57 people at UGX 80,000 per trip.

TASK;

(a) Express the information as mathematical statements

(b) Help your sister **minimize** transportation expenses by determining the number of trips each vehicle should make, using the mathematical statements in (a) above.

ITEM 6

Molly started a wholesale business while still at her parent's home. Below is how she plans to use her net profits.

- 20% of the net profits to be re-invested in the business.
- Part of the balance is to be saved in her savings account and the rest is to be for her major personal expenses. This will be in the ratio of 1:3 respectively.

She plans to move out of her parent's house if the portion of her net profits that she plans to spend on her major personal expenses can cover all of them. Her major expected personal expenses are; house rent of about UGX.300,000, and groceries of about UGX. 200,000 and transport of about UGX. 100,000. The business made a net profit of one million five hundred thousand Uganda shillings in the first month.

She bought 36 bars of bathing soap and 18 packets of detergent that were all to be packed by her worker in such a way that each package contained the same number of both items. The packages were to be given to those who bought goods in plenty as gifts. All packages were given out before Molly got to know the highest number of packages that her worker was able to make out of the bought items.

TASK:

a) (i) How much of her net profit does she plan to re-invest in the business?
b) (ii) How much of her net profit does she plan to spend on personal expenses?
(iii) Will Molly move out of her parents' house? Justify your answer.
c) Help Molly to know the highest number of packages her worker was able to make out of the items she bought.

ITEM 7

James is starting a baking business, selling cakes and cookies. To estimate profits, he consulted a friend in the industry. The friend shared data from their own experience: Initial phase: 40 cakes, 30 cookies, total profit UGX 29,000; Later phase: 50 cakes, 20 cookies, total profit UGX 31,000.

James aims to start by producing at least 120 items (cakes and cookies combined). Since cakes sell more, he wants to make at most 80 cakes and at most 60 cookies. He needs to determine the optimal number of cakes and cookies to produce initially.

TASK;

a) What are the expected earnings from each cake and cookie, based on his friend's experience?
b) (i) What mathematical inequalities are making decision-making hard for James?
(ii) Use the inequalities to help him decide on the highest number of cakes and cookies he can start with.

SECTION B: PART I

(DATA AND PROBABILITY)

ITEM 8

To enhance the yields of Rice, Beans, Sugarcane, and Peas in Iganga district, the Ministry of Agriculture's Farmer Training and Capacity Building program conducted a survey, yielding the following findings; Among the 80 rice farmers surveyed, 45 also grow beans, 60 cultivate sugarcane, and 5 focus solely on peas and rice. Additionally, 5 farmers dedicate their land solely to rice. The number of farmers who grow beans, sugarcane, peas, and rice is equal to those who grow peas, sugarcane, and rice. Moreover, the farmers who cultivate rice, and sugarcane only are equal in number to those who grow rice, peas, and beans, and are 5 fewer than those who grow all four crops.

The ministry plans to provide support to these farmers as follows:

- A farmer who cultivates all four crops (beans, sugarcane, peas, and rice) will receive a package consisting of 4 tractors and a cash grant of UGX 3,000,000.
- One who plants only three crops will receive 3 tractors and UGX 2,000,000.
- A farmer who grows two crops only will receive 2 tractors and UGX 1,500,000.
- For a single crop will receive 1 tractor and UGX 1,000,000.

This support aims to motivate farmers to diversify their crops and boost their productivity.

The ministry needs to calculate the total cost of **tractors** for farmers, based on the number of tractors needed for each group, with each tractor costing UGX 68,000,000.

TASK

a) Assist the ministry in determining:
(i) The total number of farmers cultivating all four crops

(ii) The number of farmers growing only three crops
(iii) The chance of selecting a farmer who grows only two crops in Iganga district
(iv) The likelihood of selecting a farmer who does not grow Peas

b) Set the total funding required for the ministry's farmer support initiative.

ITEM 9

To address concerns about battery durability, Uganda Batteries Limited (UBL), a trusted manufacturer since 1967, conducted a thorough test on a random sample of 50 batteries. Their experts carefully selected and examined these batteries, yielding the following results (rounded to the nearest minute):

423	369	387	411	393	394	405	369	372	410
371	377	389	409	392	408	409	396	431	391
431	401	363	391	405	382	396	381	438	422
400	381	399	415	428	422	397	399	401	398
396	372	410	419	386	390	362	373	391	402

The director has decided to withdraw batteries with a life equal to or less than the average lifespan of the tested samples and has directed the experts to manufacture only batteries that achieve at least 99 % of the median life of the 50 tested batteries.

TASK

a) (i) Organize the data into intervals of 10 using a statistical table and analyze the trends to recommend the most effective battery replacement strategy to the director
(ii) Elaborate on the reasoning that led to your conclusion in a) i)

b) (i) Develop a graphical display to illustrate the data, allowing the director and their team to estimate the median, visualize and analyze the information
(ii) Identify the target battery lifespan for manufacturing, as recommended by the director.
(iii) Analyze the graph and explain the situation, backing your argument with data and logical reasoning.

c) Aid the manager in recognizing the chance of selecting a battery with a lifespan greater than or equal to the median value.

ITEM 10

The recently concluded Uganda Secondary Schools Sports Association (USSSA) tournament was largely dominated by schools from the western region.

The four schools that dominated include; Fort Porto SS, Tororo SS, Nyakasura HS, and Kyogera HS. Due to limited funds, the four schools decided to use two buses; Fort Portal ss and Tororo ss used the Tausi bus which charges UGX. 24,000 per Km while Kyogera HS and Nyakasura HS used Global coaches that charge UGX. 28,000 per Km.

On the tournament day, Tausi Bus embarked on its journey from Mbarara to Kampala at 4:30 a.m., cruising at a steady 80 Km/hr and arriving in Kampala at 9:00 a.m. Simultaneously, Global Bus set off from Sanga town, 50 Km from Mbarara, at 4:30 a.m. and traveled at a constant 50 Km/hr for 3 hours and 30 minutes before pausing for 30 minutes. It then resumed its journey at a steady 67.5 Km/hr until

it reached Kampala, with the bus fare being equally distributed among the participating schools that used the bus.

Upon arrival in Kampala, the four schools competed in a two-round football tournament

	Win	Draw	Loss
Fort portal	1	3	2
Tororo	2	2	2
Nyakasura	3	2	1
Kyogera	0	2	4

1st round

	Win	Draw	Loss
Fort Portal	1	2	3
Tororo	2	1	3
Nyakasura	2	3	1
Kyogera	1	4	1

2nd round

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 11.

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 candidates and needs your assistance in analyzing the data to determine the number of candidates who meet the criteria.

TASK

(a) Apply your mathematical expertise to help your friend know the number of candidates eligible for an oral interview.

(b) The organization has a program for teachers who can teach all three languages (French, German, and English). They'll be rotated among schools and paid more. What's the likelihood of a random applicant being in this program?

ITEM 12

In a certain town, there is a section of the road where many accidents occur and the residents believe it is due to over speeding so they have requested the authorities to build humps along that section, the chairperson of the roads committee has decided to do some research so a checkpoint has been put at that section to measure the speed of 50 vehicles passing that point. They will put humps if the research shows that the percentage of vehicles passing that point at a speed greater than the speed limit is greater than those who abide by the speed limit. The road sign shows a speed limit of 55km/hr for that section. The results for the 50 vehicles sampled are shown in the table below.

Speed(km/hr)	20-30	30- 40	40- 50	50- 60	60- 70	70- 80	80- 90	90- 100
Number of vehicles	5	8	7	9	6	5	4	6

TASK;

(a) Assist the chairperson in determining the average speed at which vehicles pass that point.

(b) Present a graphical analysis to guide the committee's choice of implementing traffic calming measures.

ITEM 13.

A sports organization is selecting team members to participate in marathon competitions from a group of 60 individuals. The selection process will occur in two phases. In Phase One, participants who complete the race within 137 minutes or less will qualify for Phase Two. Then, in Phase Two, those who finish within 122 minutes or less will be selected to participate in the actual competitions, which is the ultimate goal.

The following is a breakdown of the times achieved by the participants in Phase One;

Finish time (mins)	120 - 124	125 -129	130 -134	135 -139	140 -144
Number of people	15	14	13	11	7

TASK:

a) (i) How many participants advanced to Phase Two?

(ii) What is the likelihood that some of the qualifiers from Phase Two will go on to participate in the final competitions?

(iii) Based on the probability value, what is the likelihood of the organization finding suitable participants for the competitions from the group?

ITEM 14

Maria, a surveyor, embarks on a journey from Mukono to a Kampala construction site to perform crucial soil testing, as the soil's sand content plays a critical role in ensuring foundation stability and preventing potential settlement or foundation failure due to excessive sand. Maria's journey begins with a 30 Km stretch on a bearing of 080▫ to Kalagi, followed by a 330▫ turn and a 40 Km drive to Gayaza. Finally, she heads on a bearing of 30▫ to reach the construction site in Kampala which is on a bearing of 020▫ from her starting point in Mukono. Upon arrival, she collects soil samples at various depths and records the sand content percentage in the table below:

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

Maria needs to create an appropriate graph to visualize the relationship between depth and sand content and calculate the total cost of surveying materials; including 50 meters of measuring tape at UGX. 10,000, 20 soil sampling bags at UGX. 5,000 each, and fuel at UGX. 6,000 per Km that she traveled. She will submit the calculations to apply for funding from her company.

TASK

a) Help Maria draw a precise diagram illustrating her journey, including bearings and distances.
b) (i) Develop a scatter plot to illustrate the relationship between depth and sand content, aiding Maria in her data analysis.
   (ii) Describe the relationship between soil depth and sand percentage, including any trends or patterns you observe.
   (iii) Plot a line of best fit through the scatter diagram data, and use it to:
   - Predict the sand percentage at a depth of 31 cm
   - Estimate the depth at which the sand percentage is 54%.
c) Assist Maria in preparing a budget proposal to fund her project activities, including her return trip to Mukono via the same route. (20 marks)

SECTION B: PART II GEOMETRY AND MEASURES

ITEM 15.

The school club is holding a fundraiser by selling chappattis, which they've made and packaged in special containers. Each chapatti is 14 cm in diameter, has a uniform thickness of 6 cm, and is divided into six slices. The containers, shaped like a chapatti slice, each have a marked price of UGX 1000 and can hold 14,784 cubic centimeters. The cost of making each slice is UGX 140. By the end of the day, they had sold 2,000 chapattis at UGX 400 per slice, and the seller of the containers gives a 10% discount to whoever buys by cash terms. (take $\pi = \frac{22}{7}$)

TASK

a) (i) Help the members of a school club to know the number of slices that can be loaded into each container.
   (ii) Ascertain the number of containers needed to pack the entire batch of slices.

b) (i) How much money was generated from the fundraising event?
   (ii) Provide a calculation-based recommendation to the club on whether to continue this business venture in the future, given that the containers were bought on cash terms.

ITEM 16

Stanbic Bank, a prominent African financial institution, seeks to revamp its logo to align with its values and appeal to a newer, younger demographic generation. The current logo, a triangle with coordinates A(2, 3), B(4, 1), and C(1, 2) on a white rectangular background, is due for a refresh. The bank's graphic designer has suggested the following design modifications to enhance the logo;

Keep the original triangle in place, but turn it 90 degrees counterclockwise around the origin. Then, mirror the resulting triangle across the horizontal axis. Next, scale up the new triangle by a factor of 3 about the center (-5, -2), creating a logo with four triangles. Paint only the enlarged triangle with a red-to-white ratio of 3:5, using red paint that costs UGX 20,000 per square centimeter and white paint that costs UGX 15,000 per square unit. The bank has set a budget limit of UGX 205,000 per logo for painting.

TASK

a) (i) Assist the designer in creating a precise layout of the logo, showcasing the exact placement of the four triangles on the same material.
   (ii) Specify the exact vertices of the new triangles.
b) Using data-driven insights, recommend to the bank owners whether to adjust their allocation for logo painting expenses.

ITEM 17.

Uganda Crop Care Limited (UCCL) has secured a contract to supply liquid fertilizer in Kenya, with a requirement to package it in cylindrical tanks measuring 15 meters in height and 4 meters in radius. Currently, the company stores its liquid fertilizer in metallic buckets with dimensions of 10 meters in height, 1 meter in lower radius, and 3 meters in upper radius. To fulfill the order, UCCL needs to determine the number of buckets required to fill 100 tanks. Each metallic bucket costs UGX 8000 to

manufacture, and the company sells the fertilizer at UGX 3600 per liter. The manager at UCCL needs to calculate the number of buckets needed and evaluate the cost implications.

TASK

a) Ascertain the number of buckets needed to fill all the required tanks.
b) Establish the total cost that will be required to manufacture the required metallic buckets.
c) Based on calculations, evaluate UCCL's potential for success.

ITEM 18.

James, a petroleum engineering master's graduate from Makerere University, has landed a job at a Ugandan NGO. The organization offers a comprehensive benefits package, including.

○ Housing allowance: Shs. 14,000 per month ○ Marriage allowance: **y** ○ Medical allowance: Shs. 50,700 per annum
○ Transport allowance: Shs. 10,000 per month

However, James must pay an annual insurance premium of Shs. 68,900. He has five children, with three under 8, one 16-year-old, and a 20-year-old. The NGO provides a family allowance for four children, as follows: Shs. 3,400 for each child above 18 years; Shs. 4,200 for each child between 1018 years; Shs. 5,400 for each child below 9 years.

The tax rates for working-class citizens in Uganda are shown in the table below:

Income (Shs) per annum	Tax rate (%)
1st Shs. 80,000	7.5
Next Shs. 80,000 (80,001 – 160,000)	12.5
Next Shs. 80,000 (160,001 – 240,000)	20.0
240,001 – 320,000	30.0
320,001 – 400,000	36.5
400,001 – 480,000	45.0
Above 480, 000	52

The accountant revealed to James that his **annual income taxes** would be Shs 100,320. James was confused because he didn't understand how his income was calculated, and he didn't know how to figure out his **gross annual income**. He also learned that his annual **total tax free – income** would **exceed his taxable income by 24%.**

James aims to **constantly** set aside half of his annual net income to purchase **a 40 m x 22** m plot in Kayunga village within the next ten years, taking advantage of the stable land prices. The land is expected to be priced at UGX 4,000 per square meter within this time frame.

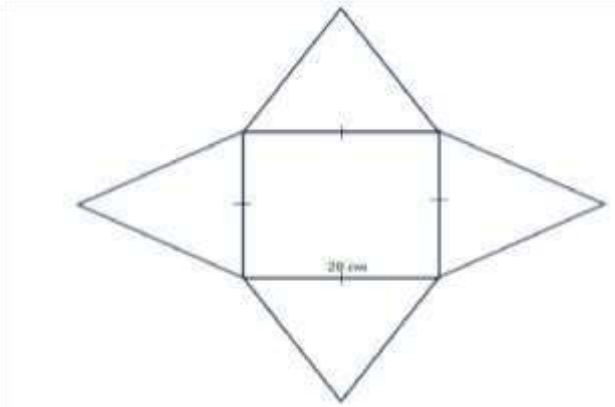
TASK

a) (i) Help James arrive at his accurate taxable income figure through careful calculation and logical thinking.
   (ii) Assist James in understanding his annual marriage allowance compensation.
   (iii) Support James in figuring out his annual take-home pay.

b) Assist James in determining if he can reach his goal of purchasing the land within the desired timeframe.

ITEM 19

Your sister has started a new role in packaging design, and her boss has given her a new gift-wrapping design to assemble as a sample for a client meeting tomorrow. She's running into trouble and needs your help to get it finished overnight.



She is also supposed to determine the material that will be needed to make each for her company to plan well.

Your sister also tells you that she will be getting a salary of UGX.1,000,000 per month which includes, a transport allowance of UGX.200,000 and a lunch allowance of UGX.6000 per day only for the five days she works.

She wants to open up an insurance policy for her child that will need her to pay a premium of UGX.250,000 per month and also remain with UGX.400,000 for upkeep for the month but also has to pay tax using the rates below;

Taxable income	Tax rates %
0 - 235000	0
235000 - 335000	10
335000 - 410000	20
410000 - 1500000	30

She's uncertain if she'll have sufficient funds left to cover the insurance premium.

TASK

(a) (i) Show her what the pack will look like after it has been assembled.

(ii) Use your mathematics to help your sister determine the material required to make one pack.

(b) Will your sister be able to pay her child's premium?

ITEM 20

Your father is one of the organizers of a marathon they want to draw the map of the route that the participants will during the race.

At their chosen starting point they chose to take a road that turned E30^{o}S and they moved for 5km where they set up point **B** which will be used as a checkpoint, they then turned through 235^{o} moving a distance of 9km to point **C** which will be the finishing point, however on returning to the office they decided that the finishing point should be put at point **A** to cut costs of organizing the two places but they were not sure of the details of that route from **C** to A that had to be included on the map.

They want to hire a vehicle that will be used to film the racers, the vehicle available consumes 2 litres per km and a litre costs UGX.5500, the owner of the vehicle has asked for UGX.500,000 plus fueling the vehicle for the total distance to be covered but the vehicle owner plans to buy fuel from the fuel station where he is given a discount of 5% for every 100,000 worth of fuel he buys since he is a regular customer.

TASK;

(a) Help your father determine the direction from point C to the new finishing point A that will be shown on the map to be drawn.

(b) (i) You are required to determine the total cost of hiring the vehicle.

(ii) Do you think the vehicle owner will save some money on fuel if so how much?

END