

## 1.2 ASSESSMENT OBJECTIVES

The End of Cycle assessment for Subsidiary Mathematics will be guided by four assessment objectives focusing on the learner's ability to:

**A01:** Analyse real world situations involving data and uncertainty to support informed decision making.

**A02:** Model relationships between quantities using algebraic concepts to solve real life problems.

**A03:** Apply concepts of change and accumulation to solve real world problems.

**A04:** Analyse spatial relationships to solve real world challenges

## 3.0 STRUCTURE OF THE EXAMINATION PAPER

There will be one examination paper for Subsidiary Mathematics at Advanced Secondary Curriculum (ASC). This paper will be tailored for students who need mathematical skills to enhance their studies in other subjects, emphasizing the importance of mathematical computation in everyday life and future careers. It will assess the four constructs (Algebra, Calculus, Geometry, and Data analysis and Probability) focusing on both theoretical understanding and practical application. The paper will contain 6 items (one item from Calculus, one from Geometry, two items from Algebra and two from Data analysis and Probability). Each construct will form a section (Section A: Data Analysis and Probability, Section B: Algebra, Section C: Calculus and Section D: Geometry). The learner will be required to answer one item from each section. The items in the paper will be scenario based. The duration of the examination will be 2 hours and 15 minutes (Each item will take 30 minutes and 15 minutes for the learner to read through and make a choice out of the optional items).

### SUBSIDIARY MATHEMATICS PAPER SET 1

**Time: 2 hours 15 minutes**

#### INSTRUCTIONS TO CANDIDATES:

*This paper consists of **four** sections; **A, B, C** and **D**. It has six examinations items.*

*Section **A** has **two** items. Answer one item only.*

*Section **B** has **two** items. Answer one item only*

*Section **C** has **one compulsory** item.*

*Section **D** has **one compulsory** item*

*Answer a total of **four** items.*

Any additional item(s) answered will **not** be scored.

All answers **must** be written in the answer booklets/sheets provided.

Graph paper is provided.

Silent non-programmable scientific calculators and mathematical tables with a list of formulae may be used.

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SECTION A	ITEM 1	
	ITEM 2	
SECTION B	ITEM 3	
	ITEM 4	
SECTION C	ITEM 5	
SECTION D	ITEM 6	
	TOTAL	

### SECTION A

#### ITEM 1

The Sports Department at your school plans to introduce a special holiday training program for learners living within the community. The masses (to the nearest kilogram) of learners who have expressed interest in the program are normally distributed as recorded below:

24 55 63 34 36 56 40 28 43 66  
55 58 72 48 49 50 51 61 52 53  
53 54 45 41 56 39 57 57 46 58  
59 60 51 62 31 64 65 44 68 47

The program will only commence if the likelihood of learners whose mass exceeds 38 kg is greater than half. The data collected is to be organized in groups of ten from the smallest mass.

The department is also planning to have three types of weekly training activities for learners such as Cardio sessions, Strength training sessions and Flexibility sessions.

There is need for the department to design a balanced weekly schedule from the following information gathered from the learners who have participated in similar programs.

Two cardio sessions, five strength sessions, and two flexibility sessions take a total of 9 hours per week.

Nine cardio sessions, four flexibility sessions and three strength sessions, take a total of  $18\frac{1}{2}$  hours per week.

Two flexibility sessions, three strength sessions, and seven cardio sessions take a total of 14.5 hours per week.

The following table gives the cost of each session per hour in 2024 and 2025.

Session	Cost per hour (2024)	Cost per hour (2025)	Duration of each session per week
Cardio	UGX.10000	UGX.8500	_____
Strength	UGX. 8000	UGX.6000	_____
Flexibility	UGX. 5000	UGX.7000	_____

The department would like to know the percentage change in cost of the training sessions in order to make an informed communication to the community regarding the change.

### Tasks:

Help the department to determine:

- Whether the training program for 2025 should begin.
- The percentage change in cost of the training sessions per week using 2024 as base year.

### ITEM 2

There was a rising absenteeism among learners in your school linked to poor nutrition. The school administration decided to introduce a more nutritious lunch and must decide whether to keep funding it.

After lunch, a pilot survey of 48 random learners was conducted to rate the meal on a 1 - 5 scale. Of these, 3 rated it 1, 10 rated it 2, 12 rated it 3, 5 rated it 4, and 18 rated it 5.

The program will be kept only if the variability is at most 1.2.

The administration wants evidence to decide whether to raise the lunch price or seek a subsidy.

To judge affordability, the administration will also use suppliers price data from February 2024 and February 2025. The four core items and weekly use-weights are:

Food stuff	Weight	Price Feb 2024 (UGX)	Price Feb 2025 (UGX)
Maize flour	6	2000	2200
Beans	4	3500	4100
Rice	3	3800	3400
Cooking oil	7	7000	7800

In 2024, each lunch plate was valued for UGX 3,500.

**Task:**

Help the school administration to:

- (a) Evaluate whether to keep funding the nutrition lunch.
- (b) Decide whether they should rise the price of each lunch plate.

**SECTION B**

**ITEM 3**

A secondary school has poor sanitation facilities and is considering holding a fundraising concert to renovate them as they plan to construct new facilities. The school administration is unsure if the fundraising concert is a tentative viable solution, especially since it requires some initial spending of UGX 5,000,000 on tickets. They plan to sell tickets and make profits using the profit model:

$$R(x) = -x^2 + 10000x - 200000,$$

where  $x$  is the number of tickets sold and  $R(x)$  is total revenue expected.

A group of old students of the school, intend to construct new sanitation facilities. They started with a contribution of UGX 1,000,000 and increased it by a monthly contribution of UGX 2,000,000 each month for a period of 14 months. They intend to put the full amount raised on a fixed account at an annual compound interest rate of 12% in order to grow their contributions and raise UGX 42,855,000 to fund the construction project.

**Tasks:**

- (a) Advise the school administration as to whether the fundraising concert is a viable solution.
- (b) Help the old students to determine the time required to raise the estimated total cost of the construction project.

**ITEM 4**

A certain district is scheduled to host a regional football tournament involving teams from five districts. Therefore, the stadium needs to be renovated to accommodate the event.

The stadium's spectator corridors are too narrow, creating safety risks during matches. Management intends to widen two main corridors without reducing seating capacity by removing space equal to 3 rows and re-arranging the chairs by adding 2 columns between sections. The total number of chairs must remain 180. Management needs to confirm that the new layout truly widens the corridors while keeping 180 chairs.

The management plans to replace the old 180 chairs that have been in use for some time. The old chairs were bought at Shs. 300,000 each and have been depreciating at a rate of 20% per year.

The procurement officer has confirmed that the current resale value of the chairs is 40% of their original cost. However, the committee is uncertain about the exact period the chairs have been in use.

**Task:**

Help the management to:

- (a) Find out if the new layout widens the corridors while keeping the total number of chairs at 180.
- (b) Estimate how long the chairs might have been in use.

**SECTION C**

**ITEM 5**

The main market in a certain town council, which serves people daily, is congested, and litter quickly piles up during market hours. Environmental officers have raised concerns that if this waste is not managed properly, it will attract flies and rodents, and could spark outbreaks of cholera and other diseases. The officers have observed that the rate of change of litter accumulation in the market can be modeled by:

$$\frac{dL}{dt} = 6t - 0.5t^2 \text{ (kg/h)}, \quad 0 \leq t \leq 8$$

where:  $L(t)$  is the total amount of litter (kg) accumulated in  $t$  hours after the market opens. Currently, the market operates for 8 hours daily between 8 : 00 am -- 4 : 00 pm.

The council's waste truck has been collecting all waste in one trip. It can only carry 60 kg per trip. The council needs to know whether a single trip is still enough or plan for more trips.

Also, the safety committee is concerned about the speed of the truck inside the market. To ensure safety of the people, the waste truck moves along an internal lane, and its displacement from the market gate to the collection bay is modeled by:  $S(t) = 67.5t^3 - 39t^2$  (m), where  $t$  is hours after the truck enters the gate. It uses  $\frac{4}{3}$  hours to reach the bay. The recommended speed is 5m/min.

**Task:**

Advise the council on:

- (a) whether a single trip is still enough to clear the litter out of the market by the closing time. If not, determine how many trips would be required.

- (b) the maximum speed of the truck as it moves towards the collection bay, that guarantees the safety of the people in the market.

## SECTION D

### ITEM 6

A family in your area has been grappling with a land dispute for years. It hired a surveyor to give them a sketch map of its land boundaries.

The surveyor established a fixed reference point on the land, called Point  $A(0,0)$ . From this reference point, she measured a displacement represented by the vector  $\begin{pmatrix} 40 \\ 25 \end{pmatrix}$  metres, which led directly to the first corner Point  $C_1$ .

From  $C_1$ , she measured another displacement vector,  $y = \begin{pmatrix} 15 \\ -10 \end{pmatrix}$  metres. This led to the second corner Point  $C_2$ .

She then faced the challenge of positioning the final corner point  $C_3$ . She considered that the land is in the shape of a parallelogram and has only managed to identify the  $x$  coordinate of  $C_3$  as 15.

#### Task:

Assist the surveyor in obtaining the **detailed** sketch of the land.

END

## SUBSIDIARY MATHEMATICS PAPER SET 2

TIME: 2 HOURS AND 15 MINUTES

### INSTRUCTIONS TO CANDIDATES:

*This paper consists of **four** sections; **A, B, C** and **D**. It has six examinations items.*

*Section **A** has **two** items. Answer one item only.*

*Section **B** has **two** items. Answer one item only.*

*Section **C** has **one compulsory** item.*

Section **D** has **one compulsory** item

Answer **four** examination items in all.

Any additional item(s) answered will **not** be scored.

**All answers must** be written in the answer booklets/sheets provided.

Graph paper is provided.

Silent non-programmable scientific calculators and mathematical tables with a list of formulae may be used.

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### SECTION A

#### ITEM 1

A youth group in Uganda plans to host a National Youth Camp in November to empower young people in agriculture. However, recent camps have been disrupted by unpredictable rainfall and rising malaria cases.

They have obtained monthly rainfall data along with the corresponding number of reported malaria cases.

Months	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT
--------	-----	-----	-----	-----	-----	-----	-----	-----	------	-----

Rainfall(m m)	56	48	132	185	160	198	16 5	143	98	120
Malaria case s	21	18	45	70	108	91	75	60	35	29

The organizing team intends to forecast the expected rainfall in November in order to estimate Malaria cases in the same month, based on the relationship between the two.

The team classifies:

High rainfall months as those with rainfall  $> 120$  mm.

High malaria risk months as those with malaria cases  $> 60$ .

They want to know how likely malaria outbreaks are, given high rainfall if the weather trend continues.

**Tasks:**

Help the organizing team to:

- (a) Make a recommendation based on the expected rainfall and its relationship with malaria cases for November, to ensure the success of the planned camp.
- (b) Analyse the likelihood that the camp could experience high malaria risk given high rainfall.

**ITEM 2**

A recent report shows that many retired civil servants face severe delays in accessing their pensions. To address this, the Ministry plans to predict retirement trends more accurately, to ensure timely pension distribution. Data indicates that the average retirement age is 60 years, with a variation of 5 years. The Ministry, employing 20,000 civil servants across selected districts, wants to determine how many will retire at the age of at least 58 years to prepare pension funds in time.

There must be two representatives chosen one after the other from 20 pensioners, 12 of whom are male. Among them, 7 males and 5 females have leadership experience. The Ministry seeks to ensure that at least one selected representative has experience so that they help in the process of accessing pension benefits.

Additionally, retirees must manually fill pension forms before receiving benefits. The Ministry is studying how time varies during this process. A researcher found that the rate of filling pages is given by the function  $f(t) = 3 - 0.2t$ , where  $t$  is the time in minutes, up to a maximum of 15 minutes.

**Tasks:**

Help the ministry to:

- (a) Establish how many civil servants are likely to retire at the age of at least 58 years and the likelihood that at least one selected representative has experience.
- (b) Estimate the total number of pages a retired civil servant fills in 15 minutes.

## SECTION B

### ITEM 3

The staff at your school are planning to hold an end-of-year party in 12 months. The total amount required is UGX 25,200,000, to be raised equally by 20 staff members.

The organizing committee has proposed that each member starts by contributing a certain amount in the first month, and that the contribution should increase by a constant amount every subsequent month. By the sixth month, each member is expected to contribute UGX 100,000.

In addition, the staff must select a welfare committee of 5 members from a pool of 12 volunteers, of which 7 are women. To ensure fair gender balance, the difference between the two genders on the committee should be 1.

#### Tasks:

Help the committee to:

- Establish the starting contribution in the first month and the constant amount by which each member's monthly contribution should increase so that the required total is raised within 12 months.
- Establish the different ways a committee that promotes gender balance can be selected.

### ITEM 4

Your friend is starting a natural juice production business. Her goal is to maximise weekly profits and run cost-effective advertising for her business since it is new. However, she is not certain whether her targets are realistic.

Market analysis shows that profit  $P$ , in thousands of UGX, based on an initial investment  $x$  (in millions of UGX), follows:

$$P(x) = 20 + 14x - x^2$$

For advertising, she plans to use digital adverts to grow her customer base. The monthly advertising cost  $C$  in UGX, based on the number of thousands of customers reached  $n$ , follows the equation:  $n = 10^{\frac{C}{a}} - 1$ , where  $a$  is a constant.

She found out that advertising to 999 customers costs UGX 225,000.

She wishes to reach 5000 customers in advertising using UGX 200,000 per month.

#### Tasks:

Basing on the prevailing market conditions, help your friend to:

- Decide the amount of capital to invest for maximum weekly profit.
- Evaluate whether her advertising target is achievable with the available resources.

## SECTION C

## ITEM 5

A landscape designer in **Kampala District** has been hired to decorate the compound of a certain school. He wants to estimate the area that can be covered by flowers. One side of the plot is a straight line measuring 16 meters while the opposite side is in form of a curved path modelled by

$$y = 0.05x^2 + 0.2x - 3$$

where  $y$  is the length in metres above the straight line, and  $x$  is the horizontal distance in metres from the start of the straight line.

After estimating the area of the plot, the designer wants to predict how the height of the flower plants will increase over time, depending on the amount of rainfall and nutrients on the soil.

Agricultural experts explain that the rate of growth of each flower plant is proportional to the difference between the maximum possible height, 1 metre, and the current height of the plant.

At the start of the rainy season, the coffee seedlings were 0.05 metres tall. After 4 months, the average height of the plants was observed to be 0.25 metres.

### Tasks:

Assist the designer to:

- (a) Know the area of plot that can be covered by the flower plants.
- (b) Predict the height of the flower plants after 6 months.

## SECTION D

## ITEM 6

The adventurous activity of hiking and mountain climbing in Uganda attracts many tourists. However, there has been a rise in cases of hikers getting lost due to poor navigation.

You have been provided with information about two hikers,  $A$  and  $B$ . Both hikers started from the same point  $O$  on their way to the campsite. Hiker  $A$  walked 5 km in the direction of  $3i + 4j$ , while hiker  $B$  walked 6 km in the direction of  $5i + 12j$ . After covering these distances, they lost sight of each other.

While continuing the journey, Hiker  $A$  spotted a beautiful waterfall near the campsite. From a point on level ground, he measured the angle of elevation to the top of the waterfall as  $35^\circ$ . After continuing moving along the same level, 50 metres closer in a straight line toward the base, the angle of elevation increased to  $53^\circ$ . Hiker  $A$  became curious and wanted to estimate the height of the waterfall above the ground.

### Tasks:

- (a) Help the hikers establish how far apart they were when they lost sight of each other.
- (b) Given observations by Hiker  $A$ , approximate the height of the waterfall above the level ground.