P425/2
PRINCIPAL
MATHEMATICS
Paper 2
2026
$2\frac{1}{2}$ Hours.

GANGU SECONDARY SCHOOL

Uganda Advanced Certificate Of Education

PRINCIPAL MATHEMATICS

Paper 2.

Time Allowed: 2 hours 30 minutes.

INSTRUCTIONS TO CANDIDATES:

- This paper consists of **five examination** items with two sections: **A** and **B**.
- Section A consists of **one compulsory** item. You must answer it.
- Section B has two parts, **I** and **II** and each with two optional items. Respond to only two items from section B, choosing one item from **each** of the parts, **I** and **II.**
- Respond to **three** items in all.
- Any additional item(s) answered will **not** be scored.
- Begin each item on a fresh page.
- **All** answers, numerical working, and evaluative conclusions **must** be shown clearly.
- Graph sheets/squared papers will be provided for statistical diagrams and plots.
- Silent, non-programmable scientific calculators and mathematical tables with a list of formulae may be used where appropriate.
- Unless specified otherwise, use the acceleration due to gravity, $\mathbf{g = 9.8\ ms^{-2}}$.
- Candidates are expected to demonstrate clear mathematical modeling, precise calculation execution, and contextual interpretation of their results.

 1Email: mutyabaezra8@gmail.com

SECTION A: COMPULSORY.

ITEM 1

Mukisa is the newly appointed manager of Kasenge Livestock Farm. The farm director is concerned about the uneven growth patterns and feed efficiency of the beef cattle herd. To make an informed decision on whether to overhaul the expensive current feeding programme, Mukisa samples and records the weights (in kilograms) of 50 mature cattle. The raw data collected is shown below:

60	**81**	**76**	**68**	**84**	**112**	**76**	**102**	**86**	**67**
65	**98**	**107**	**110**	**72**	**99**	**87**	**92**	**76**	**77**
94	**102**	**87**	**86**	**73**	**118**	**98**	**120**	**62**	**87**
65	**92**	**104**	**116**	**91**	**93**	**78**	**122**	**102**	**92**
80	**111**	**73**	**120**	**106**	**123**	**94**	**109**	**80**	**96**

The farm policy dictates that the current feeding programme must be reviewed and changed if any of the following conditions are met:

- The average weight of the herd is **less than 90 kg.**
- The median weight (estimated from an Ogive) falls **below 90 kg.**
- Fewer than 10 cattle weigh **118 kg and above.**

Furthermore, for export quality control, the herd's weight variation must be stable. If the standard deviation of the weights **exceeds 18 kg**, the current feed is considered inconsistent and must be discontinued.

TASK:

As an assistant data analyst at the farm, help Mukisa process this data and present a comprehensive report to the director. Your report should include:

a) A well-constructed grouped frequency distribution table starting with the class (**60 – 69**).
b) Accurate statistical calculations for the estimated average weight and standard deviation of the herd.
c) A clearly drawn Ogive (cumulative frequency curve), use it to estimate the median weight.
d) A clear, mathematically justified conclusion advising the director on whether to maintain or review the feeding programme based on all four criteria.

 2Email: mutyabaezra8@gmail.com

SECTION B: CHOICE-BASED.

PART I: ***Respond to one item from this part.***

PART I.

ITEM 2

The Academic Committee of **GANGU SS** is evaluating the relationship between students' internal marks in Mathematics (***x***) and Physics (***y***) to design a data-driven learner support framework. The committee tracks a random sample of 10 students who sat for both papers. The marks (out of 50) are recorded below:

Student	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**
Mathematics (*x*)	**28**	**20**	**40**	**28**	**21**	**31**	**36**	**29**	**33**	**24**
Physics (*y*)	**30**	**20**	**40**	**28**	**22**	**35**	**35**	**27**	**31**	**23**

The committee operates under two strict academic policies:

1. **Targeted Guidance:** Any student scoring 37 marks in Physics will be given an estimated target score for their Mathematics exam based on a visual trend line of best fit.

2. **Framework Evaluation & Significance**: The school will invest resources into a combined STEM weekend workshop only if there is a highly significant, strong positive rank correlation between the rankings of the two subjects, proving that high performance in one directly corresponds to high performance in the other.

TASK:

As the student body statistics representative, assist the committee by processing this data. Your response should include:

a) A clearly plotted scatter diagram representing the data points, including a visual line of best fit.

b) An estimation of the expected Mathematics score for a student who scored 37 in Physics using your line of best fit.

c) A well-structured table showing the ranking of both subjects and the calculation of Spearman's Rank Correlation Coefficient.

 3Email: mutyabaezra8@gmail.com

d) A critical evaluation explaining the significance and reliability of your estimation in part **b)** based on your calculated value, concluding whether the STEM workshop should be funded or not.

ITEM 3

The Regional Teachers' Association conducted a standardized Physics Mock Examination across several schools. To evaluate the quality of the exam paper before final grading, the association analyzed a sample of 85 students' scores. Because of the distribution of marks, the performance data was grouped into unequal class intervals as shown below:

Scores (%)	**Number of Students (f)**
5 - < 30	17
30 - < 40	21
40 - < 50	30
50 - < 60	14
60 - < 80	3

The association grades and measures the exam's structural health using these exact criteria:

1. **Overall Performance:** The exam performance is considered "Satisfactory" if both the average (mean) mark and the dominant (modal) mark are ***at least 41%***.

2. **The Distinction Benchmark:** The top 10% of students (the 9^{th} decile) must score ***at least 55%*** to qualify for regional awards.

3. **The Core Performance Range:** The association needs to isolate the **middle 60% of the student population** to determine the score range where the vast majority of average learners lie.

TASK:

As the regional education quality officer, analyze this data-set to evaluate the exam. Your response must include:

a) A modified frequency distribution table representing all the data.

b) A precisely drawn histogram representing the data above, using it to graphically estimate the dominant mark.

 4Email: mutyabaezra8@gmail.com

c) Accurate mathematical calculations for:

i. The **mean mark** of the sample.

ii. The **9th decile (D_9)** to check the distinction benchmark.

iii. The **middle 60% range** of scores.

e) A brief evaluation report advising the association whether the exam performance was "Satisfactory" and whether the distinction benchmark was achieved based on your calculations.

PART II:

Respond to one item from this part.

ITEM 4

A marine engineering team at the Jinja Pier shipyard is testing a newly designed automated tugboat tugging a disabled cargo barge into a docking ship. The tugboat's dual-thruster engine layout generates a net propulsion force vector $\vec{F}$ modeled by the expression:

$$\vec{F} = p\boldsymbol{i} + 12\boldsymbol{j}$$

(where components are in kilo-newtons, kN, and p is an unknown real constant)

The digital hull tension monitors indicate that for the towline to remain stable without snapping, the scalar magnitude of this net force vector, $\vec{F}$ must be maintained at **exactly 13 kN.**

To calibrate the tugboat's automated steering and track its trajectory relative to the eastward reference line (***i - axis***), and northward reference line (***j - axis***), the engineering system requires a complete mathematical breakdown of all possible operating modes.

TASK:

As the lead marine control systems analyst, solve the structural parameters of this operations test:

a) Set up a vector magnitude equation and solve for the **two possible value**s of the horizontal force components ***p***.

b) Construct the two distinct possible force vectors $\overrightarrow{\mathbf{F_1}}$ and $\overrightarrow{\mathbf{F_2}}$ based on your values of ***p***, and derive the unit vector for each mode to program the navigation computer.

c) Calculate the two corresponding inclination angles of the force vector relative to the positive horizontal ***i axis*** for both operational modes.

d) **The Contextual Dilemma**: if the docking slip lies directly to the North-East of the tugboat's current position, write an operational directive to the helmsman identifying which value of ***p*** must be selected to successfully dock the barge, and explain why the other value must be rejected.

ITEM 5

A structural design firm in Kampala is developing a standardized toolkit for analyzing crane joints and support frames.

1. **Phase 1 (The Theoretical Model)**: To calibrate their software, the engineering team must mathematically prove the general equations for the resultant R of any two co-planar forces, P and Q, acting at a point separated by an angle Θ.

 6Email: mutyabaezra8@gmail.com

2. **Phase 2 (The Practical Stress Test):** The engineers then apply their component resolution models to a square steel bracing panel, labeled **ABCD** clockwise. Four structural load forces are directed along the frame edges and diagonal:

A force of **2N** acting along line **AB**.

A force of **1N** acting along line **BC**.

A force of $\sqrt{2}$ **N** acting along the diagonal line **AC**.

A force of **4N** acting along line **DA**.

TASK:

Complete the structural report by addressing both development phases:

Part I: Theoretical Calibration.

a) Consider two forces P and Q acting at an angle Θ to each other. If their single equivalent resultant is R and makes an angle α with force P, show clearly that:

i) $\boldsymbol{R^2 = P^2 + Q^2 + 2PQ\cos\Theta}$

ii) $\boldsymbol{\tan\alpha = \frac{Q\sin\Theta}{P+Q\cos\Theta}}$

Part II: Frame Stress Test Analysis

b) Using line AB as the positive horizontal reference axis, state or calculate the precise direction angle for each of the four forces acting in the square frame (AB, BC, AC and DA).

c) Resolve all four load forces into their respective horizontal and vertical components, calculating the total net horizontal force and the total net vertical force.

d) Calculate the final magnitude and direction (the angle it makes with AB) of the net single resultant force acting on the bracing panel.

END.

"The only way to learn mathematics is to do mathematics." - Paul Halmos.

 7Email: mutyabaezra8@gmail.com