

SECTION A

The item in this section is compulsory

Item 1

An engineer working with a mobile communication company in Uganda is designing a signal synchronization system to improve network stability along the Jinja-Mbale transmission line. The operating condition of the system is modelled by $\cos x = \ln x$.

From preliminary observations, the engineer established that the required operating point lies within the interval $1 \leq x \leq 2$.

To reduce signal delays and network interruptions, the engineer first wants an approximate value of the operating point using graphical method correct to 1 decimal place, followed by a more accurate value correct to 3 decimal places using a suitable iterative method. The engineer will use the operating point for synchronization if successive approximations converge to the same value; otherwise, the iterative mode; will be changed.

The engineer also studies the behavior of the system over the same interval from the graph by considering the area under the curve $y = \cos x$.

To estimate this area, table of values is prepared at equal interval using 5 equal strips. However, the engineer is not sure whether the estimated area is sufficiently accurate for system calibration.

The engineer will approve the system for operation if the difference between the exact area under the curve $y = \cos x$ and the estimated area is less than 0.05, otherwise, the calibration will be repeated.

Task

As a student of Mathematics, help the engineer interpret the information, choose suitable numerical methods, and make justified decisions about the synchronization and calibration.

SECTION B

Answer only two items from this section, choosing one item from each of the parts I and II

PART I

Item 2

The Lake Victoria fish management received a consignment of fish from different fish mongers. Before inspection various fish samples were picked, their weight in grams determined and summarized the results in the table below.

Weight (grams)	102-140	140-150	150-160	160-170	170-180	180-200	200-220
Number of fish	6	16	30	36	29	2	1

According to the management, only fish mongers with fish whose estimated mean weight of at least 160g are given bail. When the interquartile range graphically is less than standard deviation then these fish mongers will be banned from fishing any more.

Management also discovered that for the first mongers A, B and C had ran away and their fish was in the ratio 2: 3: 5. But their chances of having low weight fish was $\frac{1}{7}$, $\frac{1}{2}$ and $\frac{2}{9}$ respectively. These fish mongers will be imprisoned if the chance of having low weight fish is more than 20%.

Task

As a mathematics student help the management to;

- advise whether to give bail or ban the fish mongers from fishing.
- know whether the three fish mongers will be imprisoned.

Item 3

The table below gives the point awarded to eight schools by three judges A, B and C during a music competition. A was the chief judge.

A	71 _{2.6}	50 _{5.5}	50 _{5.5}	54 ₄	36 ₅	38 ₇	83 ₁	71 _{2.5}
B	50 ₅	55 ₊	70 _{2.5}	40 ₇	40 ₇	40 ₇	73 ₁	70 _{2.5}
C	60 ₅	40 _{7.5}	63 ₊	70 ₁	40 _{7.5}	49 ₅	68 _{2.5}	68 _{2.5}

The schools are conspired to have bribed one of the judges B and C but the management is not aware of which judge could have been bribed.

The marks for a certain team X were found to be normally distributed. 10% of the participants were awarded gifts for obtaining over 75 points. 20% of the participants failed with a mark of under 40 points. The management wants to know the chance for a team that gets between 45 and 60 points which should be given opportunity to host the next tournament provided that chance is at least 30%.

Task

Help the management determine the judge who could have been bribed and to know the chance that the next hosting school is having.

PART II

Item 4

At a road construction site along the Iganga-Luuka road, engineers are installing a regular hexagonal steel warning frame ABCDEF to hold reflective traffic signs. The frame is placed such that side AB is perfectly horizontal. To stabilize the frame against strong winds from passing trucks, steel cables are attached along the sides of the hexagon producing the following steady forces of 2, $4\sqrt{3}$, 8, $2\sqrt{3}$ and 4N along AB, AC, AD, AE and AF respectively. The engineers must determine a single force with the same effect as those forces in order to check whether the structure will remain

22.75
2.25
+

stable. If the magnitude of the single force exceeds 18N, an additional cable must be installed.

The warning frame is transported to the installation site using a pickup truck pulling a trailer loaded with the steel materials. The pickup truck has a mass of 1200kg, while the trailer carrying the frame has a total mass of 800kg. The resistance to motion of the pickup truck is 400N and that of the trailer is 300N. The engine of the pickup truck provides a driving force of 3200N. The engineers want to determine the acceleration of the system and the tension in the tow bar connecting the trailer to the pickup truck. The tow bar can safely withstand a maximum tension of 1500N, beyond which it may break.

When the truck arrives at the site, workers offload the steel frame by pulling it up a wooden ramp inclined at 30° to the horizontal. The mass of the steel frame being pulled up the ramp is 50kg, and the coefficient of friction between the steel and the wooden ramp is 0.4. Workers use a rope to pull the frame parallel to the ramp. The rope can safely withstand a pulling force of 300N. If the required pulling force exceeds this value, the contractor will have to hire a mechanical hoist.

Task

- (a) Will the engineers install the additional support cable?
- (b) Determine;
 - (i) the acceleration of the pickup truck and trailer
 - (ii) whether the tow bar is safe to use
- (c) Advise whether the workers should use the rope or hire the mechanical hoist.

Item 5

A pilot is investigating the course set and the time taken to fly from an airfield; A to another airfield; B 500 km away on a bearing of 140° and also to make a return journey when there is a steady wind of 30kmh^{-1} from North East. The helicopter has an airspeed of 150kmh^{-1} . Assuming the direction of the wind does not change. If the difference in bearing is at least 200° and the difference in time is at most 8 minutes the flight company will make these journeys official.

Two airstrips P and Q are 100km apart, P being west of Q. Two helicopters A and B fly simultaneously from P and Q respectively, at 11.00a.m. Helicopter A is flying with constant speed of 400kmh^{-1} in a direction $N50^\circ E$. Helicopter B is flying at a constant speed of 500kmh^{-1} in the direction $N70^\circ W$. It is required to know the shortest distance between these planes and the time it takes to do so. If the distance is beyond 12km and the time is below 11:05am then the course must be changed to avoid a collision.

Task

- As a mathematics student help the company make investigation on whether the;
- (a) flight will be made official
 - (b) course will be changed.

END

P425/2
PRINCIPAL
MATHEMATICS

Paper 2

2026

3 hours



BURJEB MOCK EXAMINATIONS 2026

Uganda Advanced Certificate of Education

PRINCIPAL MATHEMATICS

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3 hours

INSTRUCTIONS TO CANDIDATES

This examination paper consists of two sections; A and B. It has five examination items.

Section A consists of one compulsory item.

Section B has two parts, I and II 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) responded to will not be scored.

Begin each item on a fresh page.

Where necessary take $g = 9.8\text{ms}^{-2}$

All necessary working must be shown clearly.

Graph paper is provided.

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