P425/1

PURE MATHEMATICS

PAPER ONE

July/august 2025

3 hours.

***UGANDA ADVANCED CERTIFICATE OF EDUCATION***

***PURE MATHEMATICS***

***S.5 E.O.T 2 EXAMS***

***PAPER 1***

***3 HOURS***

***INSTRUCTIONS:***

* This paper consists of five items, answer any four items.
* Any additional question will not be marked.
* All necessary working **must** be shown clearly.
* Begin answers of each item on a fresh page.
* Graph paper is provided
* Silent non-programmable scientific calculators and mathematical tables with a list of formulas may be used.

**ITEM ONE**

Kwagala sells photographs at art fair with small, medium and large sizes. She sells 2 more small photos than twice the difference between medium from large sized photos. It is also noted that when she sells 2 times small photos and 2 times medium photos, their sum is equal to 8 minus 2 times the number of large photos. She knows that small photos cost $10, medium $20 and large $30. She wants to determine how many of each size to sell to cover her booth rental cost of $120.

Additionally, she monitors her stock by the equation$ y= \frac{x+1}{x^{2}+ 3}$, and then considers the discriminant of a suitable quadratic equation to determine the range of possible values of y which would give real stock value of x.

Task;

Help kwagala determine;

1. How many of each size she should sell to cover her booth rental cost.
2. The range of possible values of y which would give real stock value of x.

**ITEM TWO**

Sharon, a farmer in Mbale district is planning to construct an animal farm which is to occupy a rectangular piece of land and the farm is to take up the maximum area of 90,000m2. At the same time she is planning to fence a maximum distance around the farm using a barbered wire fence that costs UGX 5000 per miter but one side of the farm is to be enclosed with a brick wall.

She is also planning that her farm must have a conical trough from where the animals will drink water from and the type of the trough she needs to buy must have the rate of decrease in water level less than 1cm/s when the water level is 6cm. The conical trough available has a height of 10cm, a radius of 2cm and the rate at which water is collected in the trough is 3cm3/s.

Task:

As a student of senior five who has knowledge about calculus help Sharon to know;

1. The dimensions of the land onto which a farm is to be constructed.
2. The total amount needed to buy the barbered wire that is to be used to fence the maximum distance around the farm
3. Whether the conical trough available will be fit to perform the work as per her plan.

**ITEM THREE**

A city council wants to construct a settlement area 0n top of a hill and two routes R1 and R2 are to be constructed to connect this area to the main road. Route R1 will connect point A (2, 7) to B (8, 1), route R2 will connect point D (3, 2) to E (9, -4). Another route R3 will be constructed to connect R1 to R2 through the middle and a perpendicular route (M) which passes through a point F(x, y) connects R3 to the main road at G(10, 3).

As per the city plan, the route R4 is to be constructed in future whose mid-point is equidistant from A and B and at certain point it will meet with the route R3 before connecting to the main road. According to the city council the purpose of constructing all these roads is to ease accessibility to the top of the hill and a unit kilometer of each road is to take a total of 2.5 million to be constructed.

Task;

1. Determine the equations of the routes R3 and R4 respectively.
2. Help the city council to know the total amount of money needed to construct the roads R1, R2, R3, and M as per the city plan.

**ITEM FOUR**

The number of items(y) produced by a company are modeled by the equation $y=8sin2x-5cos2x$ where x represents the number of inputs needed by the company to maximize production. The company transports its products by means of water transport and the ship used sails directly towards the cliff to deliver the products. The angle of elevation of a point on top of the cliff and straight ahead of the boat increases from 100 to 150 as the ship sails a distance of 50m.

Task:

1. Use the knowledge of trigonometry(R-formula) to determine the maximum number of items produced by the company and the corresponding number of inputs needed to maximize the production.
2. Help the ship captain to determine the height of the cliff and the distance to the cliff from the point when the angle of elevation is 150.

**ITEM FIVE**

Shatra games and Sports Company organized competitions that were to include car rallies and tortoise race. During the testing of the cars that were to be used in the competition, they observed that the treads on the front tyres of cars wear more quickly than those on the rear tyres and they found out that this could result into accidents. According to the organizers, the competitions will only commence if the treads on the front and rear tyres have a rank correlation coefficient of 5% significance level. The treads on the front and rear tyres are recorded in the table below.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Cars | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Front wear | 4.1 | 4.0 | 4.2 | 3.9 | 4.8 | 4.3 | 4.6 | 5.0 | 4.7 | 4.7 |
| Rear wear | 3.9 | 4.0 | 4.8 | 4.0 | 4.2 | 4.5 | 4.4 | 4.9 | 4.8 | 4.4 |

At the same time, the specialists recorded the mass (kg) of 150 tortoises that were to participate in the competitions as below.

|  |  |
| --- | --- |
| Mass (kg) | Number of tortoises |
| 0.2 ≤ m ≤ 0.6 | 27 |
| 0.6 ≤ m ≤ 1.0 | 43 |
| 1.0 ≤ m ≤ 1.4 | 35 |
| 1.4 ≤ m ≤ 1.8 | 31 |
| 1.8 ≤ m ≤ 2.2 | 14 |

Task; as a s.5 students with the knowledge about statistics,

 a) Help the company know whether the competition of car rally will or will not commence.

 b) Use a scatter diagram to find the value of front wear if the one for rear wear is 4.7mm.

 c) Use the information in the second table to find the 10% to 90% inter percentile range and the middle 60% of the mass of the tortoise.