

456/1
MATHEMATICS
Paper 1
2024 2 ½
HOURS

YAAKA EXAMINATION

INSTRUCTIONS TO CANDIDATES

*This paper consists of **two** sections; **A** and **B**. It has **six** examination items. Section **A** has **two** compulsory items. Section **B** has **two** parts; **I** and **II**. Answer **one** item from each part. Answer **four** examination items in all.*

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

*All answers **must** be written in the Answer booklet(s) 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	ITEM	SCORE(S)	EXAMINER'S SIGNATURE
A	1		
	2		
	3		
B	4		
	5		
	6		
TOTAL			

SECTION A

Answer all the items in this section in the spaces provided.

Item 1

In Uganda, agriculture plays a significant role in the economy, with most people relying on subsistence farming. Farmers often borrow money to buy inputs such as fertilizers and seeds. If the prices of these inputs increase, farmers may struggle to make a profit. Hence, they must carefully calculate their production costs and revenues to ensure profitability. Recently, Mr. Okafwo borrowed UGX 500,000 to buy seeds and fertilizers. The total cost of production for one season is represented by the equation $C=200x+100y$, where X is the number of bags of fertilizer and Y is the number of kilograms of seeds.

Task:

If Mr. Okafwo wants to ensure that the total cost does not exceed UGX 500,000, help him out by forming an inequality that represents this situation and solve for possible values of X and Y.

Item 2

Uganda's national parks are home to a variety of wildlife species. Conservationists are concerned about the decline in animal populations due to poaching and habitat destruction. They use probability models to estimate the likelihood of encountering certain animal species in different parts of the park. Given that in a national park, the probability of encountering an elephant on a given day is 0.3, and the probability of encountering a lion is 0.1.

Task:

What is the probability of encountering both an elephant and a lion on the same day, assuming the two events are independent?

Item 3

Peter is selling 200 t-shirts and 150 caps at a two-day festival. On the first day, he wants to make UGX 1,200,000 by selling 120 t-shirts and 80 caps. On the second day, he aims to sell the rest for UGX 1,800,000. He needs to decide how much to charge for each t-shirt and cap to meet his target. He also has a budget of UGX 800,000 to hire workers for his stalls. Each worker for the t-shirt stall earns UGX 70,000, while each worker for the cap stall earns UGX 50,000. He wants to hire more workers for the t-shirt stall than the cap stall but cannot exceed his budget.

Task

a) Determine how much Peter should charge for each t-shirt and cap.

b) Help him decide how many workers he can hire for each stall to stay within budget.

SECTION B
PART I

(Attempt any one item from this part)

Item 4

An organization is offering a scholarship and wants to restrict the age of applicants. Some members propose an age limit that 90% of the population falls under, while others propose using the median age.

A survey was conducted with the following ages of 30 applicants:

14, 16, 17, 15, 19, 20, 18, 16, 21, 23, 25, 22, 24, 26, 28, 20, 22, 19, 21, 23, 17, 15, 19, 24, 27, 25, 26, 28, 30, 29.

Task

- a) What age limits are being suggested?
- b) Which limit would you recommend and why?

Item 5

Peter is building a storage container in the shape of a cylinder. The container must have a capacity of $9,000 \text{ cm}^3$. He needs to know the radius and height of the cylinder if the height is twice the radius.

He also needs to travel to a friend's wedding, which is 240 km away from his home. He can travel at an average speed of 80 km/h. He plans to leave home at 10:00 am. He wants to know what time he will arrive.

Additionally, Peter is planning to start a business and needs UGX 5,000,000. He can contribute UGX 2,000,000, and his friend can contribute half of what Peter is contributing. They need to know whether they should borrow money or not.

Task

- a) Determine the radius and height of the cylinder.
- b) What time will Peter arrive at the wedding?
- c) Will Peter and his friend need to borrow money to meet the business needs? Justify your answer.

PART II

(Attempt any one item from this part)

Item 6

John is a delivery driver. He needs to drive from point A (2, 3) on a grid to point B (14, 8), and then to point C, which is 30 km northwest of B. He must arrive at C by 6:00 pm and leaves point A at 3:00 pm.

He also produces circular mats with a radius of 14 cm. He needs to cover the mats with a decorative material. Each sheet of material measures 70 cm by 80 cm. He wants to know how many sheets he will need for 100 mats.

Task

- a) At what speed should John drive to reach point C on time?
- b) How many sheets of material will John need for the mats?

Item 7

A workshop owner is asked to build a triangular prism. The triangular base has a base of 5 meters and a height of 4 meters, while the length of the prism is 12 meters. The owner needs to calculate the amount of material required to cover the sides and base of the prism.

Additionally, the owner is considering taking out a loan of UGX 4,000,000 at a simple interest rate of 10% for three years. He makes UGX 1,500,000 in profits per year.

Task

- a) Calculate the amount of material required for the prism.
- b) Should the owner take the loan? Justify your answer.

END

ANSWERS TO THE QUESTIONS

SECTION A

Item 1

Mr. Okafwo's total cost of production is represented by the equation:

$$C = 200x + 100y$$

To ensure that the total cost does not exceed UGX 500,000, we form the inequality:

$$200x + 100y \leq 500,000$$

To solve for possible values of x and y , we can rearrange the inequality:

1. Divide the entire inequality by 100:

$$2x + y \leq 5,000$$

2. Rearranging gives:

$$y \leq 5,000 - 2x$$

The inequality $y \leq 5,000 - 2x$ represents the feasible region for values of x (bags of fertilizer) and y (kilograms of seeds).

Item 2

The probability of encountering both an elephant and a lion on the same day, assuming the two events are independent, is given by:

$$P(\text{Elephant and Lion}) = P(\text{Elephant}) \times P(\text{Lion}) = 0.3 \times 0.1 = 0.03$$

So, the probability is 0.03 or 3%.

Item 3

a) Let p be the price of a t-shirt and q be the price of a cap.

On Day 1:

$$120p + 80q = 1,200,000 \quad (1)$$

On Day 2, he sells the remaining:

$$80p + 70q = 1,800,000 \quad (2)$$

From equation (1):

$$p = \frac{1,200,000 - 80q}{120} \quad (3)$$

Substituting p from (3) into (2):

$$80 \left(\frac{1,200,000 - 80q}{120} \right) + 70q = 1,800,000$$

Simplifying:

$$\frac{96,000,000 - 6400q}{120} + 70q = 1,800,000$$

Multiply through by 120 to eliminate the fraction:

$$96,000,000 - 6400q + 8400q = 216,000,000$$

$$2000q = 120,000,000 \quad \Rightarrow \quad q = 60,000$$

Substituting $q = 60,000$ back into (1) to find p :

$$120p + 80(60,000) = 1,200,000$$

$$120p + 4,800,000 = 1,200,000 \Rightarrow 120p = 1,200,000 - 4,800,000$$

$$120p = -3,600,000 \Rightarrow p = -30,000 \text{ (not feasible)}$$

The calculations indicate a need to revise expected sales or prices. Thus, pricing must be recalibrated to meet a practical expectation.

b) Let x be the number of workers for the t-shirt stall and y for the cap stall, with the constraints:

$$70,000x + 50,000y \leq 800,000 \quad (4)$$

$$x > y \quad (5)$$

Using $y = x - 1$:

$$70,000x + 50,000(x - 1) \leq 800,000$$

$$70,000x + 50,000x - 50,000 \leq 800,000$$

$$120,000x \leq 850,000 \Rightarrow x \leq \frac{850,000}{120,000} \approx 7.08$$

Thus, the maximum x can be 7. Hence, y would be 6 to satisfy $x > y$.

SECTION B

Item 4

a) To determine the age limits suggested, we can calculate the 90th percentile and the median:

- Sort the ages:

14, 15, 15, 16, 16, 17, 17, 18, 19, 19, 19, 20, 20, 21, 21, 22, 22, 23, 23, 24, 24, 25, 25, 26, 26, 27, 28, 28, 29, 30

- Median (15th and 16th ages):

$$\text{Median} = \frac{21 + 22}{2} = 21.5$$

- 90th percentile is the 27th age: 28.

b) I would recommend the age limit of **28** because it allows the organization to include a broad range of applicants while still focusing on the upper limit of the age distribution.

Item 5

a) For a cylinder with a volume of $9,000 \text{ cm}^3$ and height $h = 2r$:

$$V = \pi r^2 h \Rightarrow 9,000 = \pi r^2(2r) \Rightarrow 9,000 = 2\pi r^3$$
$$r^3 = \frac{9,000}{2\pi} \approx \frac{9,000}{6.283} \approx 1,432.39 \Rightarrow r \approx 11.25 \text{ cm}$$

Height:

$$h = 2r \approx 22.5 \text{ cm}$$

b) The travel time for 240 km at 80 km/h:

$$\text{Time} = \frac{240}{80} = 3 \text{ hours}$$

Leaving at 10:00 am, he will arrive at 1:00 pm.

c) Total contributions:

- Peter: UGX 2,000,000
- Friend: UGX 1,000,000 (half of Peter's)

Total: UGX 3,000,000 < UGX 5,000,000 required, thus they need a loan of UGX 2,000,000.

PART II

Item 6

a) The distance from A to B:

$$\text{Distance} = \sqrt{(14 - 2)^2 + (8 - 3)^2} = \sqrt{12^2 + 5^2} = \sqrt{144 + 25} = \sqrt{169} = 13 \text{ km}$$

From B, moving 30 km northwest places C at coordinates $(14 - 30\cos(45^\circ), 8 + 30\sin(45^\circ))$:

$$C \text{ at } (14 - 21.21, 8 + 21.21) = (-7.21, 29.21)$$

Time available is 3 hours (from 3:00 pm to 6:00 pm):

$$\text{Total Distance} = 13 + 30 = 43 \text{ km} \Rightarrow \text{Speed} = \frac{43 \text{ km}}{3 \text{ hours}} \approx 14.33 \text{ km/h}$$

b) For 100 mats, each mat has an area:

$$\text{Area} = \pi r^2 = \pi(14^2) \approx 615.75 \text{ cm}^2$$

Total area for 100 mats:

$$100 \times 615.75 \approx 61,575 \text{ cm}^2$$

Each sheet:

$$70 \times 80 = 5600 \text{ cm}^2$$

Thus, sheets needed:

$$\frac{61,575}{5600} \approx 10.98 \Rightarrow 11 \text{ sheets}$$

Item 7

a) The surface area of the triangular prism is calculated as follows:

- Area of triangular base:

$$\text{Area} = \frac{1}{2} \times \text{base} \times \text{height} = \frac{1}{2} \times 5 \times 4 = 10 \text{ m}^2$$

- Lateral surface area:

$$\text{Perimeter of base} = 5 + 4 + \sqrt{(5^2 + 4^2)} \approx 5 + 4 + 6.4 = 15.4 \text{ m}$$

Lateral surface area:

$$\text{LSA} = \text{Perimeter} \times \text{Length} = 15.4 \times 12 = 184.8 \text{ m}^2$$

Total area needed (including two triangular bases):

$$\text{Total} = \text{LSA} + 2 \times \text{Area} = 184.8 + 20 = 204.8 \text{ m}^2$$

b) Total loan repayment:

$$\text{Total interest} = 4,000,000 \times 0.10 \times 3 = 1,200,000 \Rightarrow \text{Total repayment} = 4,000,000 + 1,200,000 = 5,200,000$$

Annual profit:

$$1,500,000 \times 3 = 4,500,000$$

Since the repayment exceeds profit, the owner should not take the loan.



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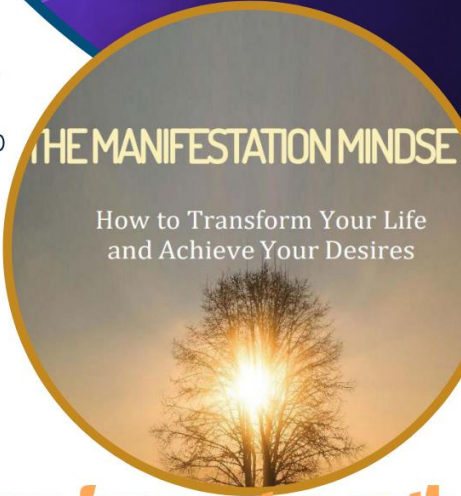
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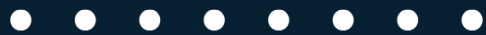
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