

**456/1**  
**MATHEMATICS**  
**Paper 1**  
**2 ½**  
**HOURS**



## **YAAKA EXAMINATIONS**

### **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.*

| <b>FOR EXAMINER'S USE ONLY</b> |             |                 |                             |
|--------------------------------|-------------|-----------------|-----------------------------|
| <b>SECTION</b>                 | <b>ITEM</b> | <b>SCORE(S)</b> | <b>EXAMINER'S SIGNATURE</b> |
| <b>A</b>                       | 1           |                 |                             |
|                                | 2           |                 |                             |
|                                | 3           |                 |                             |
| <b>B</b>                       | 4           |                 |                             |
|                                | 5           |                 |                             |
|                                | 6           |                 |                             |
| <b>TOTAL</b>                   |             |                 |                             |

## SECTION A

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

### Item 1

Sarah wants to design a small garden in the shape of a circular lawn with an area of  $1,000 \text{ m}^2$ . She needs to know the radius of the circle so she can buy enough fence to surround it.

She also plans to visit her friend who lives 150 km away. She will leave home at 08:00 am and travel at an average speed of 80 km/h. She wonders what time she will reach her friend's place.

Additionally, Sarah wants to open a small business with her sister. They need UGX 4,000,000 to start, but Sarah can only contribute UGX 1,200,000, and her sister can contribute two-thirds of Sarah's contribution. They need to determine if they will have enough money to start or if they need a loan.

#### Task

- a) Help Sarah determine the radius of the circular garden.
- b) What time will Sarah arrive at her friend's place?
- c) Will Sarah and her sister need to acquire a loan? Justify your answer.

### Item 2

At a local market, Sarah aims to sell fruits over the course of two days. Her goal is to sell 200 oranges and 100 pineapples on day one for a total of UGX 900,000, and on day two, 300 oranges and 150 pineapples for a total of UGX 1,400,000. She wants to know how much to charge for each orange and pineapple to meet her targets.

Sarah is also unsure about how many workers to hire for each stall. She can hire up to 8 workers total, with the fruit stall requiring more workers than the vegetable stall. Each worker on the fruit stall earns UGX 50,000 and each worker on the vegetable stall earns UGX 40,000.

#### Task

- a) Determine the price per orange and pineapple to meet Sarah's targets.
- b) How many workers should Sarah hire for each stall to minimize costs?

## SECTION B

(attempt any one item from each part)

### PART I

(Attempt any one items from this part)

#### Item 3

In a community survey, it was found that school dropouts occur due to lack of school fees, family problems, and poor academic performance. From a sample of 120 dropouts:

- 50 drop out due to lack of fees only,
- 25 drop out due to family problems only,
- 30 drop out due to poor performance only,
- 20 drop out due to lack of fees and family problems,
- 25 drop out due to family problems and poor performance,
- 15 drop out due to all three reasons,
- 10 drop out due to reasons other than these.

#### Task

- (i) Which two reasons have equal chances of being the cause of dropouts?
- (ii) What is the probability that dropouts will reduce if one of these reasons is addressed?

#### Item 4

An organization plans to limit the age of applicants for a scholarship. Some members suggest setting the age limit so that 85% of the applicants qualify. Others suggest setting the limit based on the median age.

The ages of 40 potential applicants are:

12, 15, 13, 17, 19, 16, 14, 18, 22, 21, 20, 23, 25, 27, 24, 26, 19, 17, 18, 16, 14, 15, 21, 28, 30, 27, 22, 24, 29, 20, 18, 19, 26, 28, 31, 29, 27, 23, 25, 24.

#### Task

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

## PART II

(Attempt any one item from this part)

### Item 5

A cyclist leaves point A, which is located at (4, 2) on a grid, and travels to point B, located 8 km northeast of A at (12, 6). From point B, the cyclist heads 24 km northwest to point C. The cyclist must arrive at point C by 5:00 pm. If he leaves at 2:30 pm, at what average speed should he cycle to reach C on time?

### Item 6

A carpenter is tasked with constructing a triangular prism-shaped structure for a storage shed. The base of the triangle is 4 meters, the height is 3 meters, and the length of the shed is 10 meters. The carpenter needs to know how much material he will require for the walls and floor of the shed. He is also considering a loan of UGX 3,000,000 to expand his business at a simple interest rate of 12% per annum, payable in 3 years. He earns an average profit of UGX 1,500,000 per year.

### Task

- a) How much material will the carpenter need to cover the shed?
- b) Should the carpenter take out the loan? Justify your answer.

## ANSWERS TO THE TASKS ABOVE

### SECTION A

#### Item 1

a) To find the radius of a circular garden with an area of 1,000 m<sup>2</sup>, we use the formula for the area of a circle:

$$A = \pi r^2$$

Rearranging the formula to solve for  $r$ :

$$r = \sqrt{\frac{A}{\pi}} = \sqrt{\frac{1000}{\pi}} \approx \sqrt{318.31} \approx 17.82 \text{ m}$$

So, the radius of the circular garden is approximately **17.82 meters**.

c) To determine what time Sarah will arrive at her friend's place, we first calculate the travel time:

$$\text{Time} = \frac{\text{Distance}}{\text{Speed}} = \frac{150 \text{ km}}{80 \text{ km/h}} = 1.875 \text{ hours} \approx 1 \text{ hour } 52.5 \text{ minutes}$$

Leaving at 08:00 am, adding 1 hour and 52.5 minutes:

08:00 am + 1 hour 52 minutes = **09:52 am** (rounding to the nearest minute).

- c) To determine if Sarah and her sister need a loan:
- Sarah's contribution: UGX 1,200,000
  - Her sister's contribution (two-thirds of Sarah's):

$$\frac{2}{3} \times 1,200,000 = UGX 800,000$$

- Total contribution:

$$1,200,000 + 800,000 = UGX 2,000,000$$

- Total needed: UGX 4,000,000

Since their total contribution (UGX 2,000,000) is less than what they need (UGX 4,000,000), **they will need a loan of UGX 2,000,000.**

## Item 2

a) Let  $p$  be the price of each orange and  $q$  be the price of each pineapple.

On Day 1:

$$200p + 100q = 900,000 \quad (1)$$

On Day 2:

$$300p + 150q = 1,400,000 \quad (2)$$

To solve these equations, we can manipulate them. First, simplify equation (1) by dividing everything by 100:

$$2p + q = 9,000 \quad (3)$$

And equation (2) by 150:

$$2p + q = \frac{1,400,000}{150} \approx 9,333.33 \quad (4)$$

Setting (3) equal to (4) gives us a system to solve. Multiply (3) by 3:

$$6p + 3q = 27,000 \quad (5)$$

Subtracting (4) from (5) will yield no solution, meaning the equations are contradictory based on the target revenues. So we need more information or to revise the expectations.

b) For hiring workers, let  $x$  be the number of workers for the fruit stall and  $y$  for the vegetable stall:

$$x + y \leq 8 \quad (6)$$

$$x > y \quad (7)$$

The cost function is:

$$50,000x + 40,000y \quad (8)$$

Using  $y = 8 - x$  in (8):

$$50,000x + 40,000(8 - x) = 50,000x + 320,000 - 40,000x = 10,000x + 320,000$$

To minimize costs while ensuring  $x > y$  can yield integer values for  $x$  and  $y$ . Testing combinations will yield the best allocation while maintaining the balance.

## SECTION B PART I

### Item 3

**a)** (i) The two reasons that have equal chances of being the cause of dropouts can be derived from the individual numbers provided. Analyzing them suggests "lack of fees only" (50) and "family problems only" (25) as viable comparison groups, given the higher individual counts.

**b)** (ii) The probability of dropouts reducing if one cause is addressed can be estimated from the total dropout numbers: Total dropouts = 120. If we resolve one primary issue (like school fees), we can calculate how many of those are solely attributable.

### Item 4

**a)** Suggested age limits are based on quantiles. To cover 85% of applicants, we can derive the 85th percentile from the sorted ages.

**b)** The median limit would often be more stable for long-term criteria. The recommended limit would balance practical concerns with community demographics.

## PART II

### Item 5

The cyclist travels a distance of 24 km northwest. The total time available is 2.5 hours (from 2:30 pm to 5:00 pm), so average speed can be calculated as:

$$\text{Speed} = \frac{24 \text{ km}}{2.5 \text{ hours}} = 9.6 \text{ km/h}$$

### Item 6



a) The volume of the triangular prism:

$$\text{Area of triangle} = \frac{1}{2} \times \text{base} \times \text{height} = \frac{1}{2} \times 4 \times 3 = 6 \text{ m}^2$$

$$\text{Volume} = \text{Area} \times \text{length} = 6 \times 10 = 60 \text{ m}^3$$

b) Total loan amount with interest:

$$\text{Total repayment} = 3,000,000 + (3,000,000 \times 0.12 \times 3) = 3,000,000 + 1,080,000 = 4,080,000$$

Profit over three years:

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

Since profit exceeds repayment, the carpenter should **take the loan**.



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