



UCE 456/1 Math paper 1

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UCE 456/1 Mathe paper 1

Time 1hour 30 minutes

Marking guide

Item 1

Two friends, Sarah and Moses, started a poultry project to which they contributed Shs. 4,000,000 and Sh. 6,000,000 respectively.

They agreed to share the profits in the ratio of their contributions and the project started with 2,000 birds.

After selling all the birds, they made a profit of one million five hundred thousand shillings. They reinvested the profit in the project and the number of birds increased to 2,500. However, Moses was not sure of the amount he re-invested as well as the percentage increase in the number of birds.

On 1st arch 2024, they bought feeds and also balanced their books of accounts. On that day, they had a meeting in which they agreed to buy feeds after every 7 days and balance their books of account after every 15 days, However, Sarah wondered if they would be another date in the future on which they would by feeds and balance their books of account on the same day.

Task

- (a) How much of the profit did Moses re-invest in the business?
- (b) What was the percentage increase in the number of birds
- (c) On which date in future would they buy the feeds and also balance their books of account on the same day

Suggested answer

(a) Moses' Reinvestment

Total contribution ratio:

- Sarah: Shs. 4,000,000
- Moses: Shs. 6,000,000

- Ratio = 4 : 6 = 2 : 3

Profit made: Shs. 1,500,000

Moses' share:

$$\frac{3}{5} \times 1,500,000 = 900,000$$

✓ Moses reinvested **Shs. 900,000** in the project.

(b) Percentage Increase in Birds

Initial number of birds: 2,000

New number of birds: 2,500

Increase:

$$2,500 - 2,000 = 500$$

Percentage increase:

$$\frac{500}{2000} \times 100 = 25\%$$

✓ The number of birds increased by **25%**.

(c) Future Date for Buying Feeds and Balancing Books

Feeds: Every 7 days

Books: Every 15 days

Starting date: 1st March 2024

We need the **Least Common Multiple (LCM)** of 7 and 15.

Multiples of 7: 7, 14, 21, 28, ..., 105

Multiples of 15: 15, 30, 45, 60, ..., 105

LCM = 105 days

Future date:

1st March 2024 + 105 days

Counting forward:

- March has 31 days → 30 days remain after March 1.
- April: 30 days → 60 days total.

- May: 31 days → 91 days total.
- June: 30 days → 121 days total.

So, 105 days falls in **June**. 91 days takes us to **31st May**. $105 - 91 = 14$ days into June.

 They will both buy feeds and balance books on **14th June 2024**.

Final Answers

- (a) Moses reinvested **Shs. 900,000**.
- (b) Percentage increase in birds = **25%**.
- (c) Next common date = **14th June 2024**.

Item 2

A tailor makes school uniforms for boys and girls. The tailor makes at least 80 sets of uniform for boys and not more than 100 sets of uniforms for girls. Each set of uniform for boys requires 4m of material and each set of uniforms for girls requires 3m of material. The tailor has at most 600m of materials to use. The tailor makes profit of sh. 8,000 on each set of boy's uniform and sh. 6,000 on each set of girl's uniform. The tailor is not sure of the number of sets of the number of uniforms to make in order to maximize profit.

Task

- Express the tailor's conditions as inequalities and equations.
- Show the feasible region of tailor's condition on a Cartesian plane
- Help the tailor to determine the possible number of sets of boy's and girl's uniform that should be made to maximize profit. Hence, state the maximum amount of money the tailor is likely to make.

Suggested answers

(a) Expressing the Conditions as Inequalities and Equations

Let:

x = number of boys' uniforms

y = number of girls' uniforms

Constraints:

- (i) At least 80 sets of boys' uniforms:

$$x \geq 80$$

- (ii) Not more than 100 sets of girls' uniforms:

$$y \leq 100$$

- (iii) Material constraint (each boy's uniform = 4m, each girl's = 3m, total ≤ 600 m):

$$4x + 3y \leq 600$$

x	75	150	80
y	100	0	

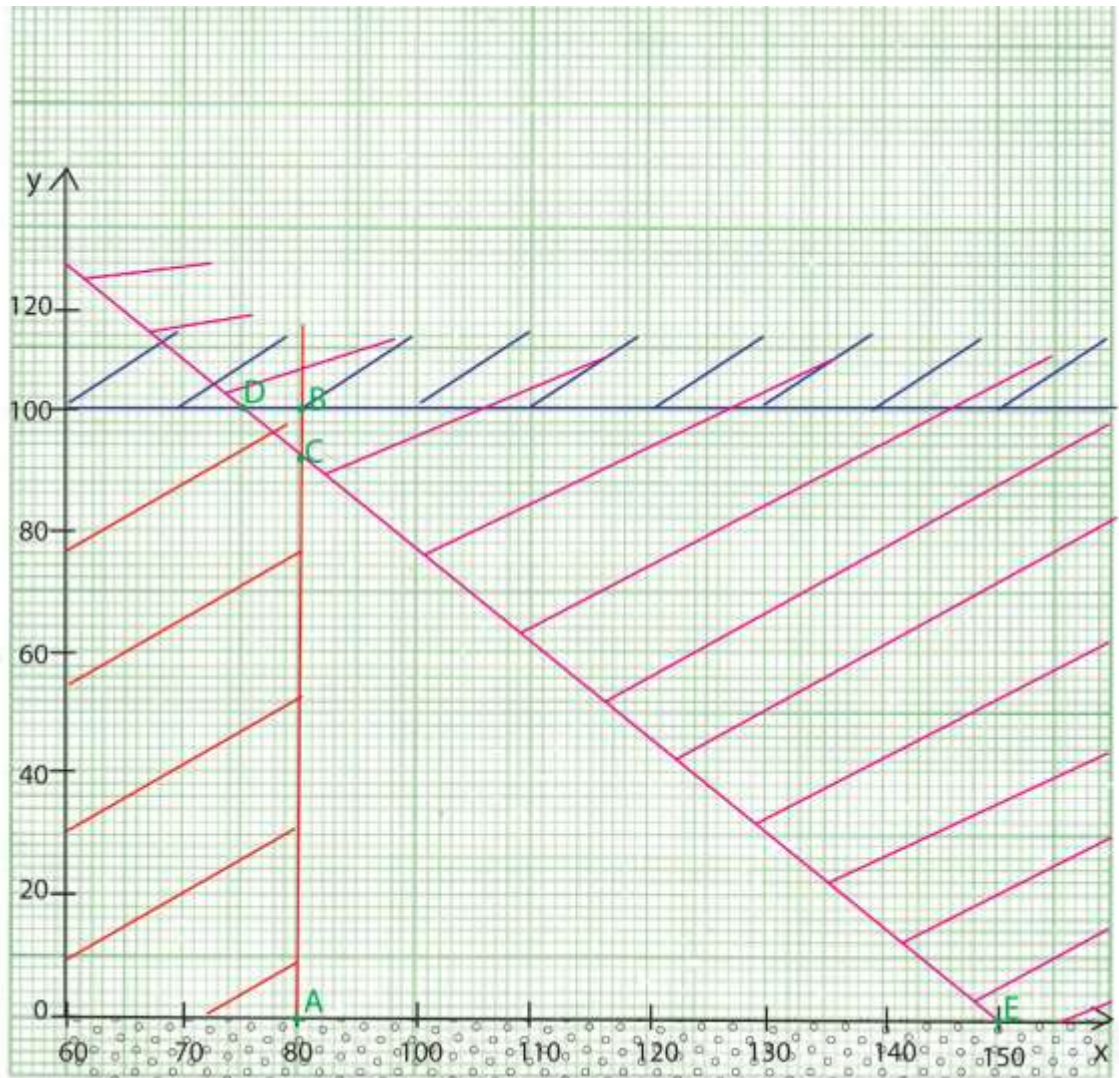
- (iv) Non-negativity:

$$x \geq 0, y \geq 0$$

Objective function (profit):

$$P = 8000x + 6000y$$

(b) Feasible Region on Cartesian Plane



(c)

(c) Maximizing Profit

We check the **corner points** of the feasible region:

- (i) **Point A:** $x = 80, y = 0$

$$P = 8000(80) + 6000(0) = 640,000$$

- (ii) **Point B:** $x = 80, y = 100$ Check material: $4(80) + 3(100) = 320 + 300 = 620 > 600$. ✗ Not feasible.

- (iii) **Point C:** Intersection of $x = 80$ and $4x + 3y = 600$:

$$4(80) + 3y = 600 \Rightarrow 320 + 3y = 600 \Rightarrow y = 93.3$$

Profit:

$$P = 8000(80) + 6000(93.3) \approx 640,000 + 560,000 = 1,200,000$$

- (iv) **Point D:** Intersection of $y = 100$ and $4x + 3y = 600$:

$$4x + 300 = 600 \Rightarrow 4x = 300 \Rightarrow x = 75$$

But $x \geq 80$. **✗** Not feasible.

- (v) **Point E:** Intersection of $x = 150, y = 0$ (from material constraint):

$$4(150) + 3(0) = 600$$

Profit:

$$P = 8000(150) = 1,200,000$$

Final Answer

- (a) Inequalities:

$$x \geq 80, y \leq 100, 4x + 3y \leq 600, x, y \geq 0$$

- (b) Feasible region: bounded by these lines on the Cartesian plane.

- (c) Maximum profit occurs at either:

- $x = 80, y \approx 93 \rightarrow \text{Profit} \approx \text{Shs. } 1,200,000$
- $x = 150, y = 0 \rightarrow \text{Profit} = \text{Shs. } 1,200,000$

 The tailor can make **either 150 boys' uniforms only OR 80 boys' uniforms and about 93 girls' uniforms** to maximize profit of **Shs. 1,200,000**.

Item 3

James has been sent to a certain region to find out whether it is necessary to set up a new office for processing National Identity Cards, Driving Permits and Passports, if the probability of a person having only one document is less than 50%

James randomly interviewed 75 people in that region. He found that 18 people did not have any of the three documents, 30 people had Driving Permits and 20 people had Passports. The number of people who had both National Identity Cards and Driving Permits only, was twice those who had Passports and Driving Permits but no National Identity cards. 4 people had Passports only

3 people had all the three documents and 12 people had Driving Permits only. James has to report about the number of people who have National Identity Cards but he has some missing information.

Task

- Help James to find the total number of people with National Identity Cards.
- Determine if there is a need for new office in the region. Give a reason for your answers

Suggest answers

(a)

Total number of people interviewed, $\epsilon = 75$

People with driving Permit, $D = 30$

People with Passports, $P = 20$

People with National Identity Cards, N ?

People with no document = 18

D only = 12

P only = 4

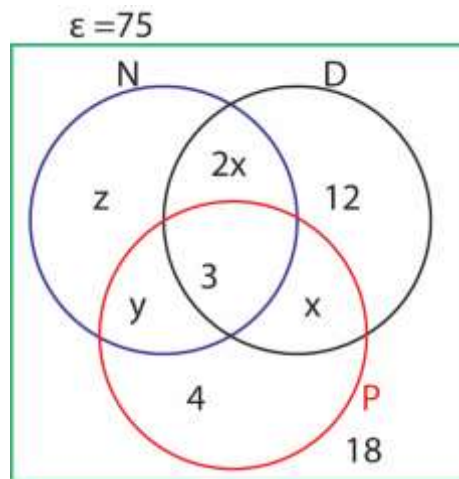
$D \cap P$ only = x

$D \cap N$ only = $2x$

$P \cap N$ only = y

N only = z

$N \cap D \cap P = 3$



$$D = 30 = 12 + 3 + x + 2x$$

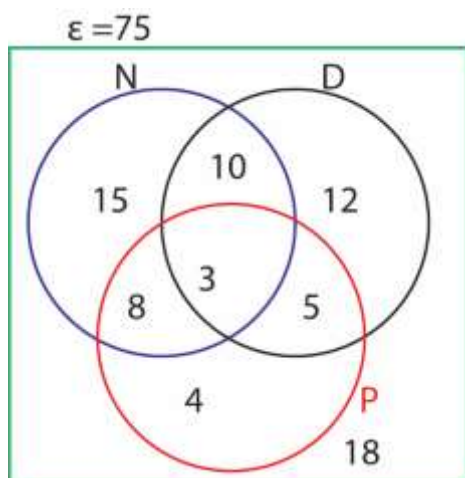
$$x = 5$$

$$P = 20 = 4 + 3 + x + y = 4 + 3 + 5 + y$$

$$y = 8$$

$$\epsilon = 75 = 18 + 4 + 8 + 3 + 5 + 10 + 12 + z$$

$$z = 15$$



$$N = 15 + 10 + 3 + 8 = 36$$

Hence people with National Identity cards = 36

(b)

$$\text{Number of people with one document } 15 + 12 + 4 = 31$$

$$\text{Probability that a person has one document} = \frac{31}{75} = 0.41$$

Hence it is necessary to set up an office because the probability that a person has one document is less than 0.5

Item 4

A farmers' cooperative society gave out fertilizers to a sample of maize farmers in the first season. The number of bags of maize harvested in the first season are given below

20	40	60	55	36	69	59	78	47	66
59	70	53	24	63	50	46	38	68	57
30	65	58	61	57	86	77	54	29	88
62	44	89	45	87	65	47	49	52	69
41	80	37	56	74	27	76	58	79	39

The society wants;

- (i) the data to be presented in a frequency distribution table with classes of interval 10 for easy interpretation.
- (ii) to determine the number of bags of maize above which half of the farmers harvested so as to establish the real effect of the fertilizer.
- (iii) To determine the number of farmers whose harvest is 44.5 bags of maize and below for re-training before the second season but lack the information.

Task

Help the society to;

- (a) represent the data in frequency distribution table.
- (b) Determine the number of bags of maize above which half of the farmers harvested.
- (c) Determine the number of farmers for retraining.

Suggested answer

(a) Frequency Distribution Table (Class Interval = 10)

We arrange the data into classes of width 10, starting from the lowest value (20) up to the highest (89).

Class Interval	Tally	Frequency	CF
20 – 29		4	4
30 – 39		5	9
40 – 49		8	17
50 – 59		12	29
60 – 69		10	39
70 – 79	/	6	45
80 – 89		5	50

Total = 50 farmers (matches the data count).

(b) Number of Bags Above Which Half Harvested

We need the **median** (the middle value when data is ordered).

- Total farmers = 50
- Median position = $\frac{50}{2} = 25^{th}$ value

From cumulative frequencies:

- Up to 29 → 4
- Up to 39 → 9
- Up to 49 → 17
- Up to 59 → 29

So, the 25th value lies in the **50–59 class**.

Using median formula:

$$\text{Median} = L + \left(\frac{\frac{n}{2} - CF}{f} \right) \times h$$

Where:

- $L = 49.5$ (lower boundary of 50–59 class)
- $n = 50$
- $CF = 17$ (cumulative frequency before median class)
- $f = 12$ (frequency of median class)
- $h = 10$ (class width)

$$\begin{aligned}\text{Median} &= 49.5 + \left(\frac{25 - 17}{12} \right) \times 10 \\ &= 49.5 + \left(\frac{8}{12} \right) \times 10 \\ &= 49.5 + 6.7 \approx 56.2\end{aligned}$$

 Half of the farmers harvested **above ~56 bags**.

(c) Farmers for Re-training (≤ 44.5 bags)

We check cumulative frequency up to 44.5:

- 20–29 = 4
- 30–39 = 5
- 40–49 = 8, but only part of this class (40–44.5).

Proportion in 40–49 class:

$$\frac{44.5 - 39.5}{10} = \frac{5}{10} = 0.5$$

So, half of the 8 farmers = 4.

Total retraining = 4 + 5 + 4 = 13.

✅ **13 farmers** harvested ≤ 44.5 bags and need retraining.

🌟 Final Results

- (a) Frequency table prepared.
- (b) Median harvest $\approx$ **56 bags** (half harvested above this).
- (c) **13 farmers** need retraining.

Item 5

Your sister bakes cakes and has received an order for a cake from your friend, Joseph who needs a cylindrical cake with a base area of 660.5cm².

Your sister has suggested two payment plans to JOSEPH. H CAN PAY SH. 400,000 CASH OR PAY A DEPOSIT OF SH. 200,000 and 2 equal installments of sh. 110,000each. However, Joseph has found it hard to decide the payment plan.

Your sister has a triangular board that she wants to use to cut out the circular tray on which the base of the cake will sit. The two sides of the triangular board measure 60cm and 48cm, and the angle between these sides is 60°.

Your sister is not sure whether the largest circular tray (inscribed circle) she can cut out of the triangular board will be enough for the base of the cake.

Task

- (a) Which of the two payment plans will you recommend to Joseph? Give a reason for your answer.
- (b) Determine whether the largest circular tray she plans to cut out of the triangular board will be enough for the base of the cake.

Suggested answer

(a) Recommended Payment Plan for Joseph

Plan 1 (Cash):

Pay Sh. 400,000 immediately.

Plan 2 (Deposit + Installments):

Deposit = Sh. 200,000

2 installments of Sh. 110,000 each = Sh. 220,000

Total = Sh. 200,000 + 220,000 = Sh. 420,000

👉 **Plan 1 is better** because Joseph pays **Sh. 20,000 less** overall.

✅ Recommend **cash payment of Sh. 400,000**.

(b) Circular Tray vs Cake Base

Step 1: Cake base area

Given:

$$A = 660.5 \text{ cm}^2$$

Area of circle = πr^2 .

$$r = \sqrt{\frac{660.5}{\pi}} \approx \sqrt{\frac{660.5}{3.1416}} \approx \sqrt{210.4} \approx 14.5 \text{ cm}$$

So, cake base radius $\approx$ **14.5 cm**.

Step 2: Triangular board dimensions

Two sides: 60 cm and 48 cm

Included angle = 60°

Area of triangle:

$$\begin{aligned} A &= \frac{1}{2} ab \sin C = \frac{1}{2} \cdot 60 \cdot 48 \cdot \sin 60^\circ \\ &= 1440 \cdot 0.866 \approx 1247.0 \text{ cm}^2 \end{aligned}$$

Third side using cosine rule:

$$\begin{aligned} c^2 &= 60^2 + 48^2 - 2(60)(48) \cos 60^\circ \\ &= 3600 + 2304 - 2880 = 3024 \\ c &\approx 55 \text{ cm} \end{aligned}$$

So triangle sides: 60, 48, 55 cm.

Step 3: Radius of inscribed circle (inradius)

Formula:

$$r = \frac{A}{s}$$

Where $s = \frac{1}{2}(a + b + c)$.

$$\begin{aligned} s &= \frac{1}{2}(60 + 48 + 55) = \frac{163}{2} = 81.5 \\ r &= \frac{1247}{81.5} \approx 15.3 \text{ cm} \end{aligned}$$

Step 4: Compare tray radius vs cake radius

Cake base radius = 14.5 cm

Tray radius = 15.3 cm



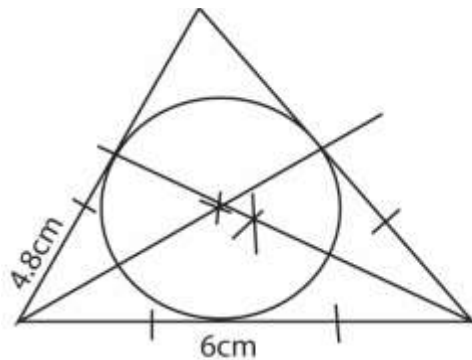
The tray is **large enough** for the cake base.

Final Results

(a) Recommend **cash payment of Sh. 400,000** (cheaper).

(b) The triangular board can produce a circular tray with radius $\approx$ **15.3 cm**, which is **sufficient** for the cake base radius of 14.5 cm.

Or the radius of inscribed circle can be determined by construction (use a scale of (1: 10))



Diameter = 3.1cm

Multiplying by scale of 10; actual diameter = 31cm

Radius of inscribed circle = 15.5cm

Hence base of cake of radius 14.5 fits.

Item 6

Your brother wants to design a children's playground. The playground will have a triangular garden and circular fence around the garden. The two sides of the triangular garden will measure 50m and 70m, and the angle between them will be 45° .

Your brother also intends to put pavers in the region outside the triangular garden but inside the circular fence. Each square meter of pavers costs sh. 35,000.

Your brother needs help in identifying the type of triangle represented by the triangular garden, coming up with an accurate design of the playground as well as the cost of buying the pavers.

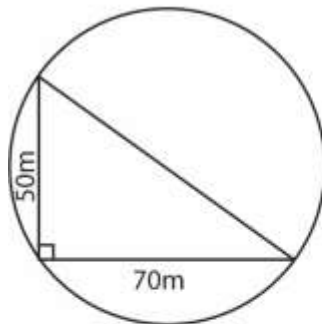
Task

Help your brother to

- construct an accurate design of the children's playground.
- Identify the type of triangle represented by the triangular garden and give reason for your answer.
- Determine the amount of money needed to buy the paver

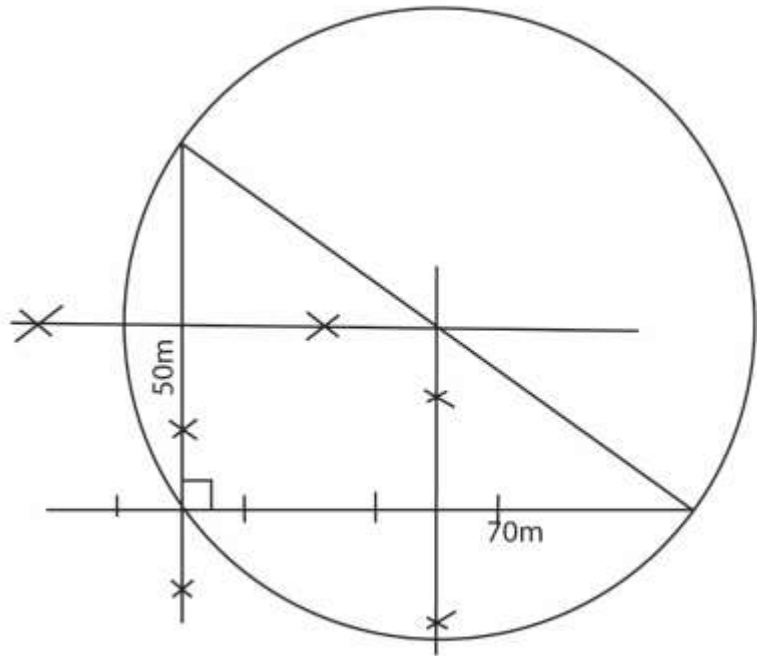
Suggested answers

(a) Sketch



Radius of the circle?

Accurate drawing



Scale 1cm : 10m

Radius of circumscribed circle = 4.3cm

Actual radius of the garden = $4.3 \times 10 = 43\text{m}$

(b) The triangle is right-angled because it contains angle 90° .

(c) Area of the = $\pi r^2 = (3.14 \times 43 \times 43) = 5,805\text{m}^2$

Area of a triangle = $\frac{1}{2}bh = \frac{1}{2} \times 70 \times 50 = 1,750\text{m}^2$

Area to be paved = $5,805 - 1,750 = 4,055\text{m}^2$

Cost of pavers = $4,055 \times 35,000 = 141,925,000/=$

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Thank you

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