

UTEB- Annual UCE Mathematics Seminar
Held at ALLIANCE HIGH SCHOOL NANSANA
'O' Level Mathematics Seminar
Date: Saturday 8th July, 2023
Tel: 0755 -100021 | 0702- 601686

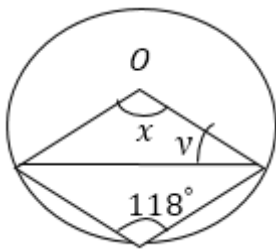


COMPOSITION OF 456/1 Mathematics Paper 1

No.	Topic	Content
1	Algebra (expressions and symbols)	<ul style="list-style-type: none"> ✓ Algebraic symbols, ✓ Algebraic equations ✓ Making the subject ✓ Operations ✓ Factorization ✓ Word problems
2	Equations and Inequalities	<ul style="list-style-type: none"> ✓ Linear and Quadratic Equations ✓ Linear and Quadratic inequalities ✓ Quadratic Graphs
3	Linear Programming	<ul style="list-style-type: none"> ✓ Forming inequalities ✓ Graphing inequalities ✓ Minimization and Maximization
4	Matrices	<ul style="list-style-type: none"> ✓ Operations of matrices ✓ Determinant of a matrix ✓ Inverse of a matrix ✓ Matrices for storage of information
5	2 – Dimensional Geometry	<ul style="list-style-type: none"> ✓ Construction ✓ Close figures ✓ Mensuration ✓ Bearing ✓ Circles and Circle properties ✓ Trigonometry
6	Transformations	<ul style="list-style-type: none"> ✓ Translation ✓ Rotation ✓ Reflection ✓ Enlargement ✓ Matrices of transformation
7	Statistics & Probability	<ul style="list-style-type: none"> ✓ Data representation ✓ Measures of central tendency ✓ Tree diagrams.

SECTION A QUESTIONS:

1. Given that $m * n = 2m^2 - n^2$, evaluate $(5 * -2) * 4$.
2. Simplify $(2b^2 - 5a^2 + 9ab) \div (2b - a)$.
3. Solve for y in $\frac{y-2}{3} - \frac{y+3}{2} = \frac{y+1}{4}$
4. Given matrices $P = \begin{pmatrix} 5 & 1 \\ 4 & 2 \end{pmatrix}$ and $R = \begin{pmatrix} 7 & -3 \\ 2 & 0 \end{pmatrix}$. Find matrix Q such that $PQ = R$
5. Given that $P = \sqrt{Q + \frac{T^3}{R}}$, express T in terms of P, Q and R.
6. In triangle ABC, $AB = 5.2\text{cm}$, $BC = 6.6\text{cm}$ and angle $ABC = 150^\circ$. Calculate the area of the triangle.
7. In the figure below O is the centre of the circle.



Find the value of x and y .

8. Musa buys 4 exercise books and 3 graph books and it cost him shs.250. If he buys 2 graph books and 1 exercise book at shs.100. Find the cost of 3 exercise books and 2 graph books.
9. A point $P(-2, 3)$ is reflected in the line $x + y = 0$ to form its image P' . State the coordinates of P' .
10. A bag contains 6 yellow and 8 blue identical balls. Two balls are picked at random from the bag, one at a time without replacement. Find the probability of picking a blue ball on the second picking.
11. Solve the quadratic equation $3x^2 - 7x + 4 = 0$.
12. Given that $A = \begin{pmatrix} -3 & 7 \\ -1 & 5 \end{pmatrix}$, find the inverse of A.
13. If $\tan \theta = \frac{5}{12}$ and $180^\circ \leq \theta \leq 360^\circ$, determine the value of $\sin \theta$ and $\cos \theta$.

14. Solve the simultaneous equation

$$5x = 4y + 17$$

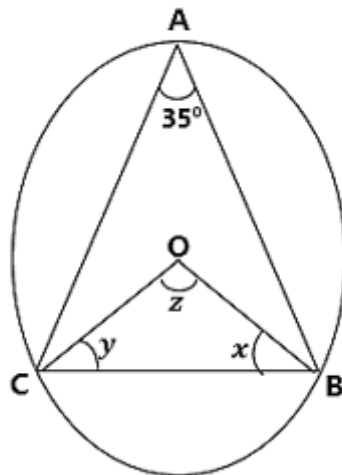
$$4y + 3x - 23 = 0$$

15. The table below shows the marks obtained by 47 students in a mathematics test.

Number of students	3	5	7	12	8	6	4	2
Marks (out of 100)	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99

Draw accumulative frequency curve (o-give) for the data.

16. Find the angle x , y and z from the diagram below.



17. Factorise completely:

$$3x^2 - 4$$

$$6h^2 - 3h - 8$$

18. Make c the subject of the formula.

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

19. Given that $a * b = a - b^2a + ba$ Evaluate :

a) $2 * 2$

b) Find the value of m for which $3 * m = 3$

20. Rotate the point P(-4,5) on a graph paper through 180° . Hence state the new position of P.

SECTION B QUESTIONS:

Question 1. | STATISTICS |

The table below shows the masses (in kg) of 30 babies in the hospital.

Mass (kg)	5-9	10-14	15-19	20-24	25-29	30-34	35-39
No. of babies	2	2	10	8	2	5	1

- a) State:
- Class interval
 - Modal class
- b) Calculate the mean mass, using an assumed mean of 22 kg.
- c) Plot an Ogive for the masses and use it to estimate the median.

Question 2. | QUADRATIC GRAPHS |

- a) Draw the graphs of $y = 1 + x - 2x^2$ and the line $y = 3x - 3$ for values of x from -3 to 3
- b) Use your graph to solve the equation $2 - x - x^2 = 0$.

Question 3. | TRIGONOMETRY |

- a) Use an equilateral triangle, show that $\sin 60^\circ = \frac{\sqrt{3}}{2}$
- b) The angle of elevation of a point A from the top of a cliff (T) 100m high is 38° . Another point B on a straight line as point A is 250m from T. calculate the distance between points A and B.

Question 4. | MATRICES |

- a) If matrix $A = \begin{pmatrix} 2 & 4 \\ 1 & 3 \end{pmatrix}$ and $B = \begin{pmatrix} -1 & 1 \\ 2 & 3 \end{pmatrix}$. Find $A^2 + 2B + I$. Where I is 2 x 2 identity matrix.
- b) Solve the simultaneous equation using matrix method:
- $$5x + 3y = 7$$
- $$4y = 2x - 2$$

Question 5. | 2-D Geometry - Bearing|

A ship sails from Entebbe on bearing of 080° for 250km to Sesse Island. From there it heads for Luzira Port 450km away on a bearing of 215° .

- By scale drawing, use a scale of 1cm to represent 50km to draw an accurate diagram showing the route of the ship.
- From the diagram, determine the distance and bearing of Entebbe from Luzira Port.
- If the ship is to sail back to Entebbe using a direct route and traveling at an average speed of 250kmhr^{-1} . Find the time it take for the journey.

Question 6. | Transformation|

- A line TX with vertices T(4,2) and X(2,4) undergo a positive quarter turn rotation about (0,-1). Find the coordinates of T'X' the image of line TX.
- Triangle PQR is mapped onto P'(1,2), Q'(1,3) and R'(3,5) by a matrix of transformation $M = \begin{pmatrix} 0 & -1 \\ -1 & 0 \end{pmatrix}$. Describe matrix M and find the coordinated of triangle PQR.

Question 7. | Linear Programming |

James wishes to transport 60 tonnes of lake sand to a building site. He has 5 trucks which can each carry 5 tonnes and has 8 tippers which can each carry 1 tonne of lake sand. The tipper makes 5 trips per day and the truck makes 2 trips per day. He has 10 drivers available. The cost of a tipper is shs.40,000 per day and a truck is shs.100,000 per day. By letting x and y be the number of tippers and trucks used respectively,

- Form the inequalities representing the above information.
- Represent all the above inequalities on the same graph by shading of the unwanted region.
- Find the number of tippers and trucks he has to use in order to minimize the total cost.

Question 8. | Transformation|

A square ABCD has vertices A(0,5), B(0,3), C(2,3) and D(2,5).

- Rotate ABCD through 270° , about O (0,0) and write down the coordinates of A',B',C' and D' the images of A, B,C and D respectively.
- Draw A''B''C''D'', the image of A'B'C'D' under reflection in the line $y = x$ and state the coordinates of A'', B'', C'' and D''.
- Determine the matrix of the single transformation which maps ABCD onto A''B''C''D''.

Question 9. | Linear Programming |

In an assessment there are two papers, each with a total mark of 50. To pass the examination, a candidate must score at least 20 marks on each paper and at least 50 marks on the two papers combined. If x and y represent the marks on paper 1 and paper 2 respectively;

- a) Write down all the inequalities based on the above facts.
- b) Using 1 cm to represent 5 marks, construct the region in which the points representing an assessment pass must lie.
- c) A candidate scores 20 marks in paper 1 and y marks in paper 2. Find the number of possible values of y which would allow the candidate to pass.
- d) Find the number of ways in which it is possible for a candidate to score at least 20 marks in each paper and yet to fail the examinations.

Question 10. | MATRICES |

- a) Use matrix method to solve the following part of simultaneous equations.

$$3y = 5x - 10$$

$$4 - y - 2x = 0$$

- b) Shamim is a businesswoman who deals in agricultural produce. She visited four markets in a certain week. In market A, she bought 5 bags of beans, 3 bags of maize, 8 bags of irish potatoes and 2 bags of millet. In market B she bought 2 bags of beans, 3 bags of irish potatoes and 1 bag of millet. In market C she bought 4 bags of beans, 5 bags of irish potatoes and 2 bags of millet. In market D she bought 5 bags of beans, 3 bags of maize, 3 bags of irish potatoes and 3 bags of millet. She bought each bag of beans at UGX 300,000. A bag of maize at UGX 150,000. A bag of irish potatoes at UGX 100,000 and a bag of millet at UGX 185,000. She later sold all the produce she had bought at UGX 350,000 per bag of beans, UGX 180,000 per bag of maize, UGX 145,000 per bag of irish potatoes and UGX 200,000 per bag of millet.
 - (i) Form a 4×4 matrix for the produce Shamim bought from the four markets.
 - (ii) Form a cost matrix to the price of the produce.
 - (iii) By matrix multiplication, find the amount of money spent on the produce in each market.
 - (iv) Find also the amount of money she got from the sale of the produce.
 - (v) Find her profit.

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Mathematics Paper 2
COMPOSITION OF 456/2 Mathematics Paper 2

No.	Topic	Content
1	Numerical concepts	<ul style="list-style-type: none"> ✓ Operations ✓ LCM/GCF ✓ Fractions ✓ Estimates ✓ Indices & Logarithms ✓ Surds ✓ Ratios ✓ Proportions ✓ Percentages
2	Set Theory	<ul style="list-style-type: none"> ✓ Union ✓ Intersection ✓ Complements ✓ Venn diagrams
3	Functions	<ul style="list-style-type: none"> ✓ Relations ✓ Mappings ✓ Domain/Ranges ✓ Arrow diagrams ✓ Composite function
4	Graphs	<ul style="list-style-type: none"> ✓ Coordinates ✓ Cartesian equations ✓ Kinematics
5	Vectors	<ul style="list-style-type: none"> ✓ Notations ✓ Operations ✓ Magnitudes ✓ Parallel / Collinear vectors
6	Three dimensional Geometry	<ul style="list-style-type: none"> ✓ Nets ✓ Lines/Planes ✓ Mensuration ✓ Surface area ✓ Volume
7	Business mathematics	<ul style="list-style-type: none"> ✓ Currency ✓ Exchange rates ✓ Discount ✓ Taxation ✓ Commission ✓ Profit/Loss ✓ Hire Purchase

1. Express $3.\overline{15}$ as a simplified mixed fraction.
2. Given a function $g(x) = 5x - 1$ find the domain whose range is $\{9, 14\}$
3. M is the midpoint of the line segment AB with A(2, -7) and B(4, 15). Determine the length of M from the origin.
4. Determine the area of a wooden cube whose volume is 64cm^3 .
5. A man deposited Shs. 200,000 in a bank at compound interest rate of $18\frac{1}{4}\%$ per year. Find the total amount he received after two years.
6. Determine the smallest number which leaves the same remainder of 2 when divided by 8 and 6.
7. Given two sets T and S with T = {first five triangle numbers} and S = {first five square numbers} Represent T and S, on a Venn diagram and hence find $n(T \cap S)$
8. Find the equation of the line passing through the point A(5, -20) and the origin.
9. Given vectors $\overrightarrow{NM} = \begin{pmatrix} 7 \\ -2 \end{pmatrix}$, $\overrightarrow{MD} = \begin{pmatrix} -4 \\ 6 \end{pmatrix}$ and $\overrightarrow{DT} = \begin{pmatrix} 5 \\ 11 \end{pmatrix}$ find:
 - a) NT
 - b) $|\overrightarrow{NT}|$
10. Calculate the volume of a hemispherical bowl of diameter 21cm.
11. Find the next two values in the sequences below
 - a) 1.1, 2.3, 5.8, 13
 - b) 11, 22, 110, 121, 202, 220..... In base three
12. Y varies inversely as the square of x. the difference between the value of y when $x = 6$ and $x = 10$ is 16. Find the law connecting x and y.
13. The coordinates of A and B are (a, -1) and (3, b) respectively. Given that (5, 2) is the midpoint of line segment AB, find.
 - a) Column vector \overrightarrow{AM}
 - b) The length of vector \overrightarrow{AM} correct to 2 decimal places.
14. Use logarithm tables to evaluate $\sqrt{0.841 - 32.7}$ correct to 3 significant figures.

15. Express $\frac{1}{\sqrt{5}} + \frac{\sqrt{5}+2}{\sqrt{5}-2}$ in the form $a + b\sqrt{c}$. Hence state the values of a, b and c.

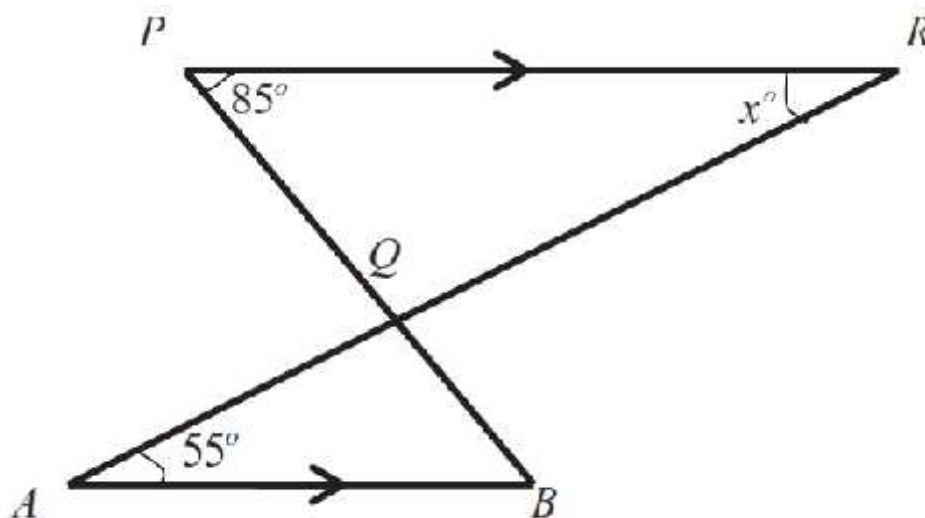
16. Given that $f(x) = \frac{x-1}{x^2-x-12}$ which $f(x)$ is undefined.

17. The ratio of new price to the old of a book is 5:4.

a) Find the percentage increase in the price of the book.

b) If the old price of the book is UGX 3000, find the new price of the book.

18. In the figure below \overline{PR} is parallel to \overline{AB} . $\overline{AQ} = 4\text{m}$, $\overline{QR} = 21\text{m}$, $\overline{PR} = 4\text{m}$ and $\overline{AB} = 7\text{m}$.



Find;

a) Angle x

b) Length \overline{PQ} and \overline{QB}

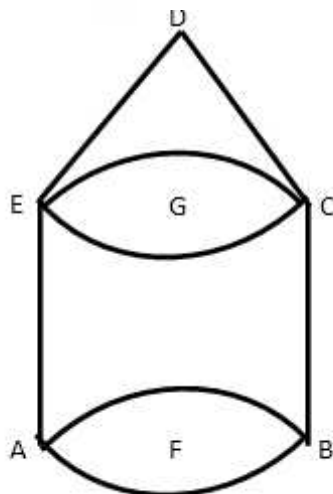
19. A map is drawn to a scale of 1; 200,000. Calculate the area of a field in km^2 that is represented by 2cm^2 on the map.

20. A chord of length 16cm is 6cm away from the centre of a circle, calculate the circumference of the circle. Use $\pi = 3.14$.

SECTION B Questions

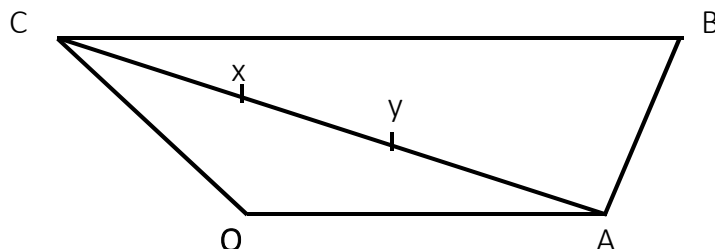
21. Forty students of Kirungu S.S were interviewed to find out how many liked posho (P), rice (R), or matooke(M). 3 liked neither of these foods. It was found that an equal number of students liked matooke and rice. 15 liked both matooke and rice, 26 liked rice, 14 liked rice and posho and 9 liked all the 3 foods.
- (a) How many students;
- (i) Liked posho
 - (ii) Did not like posho
 - (iii) Liked one food
- (b) Find the probability that a student chosen at random likes at least two foods.

22. (a) The diagram below shows a giant water tank ABCDE which is made in the shape of a right circular cone mounted on a cylinder. The radius of the cylinder $AF = EF = 6\text{m}$. The slant length of the cone $ED = CD = 7.5\text{m}$ and the height of the cylinder $BC = AE = 10\text{m}$. if the water tank has to be painted on the outer surface, calculate the surface area to be painted in m^2 (take $\pi = 3.142$).



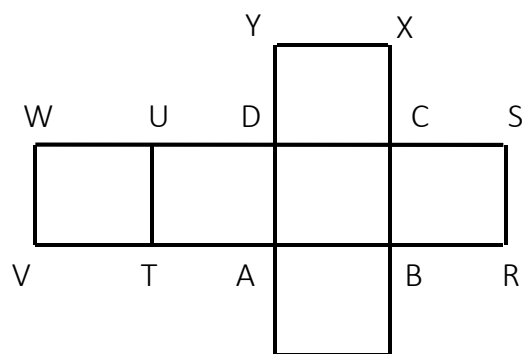
- (b) Calculate the volume of water needed to fill the tank in m^3 .
(take $\pi = 3.142$).

23. The figure below shows a trapezium OABC $OA = \mathbf{a}$, $OC = \mathbf{c}$ and $CB = 3\mathbf{a}$.



- (a) X and Y are points on AC such that $AX : XC = 1 : 2$ and $4AY = AC$. Give the following vectors in terms of ***a*** and ***c***.
- (b) Show that O, Y and B are collinear.

24. The figure below shows the net which can be used to make a cube.



The net is folded such that P and T meet at F. Q, R and V meet at E. X, S and W meet at H. U and Y meet at G.

- (a) Draw the cube formed (ABCDEFGH).
 - (b) If $VT = TA = AR = BR$ and length $VR = 20\text{cm}$, calculate;
 - (i) length DE
 - (ii) angle between the line DE and plane ABCD.
 - (iii) angle between ADHE and ABCD.
 - (iv) surface area of the cube.
 - (v) Volume of the cube.
25. A cyclist P leaves town B at 1:06pm for village A riding nonstop at a steady speed of 15kmh^{-1} and arrives in village A at 3:06pm. Another cyclist Q left village A at noon for town B. From A cyclist Q rode at a steady speed of 20km for 45 minutes. It then rested for 30 minutes and then continued with a steady speed of 15km/h and reached town B at 2:15pm.
- (a) Represent the motion of cyclists P and Q on a distance-time graph. (Use a scale of $1\text{cm} : 15\text{ minutes}$ on the x-axis, $2\text{cm} : 5\text{km}$ on the y-axis).
 - (b) Use your graph to find;
 - (i) when did the two cyclists pass each other and how far from B were they at this time.
 - (ii) How far apart were the two cyclists at 2:00pm.
26. (a) The distance in metres of an object varies partly with time t seconds and partly with the square root of time. Given that the distance $S = 14$ when $t = 4$ and $S = 27$ when $t = 9$, write equation connecting S and t .
- (b) Find the value of S when $t = 64$ using the equation above.
27. A certain employee earns a gross monthly income of Shs.910, 000. The allowance accruing to him includes:
- Housing Shs. 240,000 per year
 - Head of department Shs.300,000 per annum
 - Class-teacher Shs.10,000 per month
 - Water and electricity Shs.180,000 per year
 - House-master Shs.5,000 per week

He has also three children aged 8 years, 15 years and 18 years and the company gives child allowance for only two according to the age brackets below:

Taxable income (Shs)	Tax rate (Shs)
180,001 – 280,000	10
280,001 – 380,000	15
380,001 – 430,000	25
430,001 – 480,000	30
480,001 and above	45

- (a) Help the employee to calculate his;
 - (i) monthly allowances
 - (ii) taxable income
 - (iii) monthly income tax
- (b) What percentage of his income goes to tax?

MORE TOPICAL REVISION QUESTIONS

Question 1 | Business Mathematics

Three business partners Maseruka, Oguti and Natulinda contributed 600,000, 1,000,000 and 650,000 shillings respectively while starting their business.

- a) Find the ratio of their contributions in its simplest form.
- b) If the business made a profit of Shs. 1,350,000; Find how much Oguti got if the profit was shared in the same ratio as their contributions.

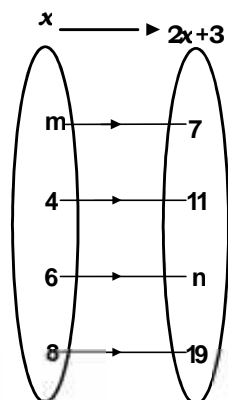
Question 2 | Numerical Concepts

The value V of a diamond is proportional to the square of its weight, W . It is known that a diamond weighing 5 grams is worth sh. 250,000.

- a) write down an expression which relates V and W .
- b) find the value of a diamond weighing 40 grams.
- c) find the weight of a diamond worth 6,400,000.

Question 3 | Functions

- a) Draw a papygram for the relation "is less than" of the set $T = \{-2, 0, 1, 3\}$
- b) Given that the mapping $x \longrightarrow 2x+3$. Find the unknown values in the domain and range below;



c) Given that $f(x) = 2\sqrt{x} + 1$ and $g(x) = x^2 - 4$

(i) $fg(x)$ when $x = -2$

(ii) $(gf)^{-1}$

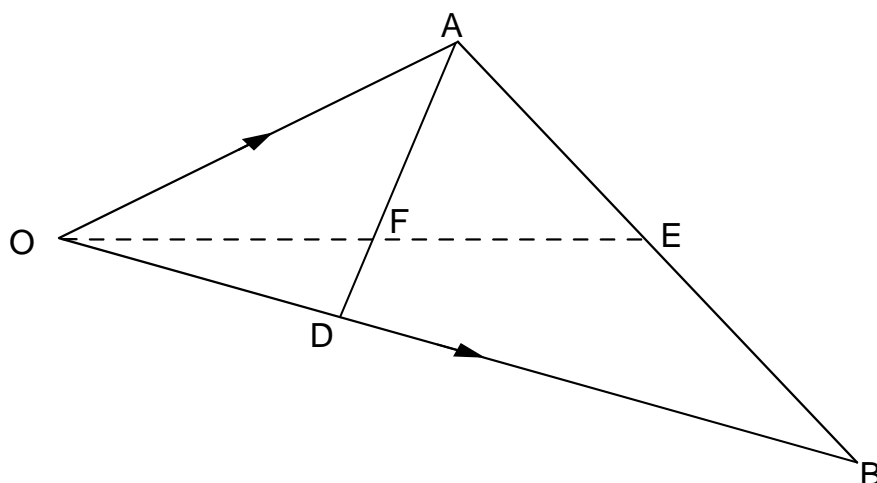
Question 4 | Sets and Logic

In a job interview of 100 applicants, 40 passed the interview. The remainder failed due to lack of at least one of the following three attributes; communication skills (C), presentation skills (P), and experience (E). 15 applicants had only one problem of lack of communication skills, 4 applicants lacked both C and E only. 5 lacked both P and C only. 3 lacked all the 3 attributes. The number of those who lacked only presentation skills were equal to those who lacked experience only.

- Represent the above information on a venn-diagram?
- How many applicants lacked experience only?
- If an applicant was selected at random among those who failed the interview, find the probability that he or she lacked only one attribute.

Question 5 | Vectors

In the figure below, E is the mid-point of AB, OD: DB = 2:3 and F is the point of intersection of OE and AD.



- a) Given that $\vec{OA} = \vec{a}$ and $\vec{OB} = \vec{b}$.
- b) Express in terms of \vec{a} and \vec{b}
 - (i) \vec{AD}
 - (ii) \vec{OE}
- c) Given further that $\vec{AF} = s\vec{AD}$ and $\vec{OF} = t\vec{OE}$. Find the values of s and t .
- d) Show that points E, F and O are collinear.

Question 6 | Kinematics

Town A and B are 80km apart. A bicycle rider leaves town A at 6:00am for town B at a steady speed of 10kmh^{-1} . Two hours later, a loaded Tukutuku leaves the same town B at a steady speed of 20kmh^{-1} , but just after an hour of its journey, the Tukutuku gets a mechanical breakdown, then repaired for 1 hour and thereafter resumes its journey with a new speed of 40kmh^{-1} . After reaching town B, the Tukutuku offloads for 30 minutes before returning to town A by the same road and arrives at town A at 2:30pm.

- a) Using scales of 2cm: 1 hour and 2cm: 10km, draw on the same axes the distance – time graphs.
- b) Use your graph to determine;
- c) The time and distance from A Tukutuku overtakes the bicycle rider on its way to town B.
 - (i) The time the Tukutuku meets the bicycle rider on its way back.
 - (ii) Find the average speed of the Tukutuku on its way back to town A.

Question 7 | Taxation

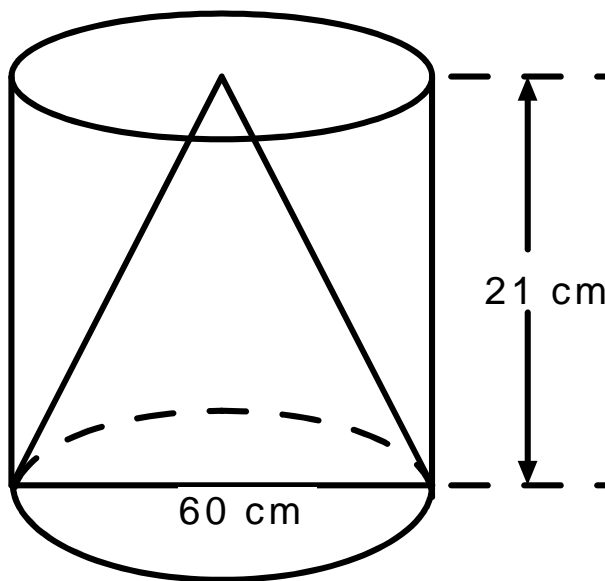
- a) The cash price of a solar panel is shs. 200,000. A customer opts to buy the solar panel of Hire purchase terms by paying a deposit of sh. 50,000. Simple interest of 10% p.a is charged on the balance and the customer is required to repay by 24 equal monthly instalments, calculate the amount of each instalments.
- b) The table below is part of the tax table structure for monthly income of employees for the year 2018.

Taxable income (shs)	Tax rate (%)
01 - 90,000	10
90001 – 200,000	15
200,001 and above	20

Given that in the year 2018, the tax on Mr. Magambo's income was shs. 29,500. Calculate his monthly income.

Question 8 | Mensuration

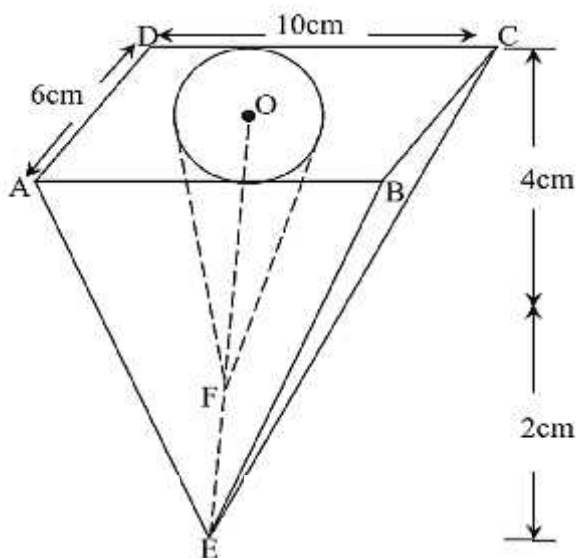
The figure below shows poultry water trough. It consists of a solid cone of height 21cm, welded into the base of a right circular cylinder of the same height. Given the diameter at the base is 60cm.



- Find the;
 - Volume of the cylinder
 - The capacity of the trough in litres
- Determine the angle which the slanting edges of the cone make with inner walls of the cylinder.
- Find the outer reflex angle at the apex of the conical solid.

Question 9 | Mensuration

A conical hole is drilled in a solid wooden pyramid as shown in the figure below.



Given that $\overline{AD} = 6\text{cm}$, $\overline{AB} = 10\text{cm}$, depth of the cone $\overline{OF} = 4\text{cm}$ and $\overline{FE} = 2\text{cm}$.

Find:

- a) the maximum volume of water in the cone contain.
- b) volume of the remaining solid wood.
- c) Surface area of the remaining solid wood.

Question 10 | Kinematics

Two cyclist A and B moved off from rest in the same direction. The speed of car A increases at a uniform rate of 20km^{-1} while the speed of B is a given in the table below:

Time (hr)	0	1	2	3	4	5	6	7	8
Speed (kmh^{-1})	0	5	15	40	100	150	180	195	200

- a) Using a suitable scale, draw on the same axes the velocity-time graph of cars A and B.
- b) From your graph find the;
 - (i) Time when the cars have equal speeds and the magnitude of the speed.
 - (ii) Difference in speeds after 5 hours.
 - (iii) Distance covered by car A in the 8 hours.

Good Luck

'O' Level Mathematics Seminar Guide

Date: Saturday 8th July, 2023

SECTION A

1. $a * b = 2a^2 - b^2$

$(5 * -2) * 4$

Using BODMAS

$$\begin{aligned}(5 * -2) &= 2(5)^2 - (-2)^2 \\ &= 46\end{aligned}$$

Then

$$\begin{aligned}46 * 4 &= 2(46)^2 - (4)^2 \\ &= 4216\end{aligned}$$

2. $(2b^2 - 5a^2 + 9ab) \div (2b - a)$

$$\frac{2b^2 - ab + 10ab - 5a^2}{2b - a}$$

$$\frac{b(2b - a) + 5a(2b - a)}{2b - a}$$

$$\frac{(2b - a)(b + 5a)}{2b - a}$$

$$= b + 5a$$

3. $\frac{y-2}{3} - \frac{y+3}{2} = \frac{y+1}{4}$

$$12 \frac{(y-2)}{3} - 12 \frac{(y+3)}{2} = \frac{y+1}{4}$$

$$4(y-2) - 6(y+3) = 3(y+1)$$

$$4y - 8 - 6y - 18 = 3y + 3$$

$$4y - 6y - 3y = 3 + 18 + 8$$

$$-5y = 19$$

$$y = \frac{-19}{5}$$

$$y = -5\frac{4}{5}$$

4. $P = \begin{pmatrix} 5 & 1 \\ 4 & 2 \end{pmatrix}$ and $R = \begin{pmatrix} 7 & -3 \\ 2 & 0 \end{pmatrix}$

$$PQ = R$$

Using $Q = P^{-1}(R)$

$$P^{-1} = \frac{1}{\det(P)} \times \text{Adj}(P)$$

$$Q^{ad} = \frac{1}{6} \begin{pmatrix} 2 & -1 \\ -4 & 5 \end{pmatrix} \times \begin{pmatrix} 7 & -3 \\ 2 & 0 \end{pmatrix}$$

$$= \frac{1}{6} \begin{pmatrix} 12 & -6 \\ -18 & 12 \end{pmatrix}$$

$$Q = \begin{pmatrix} 2 & -1 \\ -3 & 2 \end{pmatrix}$$

5. $P = \sqrt{Q + \frac{T^3}{R}} \quad (T) = ?$

$$P^2 = Q + \frac{T^3}{R}$$

$$P^2 R = QR + T^3$$

$$T^3 = P^2 R - QR$$

$$T = \sqrt[3]{P^2 R - QR}$$

6. $A = \frac{1}{2} \times 5.2 \times 6.6 \sin 30$
 $= 8.58 \text{ cm}^2$

7. $n + 118 = 180$

$$n = 62^\circ$$

$$x = 2 \times 62$$

$$x = 124$$

$$2y + 124 = 180$$

$$y = 28^\circ$$

8. Let $x \rightarrow \text{cost of a book}$
 $y \rightarrow \text{cost of a graph book}$
 $4x + 3y = 250 \dots\dots\dots (1)$
 $x + 2y = 100 \dots\dots\dots (2)$
 From eqn (2)
 $x = 100 - 2y \dots\dots\dots (3)$
 $4(100 - 2y) + 3y = 250$
 $y = 30$
 Putting in eqn(3)
 $x = 100 - 2(30)$
 $x = 40$
 Cost of 3 exercise books $= 40 \times 3$
 $= \text{shs. } 120$
 Cost of 2 graph books $= 40 \times 3$
 $= \text{shs. } 60$

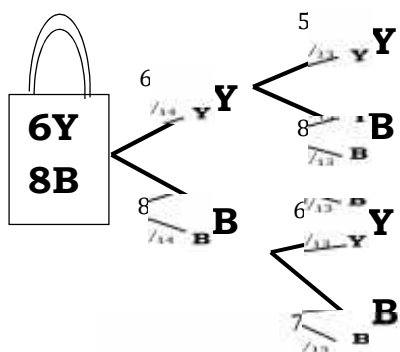
9. Reflection through $x + y = 0$

$$\begin{pmatrix} 0 & -1 \\ -1 & 0 \end{pmatrix} \begin{pmatrix} -2 \\ 3 \end{pmatrix} = \begin{pmatrix} 0 + -3 \\ 2 + 0 \end{pmatrix}$$

$$= \begin{pmatrix} -3 \\ 2 \end{pmatrix}$$

Therefore image $P^{-1}(-3, 2)$

10.



$$P(B2) = P(Y \cap B) \text{ or } P(B \cap B)$$

$$= \left(\frac{6}{14} \times \frac{8}{13} \right) + \left(\frac{8}{14} \times \frac{7}{13} \right)$$

$$= \frac{48}{182} + \frac{56}{182}$$

$$= \frac{104}{182}$$

$$= \frac{52}{91}$$

$$11. 3x^2 - 7x + 4 = 0$$

Using factorisation method

$$3x^2 - 3x - 4x + 4 = 0$$

$$3x(x - 3) - 4(x - 3) = 0$$

$$(3x - 4)(x - 3) = 0$$

$$3x - 4 = 0 \text{ or } x - 3 = 0$$

$$x = \frac{4}{3} \text{ or } x = 3$$

$$12. \text{Det } A = (3 \times 5) - (-1 \times 7)$$

$$= 15 + 7$$

$$= 22$$

$$A^{-1} = \frac{1}{22} \begin{pmatrix} 5 & -7 \\ 1 & 3 \end{pmatrix}$$

$$= \begin{pmatrix} \frac{5}{22} & \frac{-7}{22} \\ \frac{1}{22} & \frac{3}{22} \end{pmatrix}$$

$$13. (12)^2 + (5)^2 = r^2$$

$$r^2 = 169$$

$$r = 13$$

$$\sin \theta = \frac{-5}{13}$$

$$\cos \theta = \frac{-12}{13}$$

14. Rearranging the equation gives

$$5x - 4y = 17 \dots\dots\dots (i)$$

$$3x + 4y = 23 \dots\dots\dots (ii)$$

Using elimination method

Equation (i) + (ii)

$$\frac{8x}{8} = \frac{40}{8}$$

$$x = 5$$

Substituting $x = 5$ in equation (i) gives

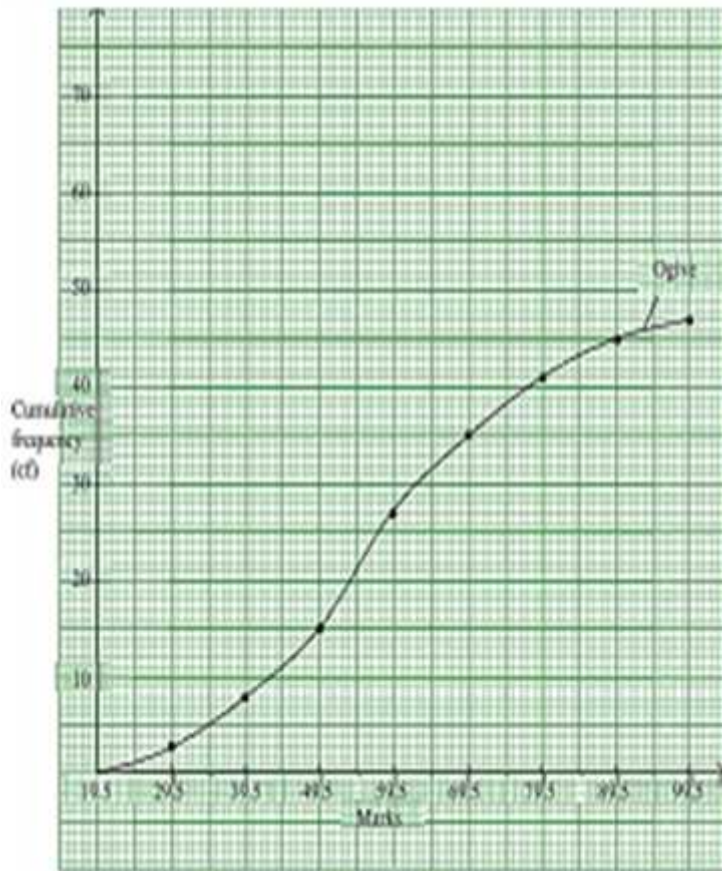
$$(5 \times 5) - 4y = 17$$

$$4y = 8$$

$$y = 2$$

15.

Cumulative frequency	Class boundaries
3	19.5 – 29.5
8	29.5 – 39.5
15	39.5 – 49.5
27	49.5 – 59.5
35	59.5 – 69.5
41	69.5 – 79.5
45	79.5 – 89.5
47	89.5 – 99.5



16. $z = (35 \times 2)$ (Angles subtended at the centre of the circle is the angle at the circumference)

$$z = 70$$

$$y = x$$

$$x + y + z$$

$$x + x + 70 = 180$$

$$2x = 110$$

$$x = 55 \text{ and } y = 55$$

17.a) $\sqrt{3x^3} - (2)^2 =$ (a difference of two squares)

$$= (\sqrt{3x} + 2)(\sqrt{3x} - 2)$$

b) $5h^2 + 5h + 8h - 8$

$$= 5h(h + 1) - 8(h + 1)$$

$$= (5h - 8)(h + 1)$$

18. Multiplying by $2a$ both sides.

$$2ax - b \pm \sqrt{b^2 - 4ac}$$

$$\pm \sqrt{b^2 - 4ac} = 2ax + b$$

Squaring both sides gives

$$b^2 - 4ac = (2ax - b)^2$$

$$4ac = b^2 - (2ax - b)^2$$

Dividing by $4a$ gives

$$c = \frac{b^2 - (2ax - b)^2}{4a}$$

19. a) $2 \times 2 = 2 - (2^2 \times 2) + 2 \times 2$

$$= 2 - 8 + 4$$

$$= 2$$

b) $3 \times m = 3 - 3m^2 + 3m$

$$3 = 3 - 3m^2 + 3m$$

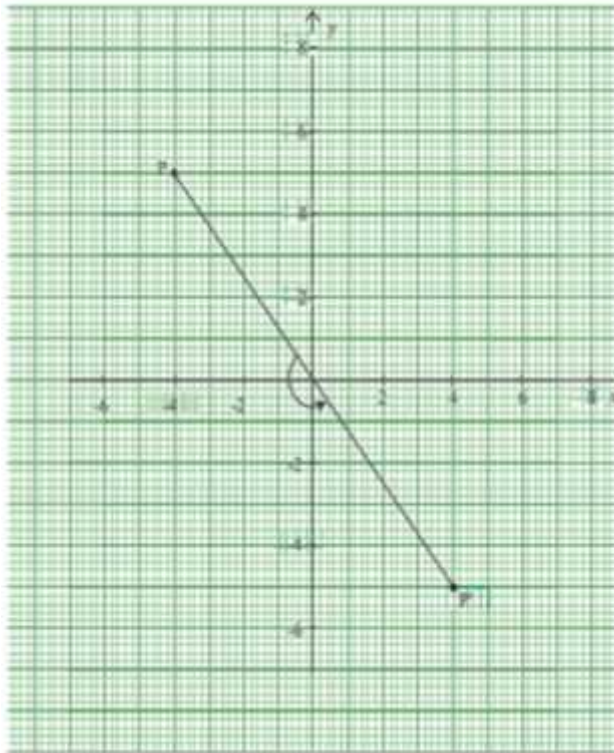
$$3m^2 - 3m = 3 - 3$$

$$3m(m - 1) = 0$$

$$3m = 0 \text{ or } m - 1 = 0$$

$$m = 0 \text{ or } m = 1$$

20.



New position of P is $P'(4, -5)$

SECTION B

Question 1.

Frequency distribution table

Class interval	Frequency (f)	x	$(x - A) = d$	fd	$c.f$	C/B
5 – 9	2	7	-15	-30	2	4.5 – 9.5
10 – 14	2	12	-10	-20	4	9.5 – 14.5
15 – 19	10	17	-5	-50	14	14.5 – 19.5
20 – 24	8	22	0	0	22	19.5 – 24.5
25 – 29	2	27	5	10	24	24.5 – 29.5
30 – 34	5	32	10	50	29	29.5 – 34.5
35 – 39	1	37	15	15	30	34.5 – 39.5
	30			$\Sigma fd = -25$		

- (a) (i) Class interval = 5kg
(ii) modal class = (15 – 19)

(b) mean mass = $A + \frac{\Sigma fd}{\Sigma f}$
= $22 + \frac{-25}{30}$

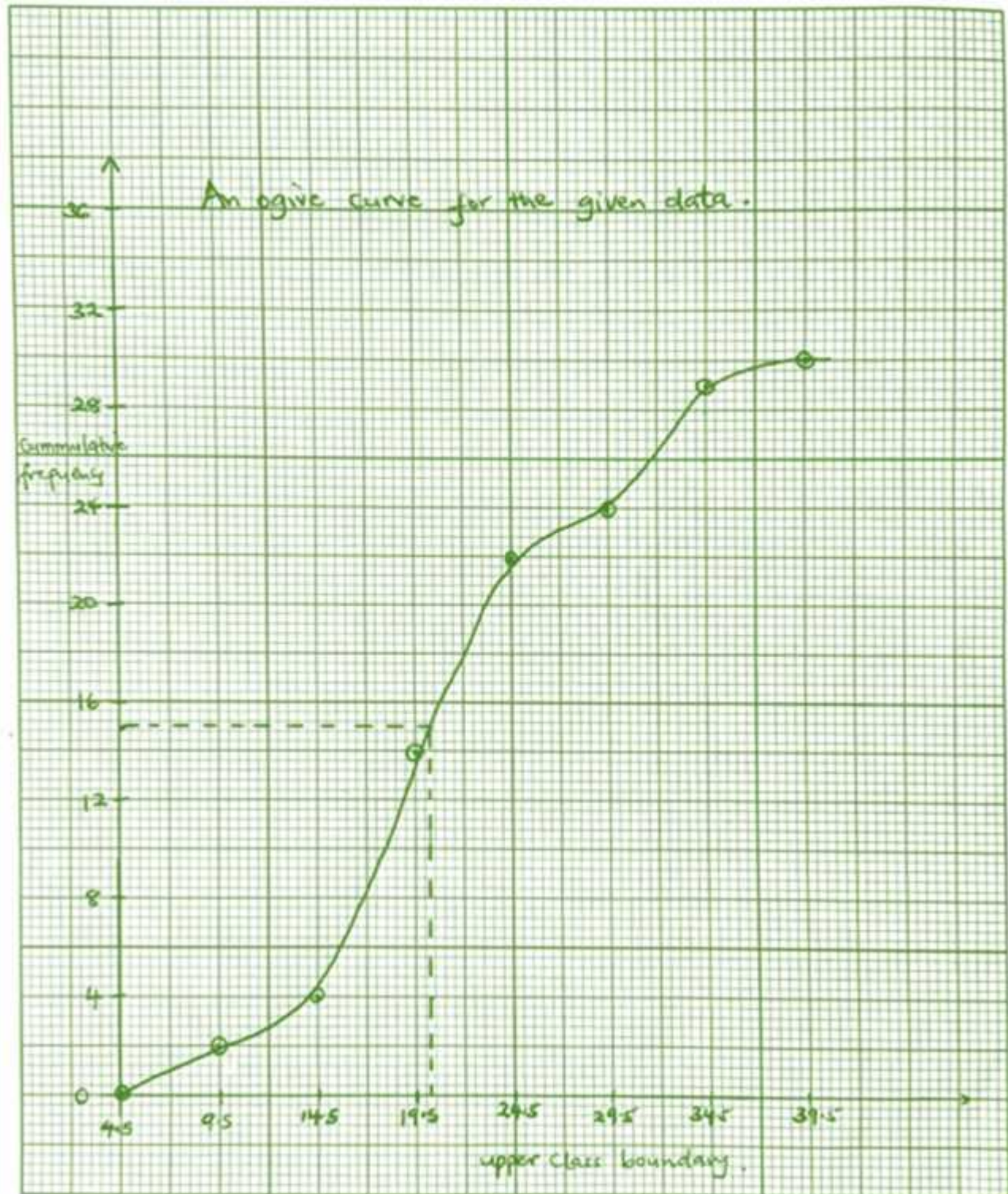
(c) Ogive – See Graph .

$$= 21.1666667 \text{ kg}$$

Hence median mass

$$= 19.5 + (1 \times 0.5)$$

$$= 20.0 \text{ kg}$$



Question 2.

12. $y = 1 + x - 2x^2$

(a)

x	-3	-2	-1	0	1	2	3
1	1	1	1	1	1	1	1
x	-3	-2	-1	0	1	2	3
$-2x^2$	-18	-8	-2	0	-2	-8	-18
y	-20	-9	-2	1	0	-5	-14
			$y = 3x - 3$				
$3x$	-9	-6	-3	0	3	6	9
-3	-3	-3	-3	-3	-3	-3	-3
y	-12	-9	-6	-3	0	3	6

(See graph)

(b) $y = 1 + x - 2x^2$

$0 = 2 - x - x^2$

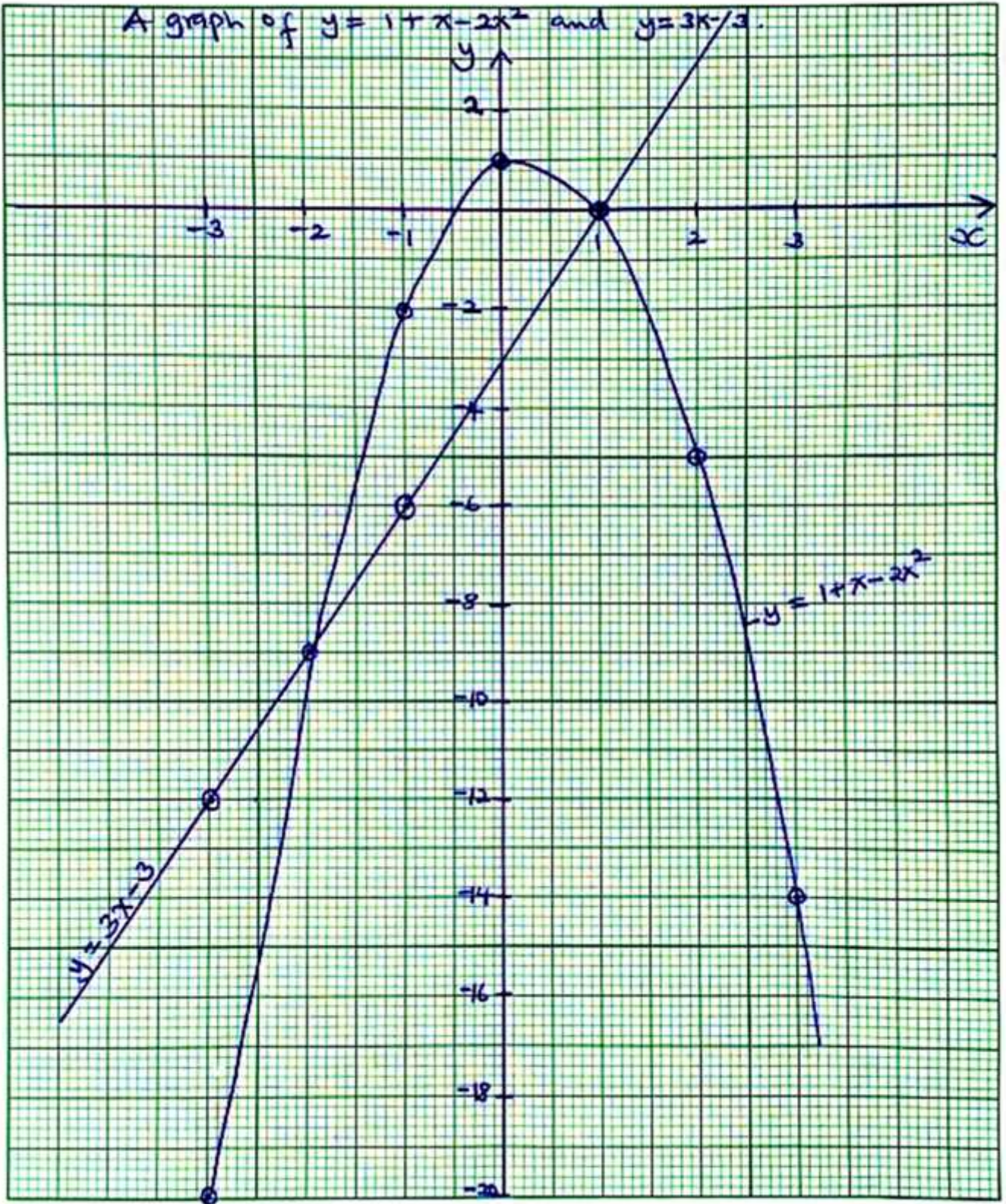
$y = 1 + x - 2x^2$

$0 = 4 - 2x - 2x^2$

$y = -3 + 3x$

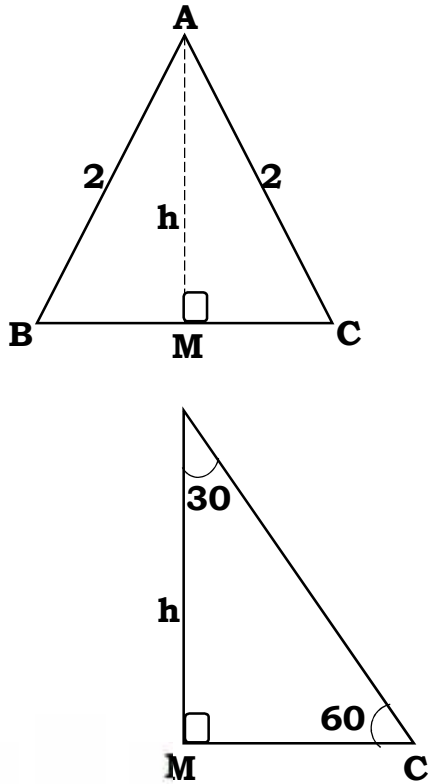
$y = 3x - 3$

Therefore from the graph the roots of $2 - x - x^2$ are $x = -2$ or 1



Question 3.

(a)



$$h^2 + 1^2 = 2^2$$

$$h^2 = 4 - 1$$

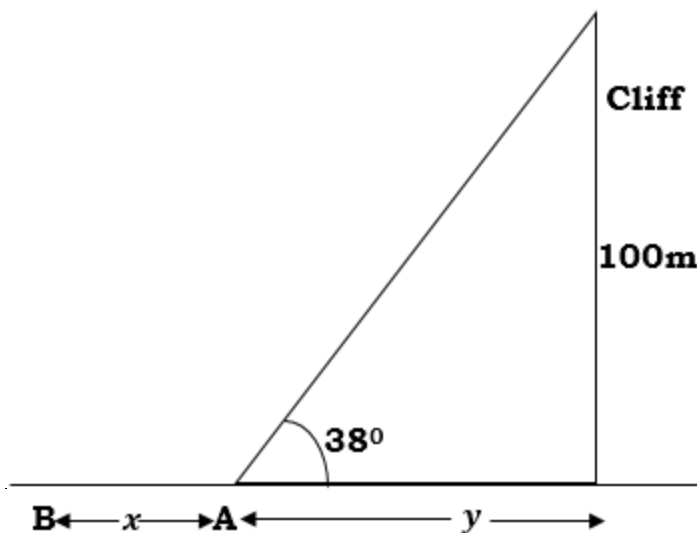
$$h^2 = 3$$

$$h = \sqrt{3}$$

$$\sin 60^\circ = \frac{h}{2}$$

$$\sin 60^\circ = \frac{\sqrt{3}}{2} \text{ as required.}$$

(b)



$$\tan 38^\circ = \frac{100}{y}$$

$$y = \frac{100}{\tan 38^\circ}$$

$$y = 127.994$$

$$y = 128$$

Distance between A and B

$$= 250 - 128$$

$$= 122\text{m}$$

Question 4

(a) $A = \begin{pmatrix} 2 & 4 \\ 1 & 3 \end{pmatrix}$ and $B = \begin{pmatrix} -1 & 1 \\ 2 & 3 \end{pmatrix}$

$$A^2 + 2B + I$$

$$\begin{pmatrix} 2 & 4 \\ 1 & 3 \end{pmatrix} \times \begin{pmatrix} 2 & 4 \\ 1 & 3 \end{pmatrix} + 2 \begin{pmatrix} -1 & 1 \\ 2 & 3 \end{pmatrix} + \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$$

$$\begin{pmatrix} 8 & 20 \\ 5 & 13 \end{pmatrix} + \begin{pmatrix} -2 & 2 \\ 4 & 6 \end{pmatrix} + \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$$

$$\begin{pmatrix} 8+2+1 & 20+2+0 \\ 5+4+0 & 13+6+1 \end{pmatrix}$$

$$A^2 + 2B + I = \begin{pmatrix} 11 & 22 \\ 9 & 20 \end{pmatrix}$$

(b) $5x + 3y = 7$
 $4y = 2x - 2$
 $5x + 3y = 7$
 $-2x + 4y = -2$
 $\begin{pmatrix} 5 & 3 \\ -2 & 4 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 7 \\ -2 \end{pmatrix}$

Inverse $= \frac{1}{26} \begin{pmatrix} 4 & -3 \\ 2 & 5 \end{pmatrix}$

$$\frac{1}{26} \begin{pmatrix} 4 & -3 \\ 2 & 5 \end{pmatrix} \times \begin{pmatrix} 5 & 3 \\ -2 & 4 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} = \frac{1}{26} \begin{pmatrix} 4 & -3 \\ 2 & 5 \end{pmatrix} \begin{pmatrix} 7 \\ -2 \end{pmatrix}$$

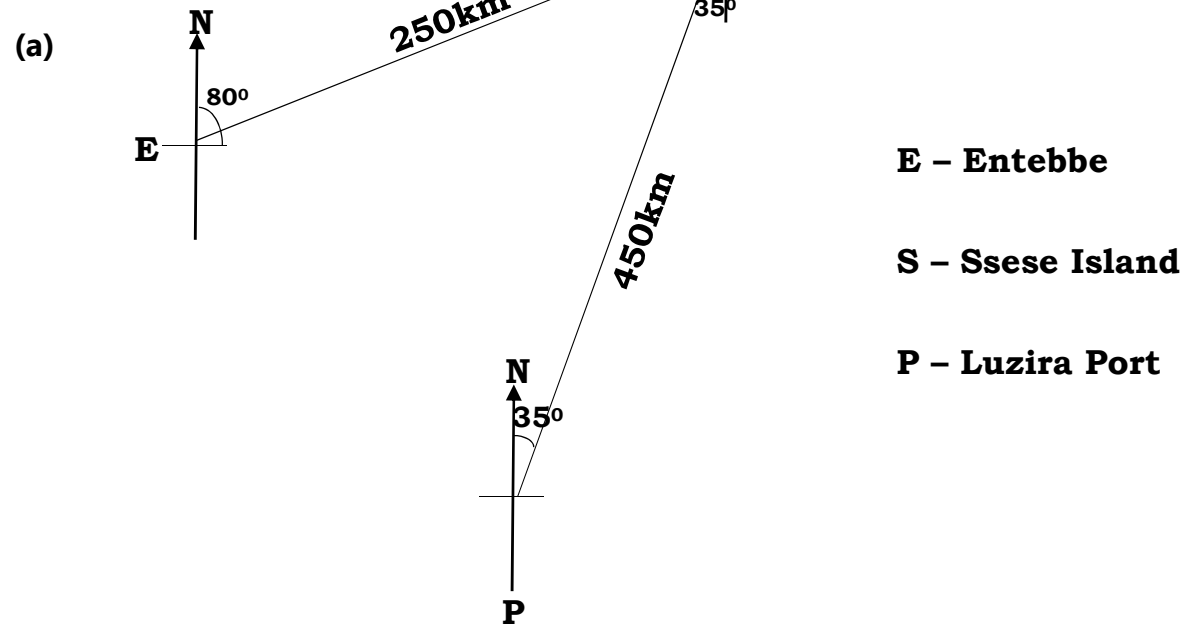
$$\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} = \frac{1}{26} \begin{pmatrix} 34 \\ 4 \end{pmatrix}$$

$$\begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} \frac{17}{13} \\ \frac{2}{13} \end{pmatrix}$$

$$x = \frac{17}{13} \text{ or } \frac{4}{13}, \quad y = \frac{2}{13}$$

Question 5.

Sketch

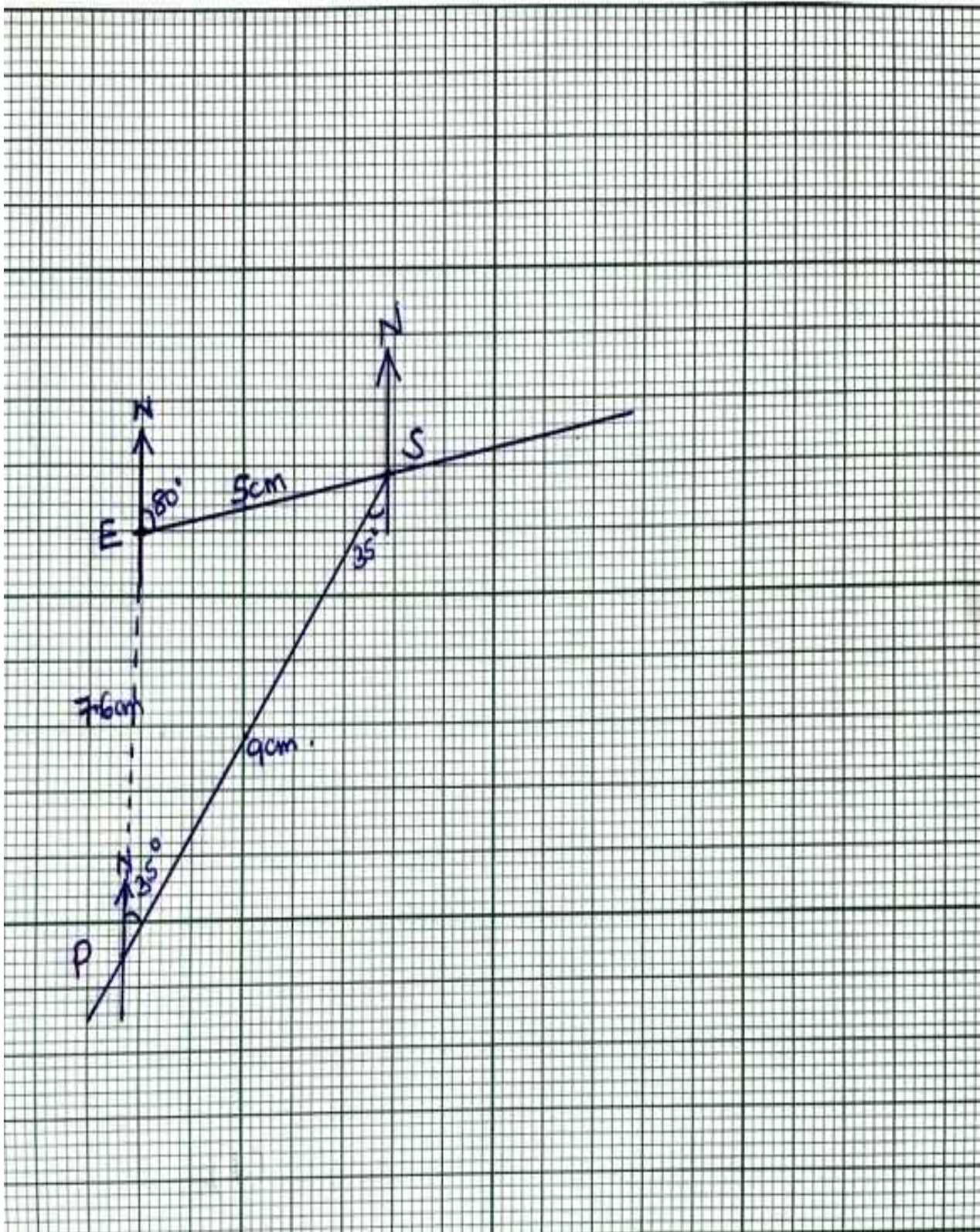


- (b) Distance of Entebbe from Luzira Port
= 7.6×50
= 380km

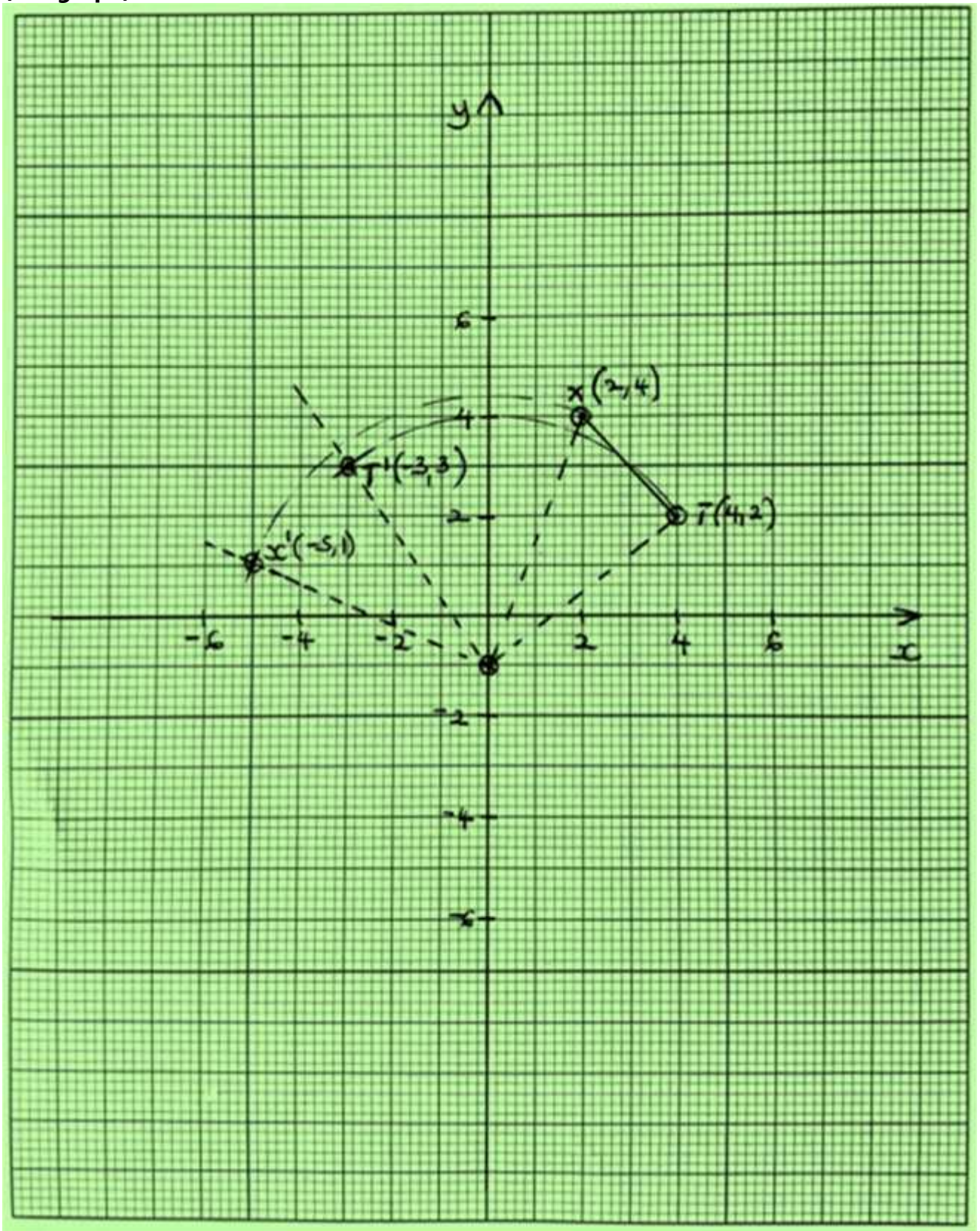
Bearing of Entebbe from Luzira Port = 003°

(c) time = $\frac{\text{distance}}{\text{speed}}$

$$= \frac{380}{250}$$
$$= 1.52 \text{ hours}$$
$$= 1 \text{ hour } 31 \text{ minutes.}$$



Question 6
(See graph)



- (a) $T^1(-3, 3)$ and $X^1(-5, 1)$
- (b) Matrix is a matrix of reflection through the mirror $y + x = 0$
 $PQR \approx m^{-1}(P^1 Q^1 R^1)$
 $m^{-1} = \begin{pmatrix} 0 & -1 \\ -1 & 0 \end{pmatrix}$
 $PQR = \begin{pmatrix} 0 & -1 \\ -1 & 0 \end{pmatrix} \times \begin{pmatrix} P^1 & Q^1 & R^1 \\ 1 & 1 & 3 \\ 2 & 3 & 5 \end{pmatrix}$
 $P^1(-2, -1)$ $Q^1(-3, -1)$ and $R(-5, -3)$

Question 7

(a)

Type of vehicle	Tipper	Truck	Total
No of vehicles	$\frac{\text{tipper}}{x}$	$\frac{\text{truck}}{y}$	(maximum) 10
No of trips	5	2	
Tanage	1	5	
Cost	40,000	100,000	

non-negative inequalities

$$x \geq 0 \dots \dots \dots (1)$$

$$y \geq 0 \dots \dots \dots (2)$$

$$x + y \leq 10 \dots \dots \dots (3)$$

$$(5 \times 1)x + (2 \times 5)y \geq 60$$

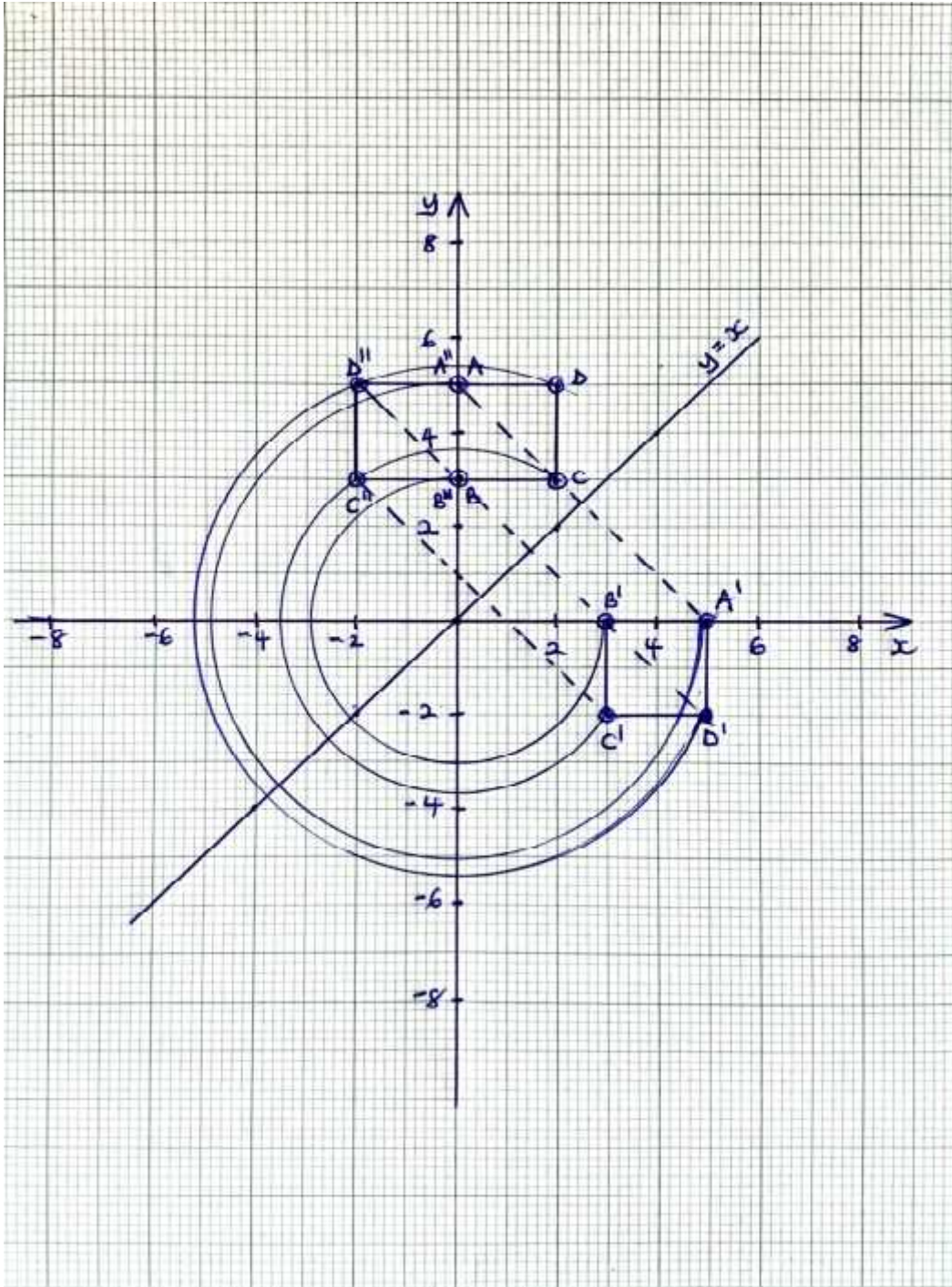
$$5x + 10y \geq 60 \dots \dots \dots (4)$$

$$x + 2y \geq 12 \dots \dots \dots (4)$$

$$x \leq 8 \dots \dots \dots (5)$$

$$y \leq 5 \dots \dots \dots (6)$$

Question 8



(i) $A^1 (5,0) B^1 (3,0) C^1 (3,-2) D^1 (5,-2)$

(ii) $A^{11}(0,5) B^{11}(0,3) C^{11}(-2,3) D^{11}(-2,5)$

(iii) $A^{11}(0,5) B^{11}(0,3) C^{11}(-2,3) D^{11}(-2,5)$

Question 9

In equalities are:

$$x \geq 20$$

$$y \geq 20$$

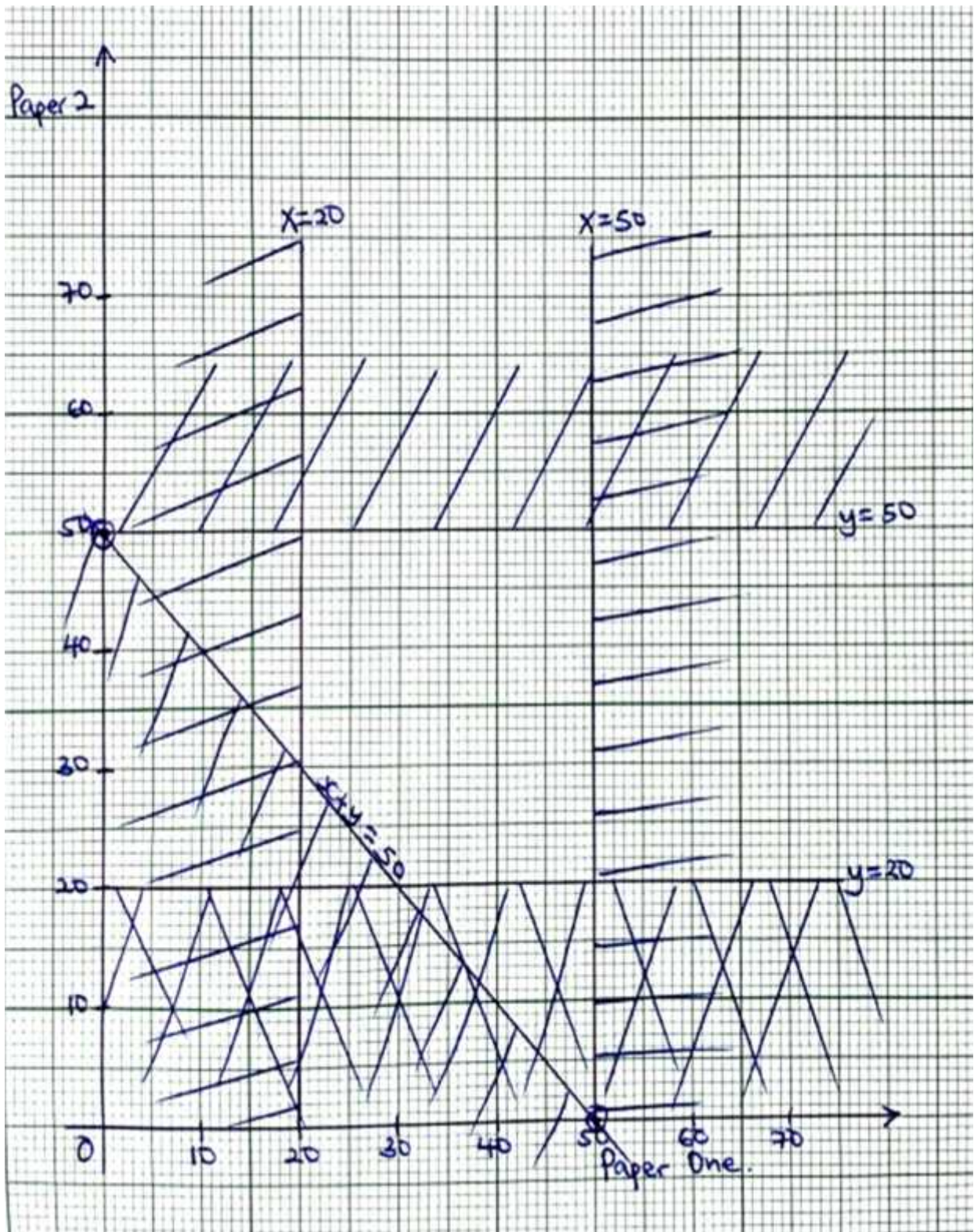
$$x + y \geq 50$$

(a) $y \geq 30$

(b)

	20	21	22	23	24	25	26	27	28	29
20	40	41	42	43	44	45	46	47	48	49
21	41	42	43	44	45	46	47	48	49	
22	42	43	44	45	46	47	48	49		
23	43	44	45	46	47	48	49			
24	44	45	46	47	48	49				
25	45	46	47	48	49					
26	46	47	48	49						
27	47	48	49							
28	48	49								
29	49									

Number of ways = 55



Question 10

(a) Rearranging the equations

$$3y = 5x - 10$$

$$4 - y - 2x = 0$$

$$\begin{pmatrix} 5 & -3 \\ 2 & 1 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 10 \\ 4 \end{pmatrix}$$

$$\frac{1}{11} \begin{pmatrix} 1 & 3 \\ -2 & 5 \end{pmatrix} \begin{pmatrix} 5 & -3 \\ 2 & 1 \end{pmatrix} = \frac{1}{11} \begin{pmatrix} 1 & 3 \\ -2 & 5 \end{pmatrix} \begin{pmatrix} 10 \\ 4 \end{pmatrix}$$

$$\frac{1}{11} \begin{pmatrix} 11 & 0 \\ 0 & 11 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} = \frac{1}{11} \begin{pmatrix} 22 \\ 0 \end{pmatrix}$$

$$\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 2 \\ 0 \end{pmatrix}$$

$$x = 2 \text{ and } y = 0$$

(b) (i) $\begin{pmatrix} 5 & 3 & 8 & 2 \\ 2 & 0 & 3 & 1 \\ 4 & 0 & 5 & 2 \\ 5 & 3 & 3 & 3 \end{pmatrix}$ is a 4×4 matrix.

(ii) Cost matrix $\begin{pmatrix} 300,000 \\ 150,000 \\ 100,000 \\ 185,000 \end{pmatrix}$

$$(iii) \begin{pmatrix} 5 & 3 & 8 & 2 \\ 2 & 0 & 3 & 1 \\ 4 & 0 & 5 & 2 \\ 5 & 3 & 3 & 3 \end{pmatrix} \begin{pmatrix} 300,000 \\ 150,000 \\ 100,000 \\ 185,000 \end{pmatrix} = \begin{pmatrix} 3,120,000 \\ 1,085,000 \\ 2,070,000 \\ 2,805,000 \end{pmatrix}$$

For market A she spent sh3,120,000

For market B she spent sh1,085,000

For market C she spent sh2,070,000

For market D she spent sh2,805,000

$$\begin{aligned}\text{Cost price for all the produce} &= (3,120,000 + 1,085,000 + 2,070,000 + 2,805,000) \\ &= \text{sh}9,080,000\end{aligned}$$

$$(iv) \begin{pmatrix} 5 & 3 & 8 & 2 \\ 2 & 0 & 3 & 1 \\ 4 & 0 & 5 & 2 \\ 5 & 3 & 3 & 3 \end{pmatrix} \begin{pmatrix} 300,000 \\ 150,000 \\ 100,000 \\ 185,000 \end{pmatrix} = \begin{pmatrix} 3,850,000 \\ 1,850,000 \\ 2,525,000 \\ 3,325,000 \end{pmatrix}$$

$$\begin{aligned}&= (3,850,000 + 1,535,000 + 2,525,000 + 3,325,000) \\ &= \text{sh}11,235,000\end{aligned}$$

$$\begin{aligned}\text{Profit selling} &= \text{selling price} - \text{cost price} \\ &= 11,235,000 - 9,080,000 \\ &= \text{Sh } 2,155,000\end{aligned}$$

Mathematics Paper 2

SEMINAR GUIDE 2023

Question 1

$$\text{Let } y = 3.15 \dots\dots\dots(1)$$

$$100y = 315.15 \dots\dots\dots(3)$$

$$\begin{aligned} (2) - (1) \\ \frac{99}{99}y &= \frac{312}{99} \\ y &= 3\frac{15}{99} \\ y &= 3\frac{5}{33} \end{aligned}$$

Question 2

$$g(x) \longrightarrow 5x - 1$$

$$5x - 1 = 9$$

$$5x = 10$$

$$x = 3$$

Domain is $\{2, 3\}$

Question 3

$$M = \left(\frac{2+4}{2}, \frac{-7+15}{2} \right)$$

$$M = (3, 4)$$

$$\overline{OM} = \sqrt{3^2 + 4^2}$$

$$= \sqrt{25}$$

$$= 5 \text{ units}$$

Question 4

$$5^3 = 64$$

$$5 = \sqrt[3]{64}$$

$$= 4$$

$$\text{Area} = 6 \times (4^2)$$

$$= 96\text{cm}^3$$

Question 5

$$\begin{aligned} A &= P(1+r)^n \\ &= 200,000 \left(1 + \frac{18\frac{1}{4}}{100} \right)^2 \end{aligned}$$

$$= 200,000 (1.1825)^2$$

$$= 279,661.25/=$$

Question 6

LCM of 6 and 8

2	6	8
2	3	4
2	3	2
3	3	1
	1	1

$$\text{LCM} = 2 \times 2 \times 2 \times 3$$

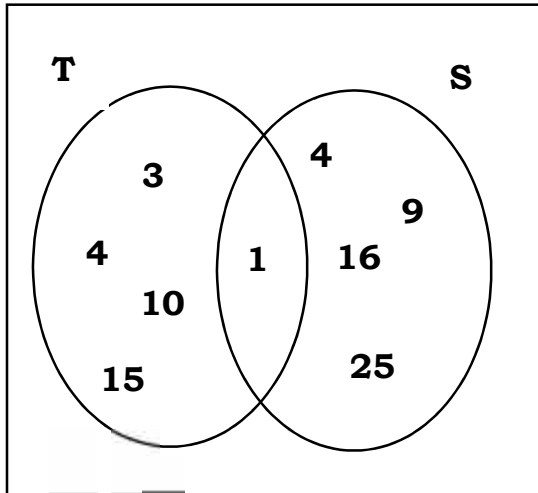
$$= 24$$

$$\text{The number is } 24 + 2 = 26$$

Question 7

$$T = \{1, 3, 6, 10, 15\}$$

$$S = \{1, 4, 9, 16, 25\}$$



$$(T \cap S)^1 = 8$$

Question 8

$$\text{Grad}_{OA} = \frac{-20 - 0}{5 - 0}$$

$$= -4$$

$$\frac{y - 0}{x - 0} = -4$$

$$y = -4x$$

Question 9

$$\text{a) } \overrightarrow{NT} = \overrightarrow{NM} + \overrightarrow{MD} + \overrightarrow{DT}$$

$$= \begin{pmatrix} 7 \\ -2 \end{pmatrix} + \begin{pmatrix} -4 \\ 6 \end{pmatrix} + \begin{pmatrix} 5 \\ 11 \end{pmatrix}$$

$$= \begin{pmatrix} 8 \\ 15 \end{pmatrix}$$

$$\text{b) } |\overrightarrow{NT}| = \sqrt{8^2 + 15^2}$$

$$= \sqrt{289}$$

$$= 17 \text{ units}$$

Question 10

Volume of hemisphere

$$= \frac{2}{3} \pi^3$$

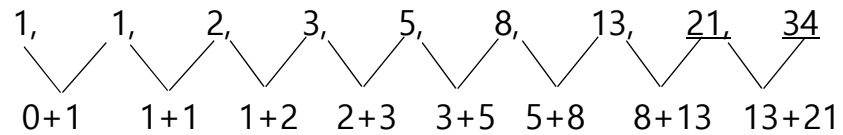
$$= \frac{2}{3} \cdot \frac{22}{7} \cdot \left(\frac{21}{2}\right)^3$$

$$= \frac{407484}{168}$$

$$= 2425.5 \text{ cm}^3$$

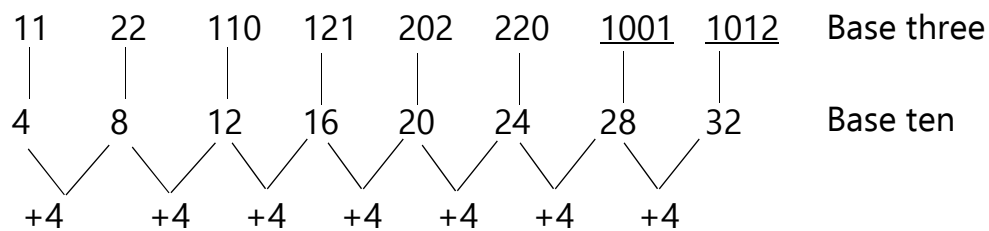
Question 11

a)



Add two consecutive values to get the succeeding value

b)



3	28	REMINDER
3	9	1
3	3	0
	1	0

$$28 = 1001_{\text{three}}$$

3	32	
3	10	2
3	3	1
3	1	0

$$32 = 1012_{\text{three}}$$

Question 12

$$y = kx^2$$

$$y = kx^2$$

$$x_1 = 6$$

$$y_1 = k \times 6^2 = 36k$$

$$x_2 = 10$$

$$y_2 = k + 10^2 = 100k$$

$$y_1 - y_2 = 36k - 100k = 16$$

$$-64k = 16$$

$$k = \frac{16}{-64} = -\frac{1}{4}$$

$$y = -\frac{1}{4}x^2$$

Question 13

$$\left(\frac{a+3}{2}, \frac{-1+b}{2}\right) = (5, 2)$$

$$\frac{a+3}{2} = 5, a = 7$$

$$\frac{-1+b}{2} = 2, b = 5$$

$$A(7, -1), B(3, 5)$$

$$\overrightarrow{AM} = \overrightarrow{OM} - \overrightarrow{OA} = \begin{pmatrix} 5 \\ 2 \end{pmatrix} - \begin{pmatrix} 7 \\ -1 \end{pmatrix} = \begin{pmatrix} -2 \\ 3 \end{pmatrix}$$

$$|\overrightarrow{AM}| = \sqrt{(-2)^2 + (3)^2} = \sqrt{13}$$

$$= 3.6056 \text{ units}$$

Question 14

Number (x)	Standard form	Log (x)
0.841	8.41×10^{-1}	$\bar{1}.9250$
32.7	3.27×10^1	+
		1.5145
32.7 x 0.841		1.4395
$\frac{32.7 \times}{\sqrt{32.7}} \times 0.841$		1.4395
		$\times \frac{1}{3}$
		= 0.4798
3.019	3.019×10^0	Anti-log 0.4798

$$\sqrt[3]{32.7 \times 0.841} = 3.02$$

Question 15

$$\frac{1}{\sqrt{5}} + \frac{\sqrt{5}+2}{\sqrt{5}-2}$$

$$= \frac{1}{\sqrt{5}} \times \frac{\sqrt{5}}{\sqrt{5}} + \frac{(\sqrt{5}+2)}{(\sqrt{5}-2)} \times \frac{(\sqrt{5}+2)}{(\sqrt{5}+2)} = \frac{\sqrt{5}}{5} + \frac{5(\sqrt{5}+2)+2(\sqrt{5}+2)}{5-4}$$

$$= \frac{\sqrt{5}}{5} + 5 + 2 \frac{\sqrt{5}}{5} + 2 \frac{\sqrt{5}}{5} + 4$$

$$= \frac{\sqrt{5}}{5} + 9 + 4 \frac{\sqrt{5}}{5}$$

$$= \frac{\sqrt{5} + 45 + 20 \sqrt{5}}{5}$$

$$= \frac{45 + 21 \sqrt{5}}{5} = \frac{45}{5} + \frac{21 \sqrt{5}}{5} = 9 + \frac{21}{2} \sqrt{5}$$

Comparing with:

$$a = 9, b = \frac{21}{2}, c = 5$$

Question 16

$f(x) = \frac{x-1}{x^2-x-12}$ is undefined when the denominator is 0.

$$x^2 - x - 12 = 0$$

$$x^2 - x - 12 = (x - 4)(x + 3) = 0$$

Either $x - 4 = 0$ $x = 4$

Or $x + 3 = 0$ $x = -3$

Question 17

The percentage for the old price is 100%

Let the percentage for the new price be N

New price : Old price = 5 : 4

$$100\% \quad 4$$

$$N\% \quad 5$$

$$500 = 4N$$

$$N = 125$$

$$\text{Percentage increase} = 125 - 100 =$$

$$25\%$$

$$\frac{100}{N} = \frac{4}{5}$$

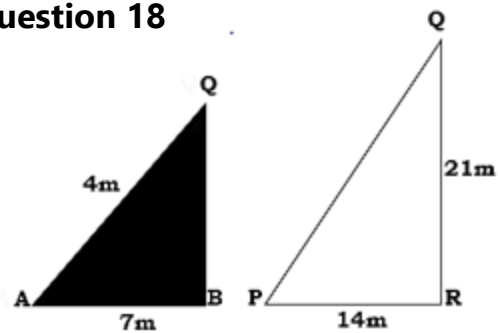
$$500 = 4N$$

$$N = 125$$

$$\text{Percentage increase} = 125 - 100 = 25\%$$

$$\frac{125}{100} \times 3000 = 3750$$

The new price is UGX 3750

Question 18

For similar figures, the corresponding sides is equal

$$\frac{\overline{PQ}}{4} = \frac{14}{7}, \overline{PQ} = 8m$$

$$\frac{\overline{QB}}{21} = \frac{7}{14}, \overline{QB} = 10.5m$$

Question 19

$$1:200000$$

$$1\text{cm}(\text{map}) = 200000\text{cm}(\text{land})$$

$$(1\text{cm})^2 \text{ map} = (200000\text{cm})^2 (\text{land})$$

$$1\text{cm}^2 \text{ map} = 4 \times 10^{10} = \text{land}$$

$$2\text{cm}^2 \text{ map} = 2 \times (4 \times 10^{10}) = \text{land}$$

$$2\text{cm}^2 \text{ map} = (18 \times 10^{10}) \text{ cm}^2 \text{ land}$$

In km^2

$$100000\text{cm} = 1\text{km}$$

$$(100000\text{cm})^2 = (1\text{km})^2$$

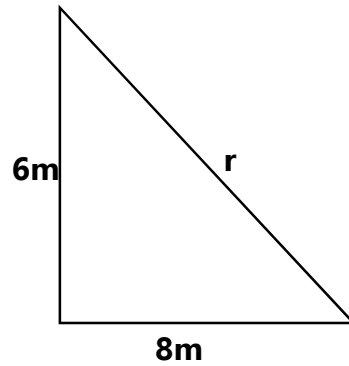
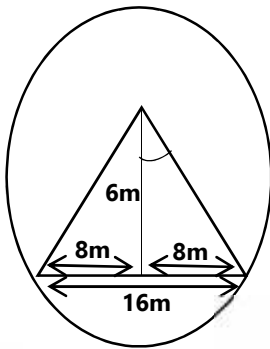
$$1 \times 10^{10} \text{ cm}^2 = 1\text{km}^2$$

$$1\text{cm}^2 = \frac{1}{1 \times 10^{10}} \text{ km}^2$$

$$(8 \times 10^{10}) \text{ cm}^2 = \frac{1}{1 \times 10^{10}} \times 8 \times 10^{10} \text{ km}^2 = 8\text{km}^2$$

Therefore, 2cm^2 on the map is equivalent to 8km^2 on land.

Question 20



$$\text{Circumference} = 2\pi r^2$$

$$r^2 = 6^2 + 8^2$$

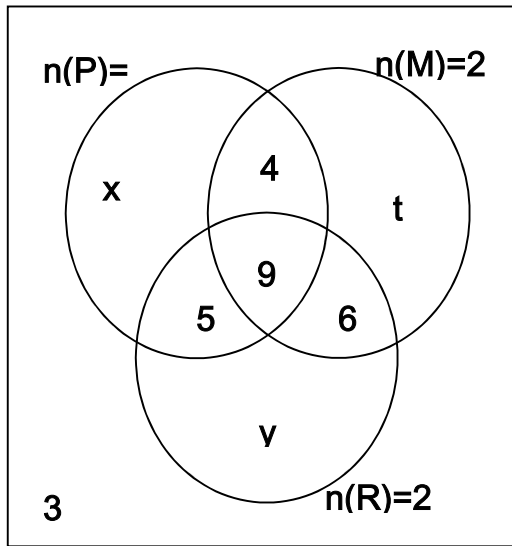
$$r = \sqrt{6^2 + 8^2} = \sqrt{100} = 10\text{cm}$$

$$\text{Circumference} = 2\pi r = 2 \times 3.14 \times 10 = 62.8\text{cm}$$

SECTION B

21.

(a)



$$\begin{aligned} y &= 26 - (5 + 9 + 6) \\ &= 26 - 20 \\ &= 6 \end{aligned}$$

$$\begin{aligned} t &= 26 - (9 + 6 + 4) \\ \mathbf{t} &= 7 \end{aligned}$$

$$\begin{aligned} x &= 40 - (26 + 5 + y + 3) \\ x &= 40 - (26 + 5 + 6 + 3) \\ x &= 40 - 40 \\ \mathbf{x} &= 0 \end{aligned}$$

$$\begin{aligned} \text{(i)} \quad n(P) &= 0 + 4 + 9 + 5 \\ &= \mathbf{18} \end{aligned}$$

$$\begin{aligned} \text{(ii)} \quad n(P^c) &= t + 6 + y + 3 \\ &= 7 + 6 + 6 + 3 \\ &= \mathbf{22} \end{aligned}$$

$$\begin{aligned} \text{(iii)} \quad n(\text{one food}) &= x + t + y \\ &= 0 + 7 + 6 \\ &= \mathbf{13} \end{aligned}$$

$$\begin{aligned} \text{(b)} \quad n(2) &= 4 + 9 + 5 + 6 \\ &= 24 \end{aligned}$$

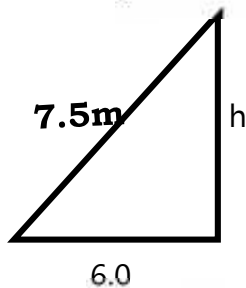
$$P(2) = \frac{24}{40} = \frac{3}{5}$$

22.

(a) T.S.A

$$\begin{aligned}
 &= \frac{1}{3} \pi r l + 2 \pi r h \\
 &= \frac{1}{3} (3.142 \times 6 \times 7.5) + (2 \times 3.142 \times 6 \times 10) \\
 &= 47.13 + 377.04 \\
 &= 424.17 \text{m}^2
 \end{aligned}$$

(b) Volume = $\frac{1}{3} \pi r l + 2 \pi r h$



$$\begin{aligned}
 h &= \sqrt{7.5^2 - 6.0^2} \\
 &= \sqrt{20.25} \\
 &= 4.5 \text{m}
 \end{aligned}$$

$$\begin{aligned}
 \text{Volume} &= \frac{1}{3} (3.142 (6^2) 4.5) + (3.142 \times 6.0^2 \times 10) \\
 &= (169.668 + 1,131.12) \text{ m}^3 \\
 &= 1.300.788 \text{m}^3
 \end{aligned}$$

23.

(a)

$$\begin{aligned}
 \text{(i)} \quad \overrightarrow{AC} &= \overrightarrow{AO} + \overrightarrow{OC} \\
 &= -a + c \\
 &= c - a
 \end{aligned}$$

$$\begin{aligned}
 \text{(ii)} \quad \overrightarrow{AB} &= \overrightarrow{AC} + \overrightarrow{CB} \\
 &= c - a + 3a \\
 &= 2a + c
 \end{aligned}$$

$$\begin{aligned}
 \text{(iii)} \quad \overrightarrow{OB} &= \overrightarrow{OC} + \overrightarrow{CB} \\
 &= c + 3a \\
 &= 3a + c
 \end{aligned}$$

$$\begin{aligned}
 \text{(iv)} \quad \overrightarrow{OX} &= \overrightarrow{OC} + \overrightarrow{CX} \\
 &= c + \frac{2}{3}(a - c) \\
 &= \frac{3c + 2a - 2c}{3}
 \end{aligned}$$

$$\begin{aligned}
 \overrightarrow{CX} &= \frac{-2}{3}\overrightarrow{AC} \\
 &= -\frac{2}{3}(c - a) \\
 &= \frac{2}{3}(a - c)
 \end{aligned}$$

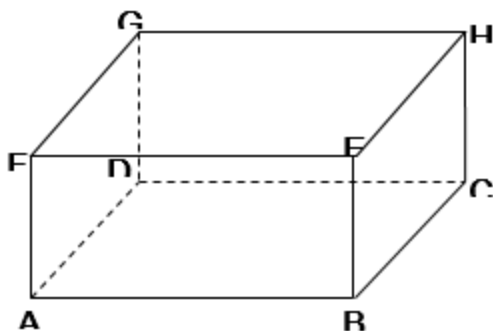
$$\begin{aligned}
 \text{(b)} \quad \overrightarrow{OY} &= \overrightarrow{OA} + \overrightarrow{AY} \\
 &= a + \frac{1}{4}\overrightarrow{AC} \\
 &= a + \frac{1}{4}(c - a) \\
 &= \frac{4a + c - a}{4} \\
 &= \frac{1}{4}(3a + c)
 \end{aligned}$$

$$\begin{aligned}
 \overrightarrow{OY} \div \overrightarrow{OB} &= \frac{3a+c}{4} \div 3a + c \\
 &= \frac{(3a+c)}{4} \times \frac{1}{(3a+c)}
 \end{aligned}$$

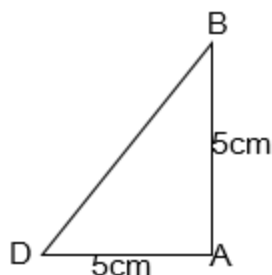
$$\frac{OY}{OB} = \frac{1}{4}$$

$\Rightarrow \overrightarrow{OY} = \frac{1}{4}\overrightarrow{OB}$, hence O, Y and B are collinear

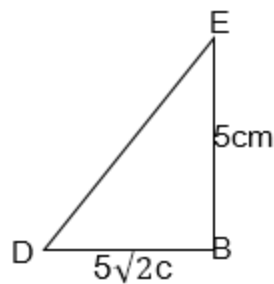
24.



$$\begin{aligned}
 \text{(i)} \quad \overrightarrow{AB} &= \frac{1}{4}(20) \\
 &= 5\text{cm}
 \end{aligned}$$

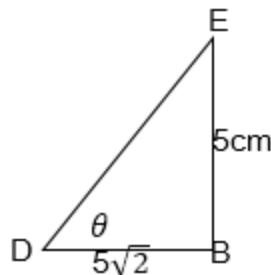


$$\begin{aligned}
 \overrightarrow{DB} &= \sqrt{5^2 + 5^2} \\
 &= \sqrt{50} \\
 &= 5\sqrt{2}cm \\
 &= \mathbf{7.07cm}
 \end{aligned}$$

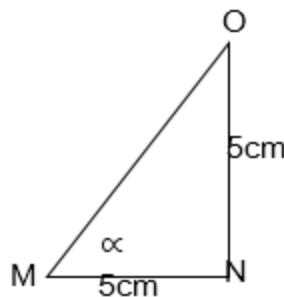


$$\begin{aligned}
 \overrightarrow{DE} &= \sqrt{(5\sqrt{2})^2 + 5^2} \\
 &= \sqrt{75} \\
 &= 5\sqrt{3} \\
 &= \mathbf{8.66cm}
 \end{aligned}$$

$$\begin{aligned}
 \text{(ii)} \quad \tan \theta &= \frac{5}{5\sqrt{2}} \\
 \theta &= \tan^{-1}\left(\frac{1}{\sqrt{2}}\right) \\
 \theta &= 35.3^\circ
 \end{aligned}$$



$$\begin{aligned}
 \text{(iii)} \quad \tan \alpha &= \frac{5}{5} \\
 \alpha &= \tan^{-1}(1) \\
 \alpha &= 45
 \end{aligned}$$



O is mid point \overrightarrow{EH}

N is mid point \overrightarrow{BC}

M is midpoint \overrightarrow{AD}

$$\begin{aligned}
 \text{(iv)} \quad \text{Surface area} &= 6 \times (5 \times 5) \\
 &= 6 \times 25 \\
 &= 150\text{cm}^2
 \end{aligned}$$

$$\begin{aligned}
 \text{(v)} \quad \text{Volume} &= 5 \times 5 \times 5 \\
 &= 5 \times 5 \times 5 \\
 &= \mathbf{125\text{cm}^3}
 \end{aligned}$$

25. (See graph)

26.

(a) $S = k_1t + k_2 \bar{t}$

$$14 = k_1(4) + k_2\sqrt{4}$$

$$14 = 4k_1 + 2\sqrt{k_2} \dots\dots\dots(1)$$

$$27 = 9k_1 + 3k_2 \dots\dots\dots(2)$$

$$3 \times (1) \quad 42 = 12k_1 + 6k_2 \dots\dots\dots(3)$$

$$2 \times (2) \quad 54 = 18k_1 + 6k_2 \dots\dots\dots(4)$$

$$(4) - (3)$$

$$54 = 18k_1 + 6k_2$$

$$-42 = 12k_1 + 6k_2$$

$$12 = 6k_2 + 0$$

$$k_1 = 2$$

Put $k_1 = 2$ in (1)

$$14 = 4(2) + 2k_2$$

$$14 - 8 = 2k_2$$

$$6 = 2k_2$$

$$k_2 = 3$$

$$S = 2t + 3 \bar{t}$$

(b) $S = 2(64) + 3 \sqrt{64}$

$$= 128 + 3(8)$$

$$= 128 + 24$$

$$= 152$$

27.

(a) (i)

Allowance		Amount
Housing	$\frac{240000}{12}$	20,000
Head of dept	$\frac{300000}{12}$	25,000

Class teacher	$\frac{180,000}{12}$	10,000
Water & electricity		15,000
House master	5000×4	20,000
Children	$14000 + 11000$	25,000
Total Shs		115,000/=

(ii) taxable income = $910,000 - 115,000$

$$= \mathbf{795,000/=}$$

(iii) Calculations

Calculations	Tax
$\frac{10}{100} \times 100,000$	10,000
$\frac{15}{100} \times 100,000$	15,000
$\frac{25}{100} \times 50,000$	12,000
$\frac{30}{100} \times 100,000$	15,000
$\frac{45}{100} \times 100,000$	141,750/=
Total	194,250/=
Income tax = Shs. 194,250/=	

$$(b) \text{ Wage} = \frac{194,250}{910,000} \times 100$$

$$= 21.3\%$$

$$\text{Income tax} = \text{Shs. } 194,250/=$$

$$(c) \text{ Wage} = \frac{194,250}{910,000} \times 100$$

$$= 21.3\%$$

Good Luck