NAME............M.S..................................CLASS......... ADM.........

MOKASA II JOINT EXAMINATIONS.

121/2 MATHEMATICS Paper 2

ALT A

FORM FOUR

MOCK

July. 2025–$2\frac{1}{2}$ hours

Instructions to candidates

(a) Write your name and admission number in the spaces provided above.
(b) Sign and write the date of examination in the spaces provided.
(c) This paper consists of two sections: **Section I** and **Section II**.
(d) Answer all questions in **section I** and **only five** questions from section **II**.
(e) **Show all the steps in your calculations, giving the answers at each stage in the spaces provided below each question.**
(f) Marks may be given for correct working even if the answer is wrong.
(g) **Non-programmable** silent electronic calculators and KNEC mathematical tables may be used, except where stated otherwise.
(h) **This paper consists of 14 printed pages.**
(i) **Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.**
(j) **Candidates should answer the questions in English.**

For Examiner's Use Only

Section I

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Total

Section II

17	18	19	20	21	22	23	24	Total

Grand Total	

SECTION I (50 marks)
Answer all questions in this section

1. The dimensions of a rectangle are 40 cm and 45 cm. If there is an error of 5% in the measurement of it's dimensions, find the percentage error in calculation of it's the area of the rectangle. (3 Marks)

$\frac{5 \times 40}{10} = \pm 2$

$\frac{5 \times 45}{10} = \pm 2.25$

42 47.25

40 × 45

38 42.75

Max.A = 42 × 47.25 = 1984.5
Min.A = 38 × 42.75 = 1624.5 } B_1 - all correct

W.A = 40 × 45 = 1800

A.E = $\frac{1984.5 - 1624.5}{2} = 180$ ✓ M_1 ✓

$\frac{180}{1800} \times 100 = 10\%$ A1

2. Solve the following pairs of simultaneous equations. (4 marks)

$$x + y = 1$$
$$x^2 - 2xy + y^2 = 4$$

$y = 1 - x$ ✓ M_1

$x^2 - 2x(1-x) + (1-x)^2 = 4$

$x^2 - 2x + 2x^2 + 1 - 2x + x^2 = 4$

$4x^2 - 4x - 3 = 0$ ✓ M_1

$4x^2 - 6x + 2x - 3 = 0$

$2x(2x-3) + 1(2x-3) = 0$

$(2x+1)(2x-3) = 0$

$2x = -1$

$x = -\frac{1}{2}$

$2x - 3 = 0$

$x = \frac{3}{2}$ } A_1

$y = 1 - x$

$= 1 - (-\frac{1}{2})$

$= 1\frac{1}{2}$

$y = 1 - \frac{3}{2} = -\frac{1}{2}$ } B_1

M_1 - Substitution

M_1 - forming quadratic equation.

A_1 - getting values of x

B_1 - getting values of y

3. Without using a calculator or mathematical tables, evaluate leaving your answer in the form $a\sqrt{b} + c$ where a, b and c are integers. (3 Marks)

$$\frac{\tan 60^0}{1 - \cos 30^0}$$

$\frac{\sqrt{3}}{1 - \frac{\sqrt{3}}{2}} \times \frac{1 + \frac{\sqrt{3}}{2}}{1 + \frac{\sqrt{3}}{2}}$ M_1

$\frac{\sqrt{3} + \frac{3}{2}}{1 - \frac{3}{4}}$ M_1

$\frac{\left(\sqrt{3} + \frac{3}{2}\right)}{\frac{1}{4}} \frac{4}{1}$ $\times \frac{4}{1}$

$4\sqrt{3} + 6$ A1

4. A quantity y varies partly as x and partly as the square of x. When $x = 20$, $y = 45$ and when $x = 24$, $y = 60$. Find y when $x = 4$. (3 Marks)

$y = kx + cx^2$

$45 = 20k + 400c$

$60 = 24k + 576c$

$\frac{20k}{20} = \frac{45}{20} - \frac{400c}{20}$

$k = 2.25 - 20c$

$60 = 24(2.25 - 20c) + 576c$

$60 = 54 - 480c + 576c$

$6 = 96c$

$c = \frac{1}{16}$

$k = 2.25 - 20(\frac{1}{16})$

$k = 1$

$y = 4 + \frac{1}{16}(4)^2 = 5$

M_1 - forming 2 equations

M_1 - finding constant

A_1 - final answer

5. Solve for X in $\log_2 X + 3 = \log_2 X^4$. (3 Marks)

$\log_2 x + \log_2 8 = \log_2 x^4$

$\log_2 (8x) = \log_2 x^4$

$8x = x^4$

$8 = x^3$

$x = 2$

M_1 - $\log_2 8$

M_1 - factor out logs

A_1 - final answer

6. Make x the subject of the formula in: (3 Marks)

$$y + x^2 = (x + t)(x + y)$$

$y + x^2 = x^2 + yx + tx + ty$ M_1

$y - ty = yx + tx$

$\frac{y - ty}{y + t} = \frac{x(y + t)}{y + t}$

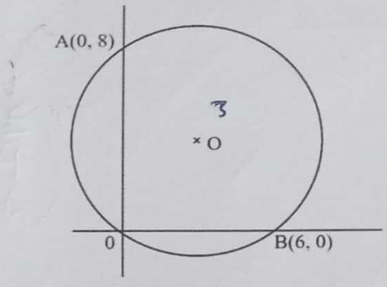
$x = \frac{y - ty}{y + t}$ or $\frac{-y + ty}{-y - t}$

M_1 - expanding correctly

M_1 - factor out X

A_1 - final answer

10. In the figure below, O is the centre of the circle and A if joined to B, passes through the centre of the circle O.



(a) Determine the centre and radius of the circle. (2 marks)

$x = \frac{6+0}{2} = 3 \quad y = \frac{0+8}{2} = 4$ 1

$(3,4)$ B1

$r = \sqrt{(6-3)^2 + (4-0)^2} = 5$ B1

(b) Express the equation of the circle in the form $x^2 + y^2 + ax + by = 0$ where *a and b* are constants. (2 marks)

$(x-3)^2 + (y-4)^2 = 5^2$ M1

$x^2 - 6x + 9 + y^2 - 8y + 16 = 25$

$x^2 - 6x + y^2 - 8y = 0$ A1

11. The table below shows the monthly income tax rates for the year 2024

Monthly taxable income	Tax rates (percentages)
1 – 9,880	10%
9,881 – 19,480	15%
19,481 – 29,080	20%
29,081 – 38,680	25%

Mr. Michael's monthly earning comprises of a basic salary of ksh. X and allowances amounting to sh.5,200. When Mr. Michael claims a monthly tax relief of ksh. 1, 056, his employer deducts from his earnings a tax of ksh. 1,282. Calculate the value of X. (3 marks)

Gross tax = 1282 + 1056 = 2338 B1

$9880 \times 0.1 = 988$

$y \times 0.15 = 1356$

$2338 - 988 = 1350$

$y = \frac{1356}{0.15} = 9{,}000$ B1

$9{,}000 + 9880 = 18{,}880$

$18{,}880 - 5{,}200 = 13{,}680$ A1

B1 – Gross tax

B1 = 9000

B1 – final answer

12. A matrix M$\begin{pmatrix} 2 & 1 \\ 2 & 2 \end{pmatrix}$ maps an object point A(x,y) to A'(x_1,y_1). A matrix T $\begin{pmatrix} 1 & 2 \\ 3 & 1 \end{pmatrix}$ maps A' to A''(X_2,Y_2). Find the matrix which maps A'' to A. (3 Marks)

TM

$\begin{pmatrix} 1 & 2 \\ 3 & 1 \end{pmatrix}\begin{pmatrix} 2 & 1 \\ 2 & 2 \end{pmatrix} = \begin{pmatrix} 6 & 5 \\ 8 & 5 \end{pmatrix}$ M1

det = (6×5) − (8×5) = −10

$\frac{-1}{10}\begin{pmatrix} 5 & -5 \\ -8 & 6 \end{pmatrix}$ M1

$\begin{pmatrix} -\frac{1}{2} & \frac{1}{2} \\ \frac{4}{5} & -\frac{3}{5} \end{pmatrix}$ A1

M1 – Multiplying TM

M1 – Inverse

A1 – find answer

13. Three grades of coffee A, B and C were mixed in the ratio 1:2:3. The cost per kg of each of the grades A, B and C were sh 700, sh 490 and sh 630 respectively. Calculate the selling price per kg if a profit of 20% is to be realized. (3 Marks)

$\frac{(1\times700) + (2\times490) + (3\times630)}{6}$ M1

sh. 595

$\frac{120\times595}{100}$ M1 $= 714$ A1

14. The gradient function of a curve is given by $4x^3 + 2x - 1$. If the curve passes through a point (-2,1), find the equation of the curve. (3 Marks)

$y = \int \frac{4x^{3+1}}{4} + \frac{2x^{1+1}}{2} - \frac{1x^{0+1}}{1} + c$

$y = x^4 + x^2 - x + c$ ✓ M1

$1 = (-2)^4 + (-2)^2 - (-2) + c$ ✓ M1

$1 = 22 + c$

$c = -21$

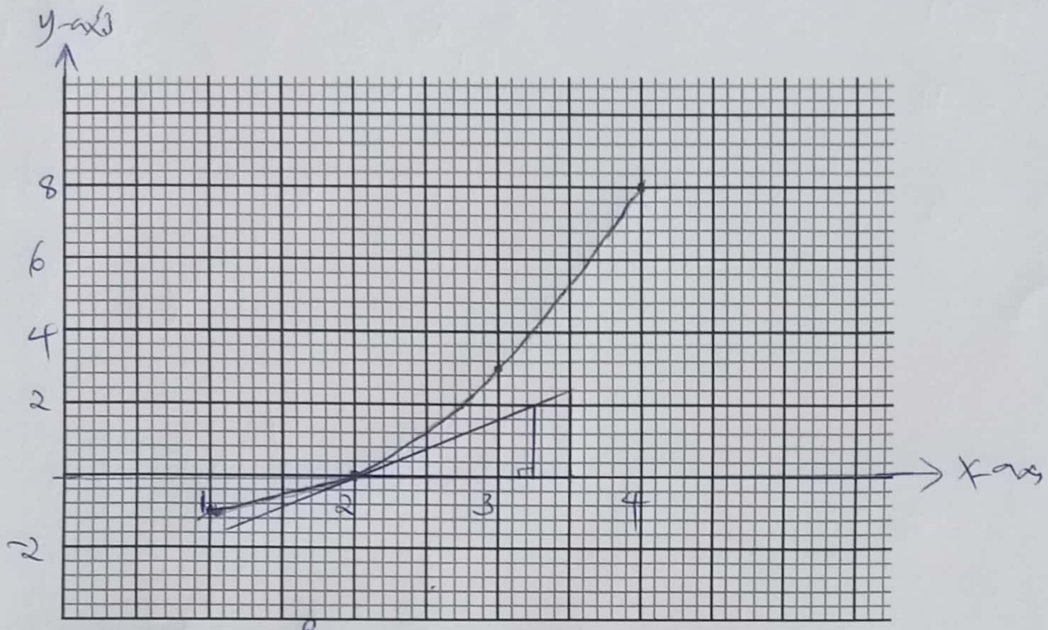
$y = x^4 + x^2 - x - 21$ ✓ A1

15. Complete the table below for curve $y = x^2 - 2x$, draw the graph. Using the graph, find the gradient when x=2. (3 Marks)

X	1	2	3	4
Y	−1	0	3	8

B_1

C_1



B_1 – fill table and correct plot

C_1 – Curve.

B_1 – final answer

$\frac{2-0}{3.5-2} = 1.333$ M_1 B_1

16. The difference between the fourth and the seventh terms of an increasing arithmetic progression is 12. Calculate the sum of the first fifteen terms of the progression if the first term is 9. (3 Marks)

$(9+6d) - (9+3d) = 12$ ✓ M_1

$3d = 12$

$d = 4$

$S_{15} = \frac{15}{2}[2 \times 9 + (15-1)4]$ ✓ M_1

$= 555$ ✓ A_1

SECTION II (50 MARKS)

Answer any five questions from this section

17. The table below shows the heights (in metres) of seedlings in Mr. Wanjala's seedbed

(a) Use the information above to complete the table below. (3 Marks)

Height (m)	F	$mid-point(x)$	$t = \left(\frac{1000x - 105}{40}\right)$	ft	t^2	ft^2
0.01 – 0.04	12	0.025	−2	−24	4	48
0.05 – 0.08	17	0.065	−1	−17	1	17
0.09 – 0.12	31	0.105	0	0	0	0
0.13 – 0.16	28	0.145	1	28	1	28
0.17 – 0.20	23	0.185	2	46	4	92
0.21 – 0.24	9	0.225	3	27	9	81
				60		266

B_1 Complete
B_1 table
B_1

(b) Using the completed table above, determine;

(i) The mean height of the seedlings. (2 Marks)

$$\bar{X} = \frac{A}{K} + \frac{C}{K}\left(\frac{\Sigma ft}{\Sigma f}\right) \quad M_1$$

$$\frac{105}{1000} + \frac{40}{1000}\left(\frac{60}{120}\right) = 0.125 \quad A_1$$

2.

(ii) The standard deviation of height of the seedlings. (3 Marks)

$$\text{variance} = \left(\frac{C}{K}\right)^2\left[\frac{\Sigma ft^2}{\Sigma f} - \left(\frac{\Sigma ft}{\Sigma f}\right)^2\right]$$

$$= \left(\frac{40}{1000}\right)^2\left[\frac{226}{120} - \left(\frac{60}{120}\right)^2\right] \quad M_1$$

$$= \frac{32}{9375}$$

$$\sqrt{\frac{32}{9375}} \quad M_1$$

0.056095

0.05610 A_1

(c) Determine the probability of the number of seedlings whose height exceeds 0.142 m. (2 Marks)

$$0.125 + \left(\frac{n-60}{28}\right)0.4 = 0.142$$

$n - 60 = 11.9$

$n = 71.9$

$n \simeq 71.9$

71 72 included

$$P = \frac{120-71}{120} = \frac{49}{120}$$

18. Taking the radius of the earth, R = 6370km and $\pi = {}^{22}/_{7}$.

(a) Calculate the shortest distance in km between the two cities, P(60°N, 80°W) and Q (60°N, 10°E). (2 Marks)

$\frac{90}{360} \times 2 \times \frac{22}{7} \times 6370 \times \cos 60° = 5005\text{km}$ M_1

A_1

(b) An airplane flew from P at 1200hrs local time to Q along the parallel of latitude at a speed of 1001km/h. What was the local time at Q when it arrived? (4 Marks)

$\frac{5005}{1001} = 5\text{hrs}$ M_1

$\frac{90}{15} = 6\text{hrs}$ M_1

1200
600 M_1
1800
500
2300hrs or 11:00p.m A_1

M_1 – time 5hrs
M_1 – 6hrs
M_1
A_1

(c) The airplane then flew due south from point Q(60°N, 10°E) to point B at speed of 194.4 knots. The distance covered by the airplane was 3888nm. Find the position of B and the local time it arrived at B if it rested for 30mins at Q in twelve hour system. (4 Marks)

$60x = 3888$
$x = 64.8$ B_1
$64.8 - 60 = 4.8$
$(4.8°S, 10°E)$ B_1

$\frac{3888}{194.4}$
20hrs B_1

23.00 +
30
23.30 +
20.00
43.30

7.30p.m Next day B_1

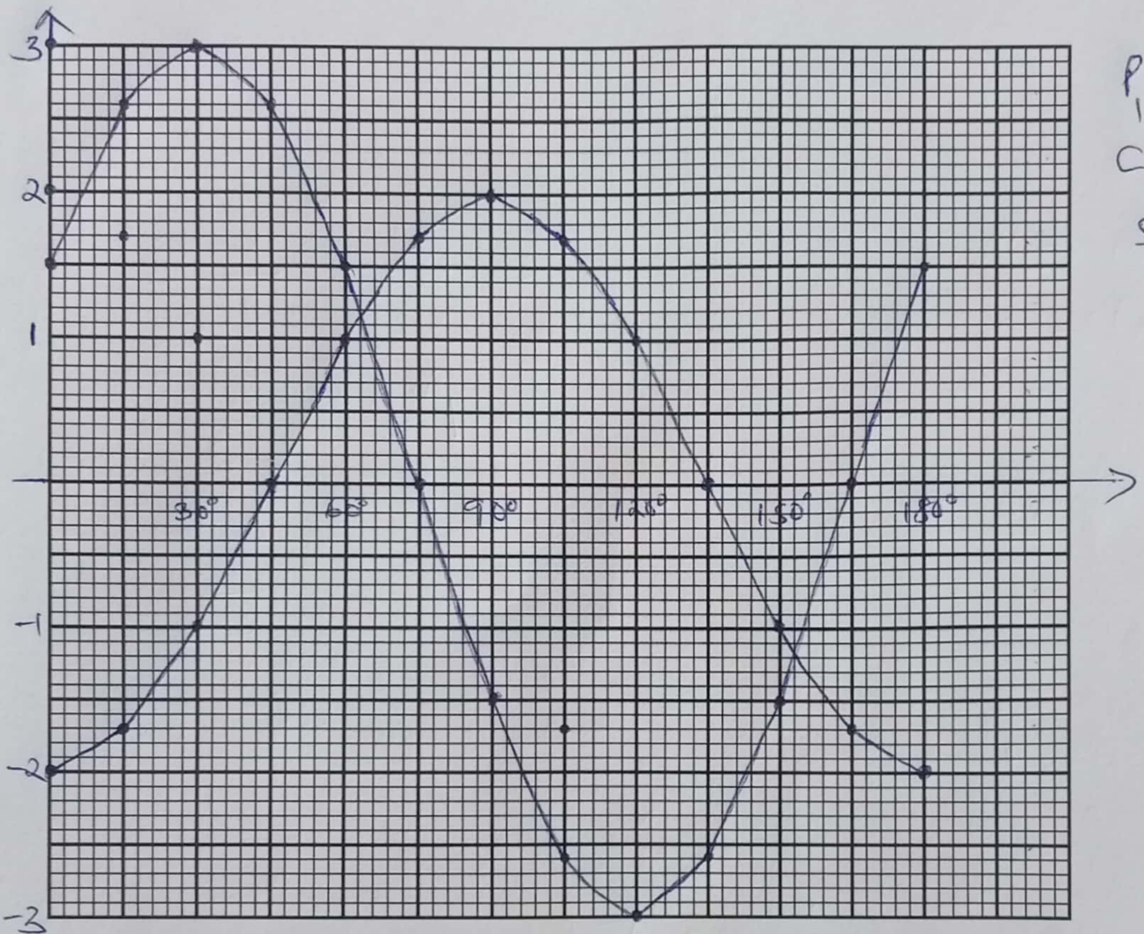
B_1 – finding 64.8
B_1 – Position of B
B_1 – 20hrs
B_1 – find answer

[Accept Conversion to km first]

19. (a) Complete the table below correct to 2 decimal places. (2 Marks)

$x°$	0	15	30	45	60	75	90	105	120	135	150	165	180	
$-2\cos 2x$	-2	-1.7	-1.00	0	1	1.7	2.0	1.7	1.0	1.0	-1.0	-1.7	-2.0	B1
$3\sin(2x+30)$	1.5	2.6	3	2.6	1.5	0.0	-1.5	-2.6	-3	-2.6	-1.5	0	1.5	B1

(b) Using a scale of 1 cm for 15° on the x-axis and 2 cm for 1 unit on the y-axis, and on the same Axes draw the graphs of $y = -2\cos 2x$ and $y = 3\sin(2x+30)$ for $0° \leq x \leq 180°$. (5 Marks)



P1 P1

C1 C1

S1

c) Using the graph in (b) above, solve the equation $3\sin(2x+30) + 2\cos 2x = 0$ (2 Marks)

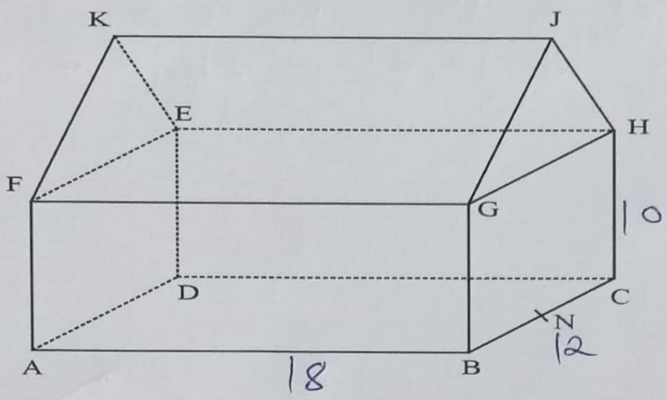
63 ± 1.5 153 ± 1.5 B1 B1

d) Find the range of values of x for which $3\sin(2x+30) \leq -2\cos 2x$ (1 Mark)

$63 \leq x \leq 153$ B1

± 1.5 ± 1.5

20. In the figure below a triangular prism is placed on top of a cuboid. Point K and J lie vertically above line AD and BC respectively. AB = KJ = 18 m, BC = 12 m and CH = 10 m. FK=KE=JH=JG=8m . N is the mid-point of BC.



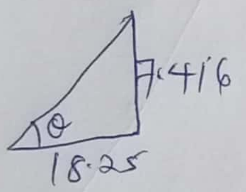
Calculate,

(a) The height of ridge KJ above the base ABCD. (2 Marks)

$\sqrt{8^2 - 3^2} = 7.416$ M1

$7.416 + 10 = 17.42$ A1

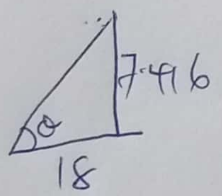
(b) The angle between line FJ and plane EFGH. (2 Marks)



$\sqrt{18^2 + 3^2} = 18.25$ M1

$\tan\theta = \frac{7.416}{18.25}$ $\theta = 22.11^\circ$ A1

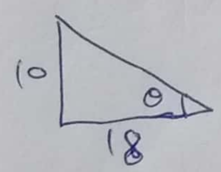
(c) The angle between plane FEJ and plane ABCD. (2 Marks)



$\tan\theta = \frac{7.416}{18}$ M1

$\theta = 22.39^\circ$ A1

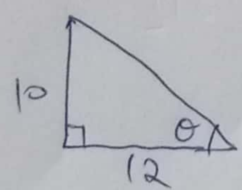
(d) The angle between plane FEN and plane ABCD. (2 Marks)



$\tan\theta = \frac{10}{18}$ M1

$\theta = 29.05^\circ$ A1

(e) The angle between GC and AD. (2 Marks)



$\tan\theta = \frac{10}{12}$ M1

$\theta = 39.81^\circ$ A1

21. A piece of land can be bought on cash at ksh.1,000,000 or on hire purchase terms, by making a down payment of ksh. 200,000 and a 24 monthly installment of sh.100,000 each.

(i) Calculate the carrying charge (2 Marks)

$200,000 + (24 \times 100,000) - 1,000$ M1

$1,600,000$ A1

(ii) Calculate the rate of interest charged per month on hire purchase terms. (2 Marks)

$2,400,000 = 800,000 \left(1 + \frac{r}{100}\right)^{24}$ ✓M1

$3 = (1 + 0.01r)^{24}$

$1.0468 = 1 + 0.01r$

$0.0468 = 0.01r$

$r = 4.68\%$ p.m A1

(iii) If the piece of land appreciated at a rate of 5% p.a for the first two years compounded annually, in the next 3 years it appreciated at a rate of 12% p.a compounded quarterly. Calculate the value of the land after 5 years. (4 Marks)

M1

$1,000,000 \left(1 + \frac{5}{100}\right)^2 = 1,102,500$ A1

M1

$1,102,500 \left(1 + \frac{3}{100}\right)^{12} = 1,571,901.38$ A1

(iv) After five years, due to the environmental degradation the value of the land depreciated at a rate of 6% p.a. How long will it take for the value to depreciate to 1,153,625. (2 Marks)

$1,153,625 = 1,571,901.38 \left(1 - \frac{6}{100}\right)^n$ ✓M1

$0.7339 = 0.94^n$

$\frac{\log 0.7339}{\log 0.94} = n$

$n = 5$ yrs ✓ A1

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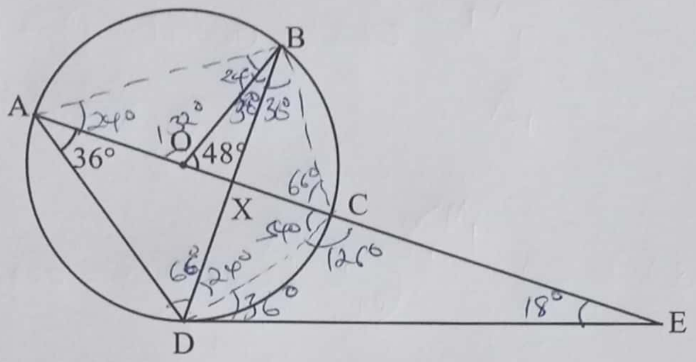
22. In the figure below O is the centre of the circle. A, B, C and D are points on the circumference of the circle. A, O, X, C and E are points on a straight line. DE is a tangent to the circle at D. Angle BOC= 48° and angle CAD= 36°.



(a) Giving reasons in each case, find the value of each of the following angles:

(i) DBC 36°, angles substended by the same chord on the segment are equal (2 Marks)

$B_1 B_1$

$\angle DAC = \angle DBC = 36°$

(ii) DEC (2 Marks)

18°, angles in a triangle adds upto 180°

$B_1 B_1$

(iii) BCD (2 Marks)

66 + 54 = 120°

Opposite angles in a ~~cy~~ cyclic quadrilateral ABCD adds upto 180°

$B_1 B_1$

(b) Given that AD = 15 cm, CE = 12cm. Calculate correct to 2 decimal places the:

(i) radius of the circle. (2 Marks)

$\frac{15}{\sin 54°} = 2R$ $2R = 18.54$

$R = 9.27$

$M_1 A_1$

(ii) length DE (2 Marks)

$DE^2 = 12 \times 30.54$

$DE = 19.14$

$M_1 A_1$

23. Using a ruler and a pair of compasses only for all constructions in this question;

(a) Construct triangle ABC in which AB = 6cm, BC = 7cm and ∠ABC = 75°. (3 Marks)

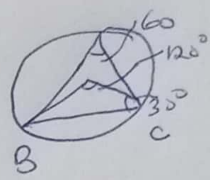
$\frac{150}{2} = 75^\circ$ or $60 + \frac{30}{2} = 75$

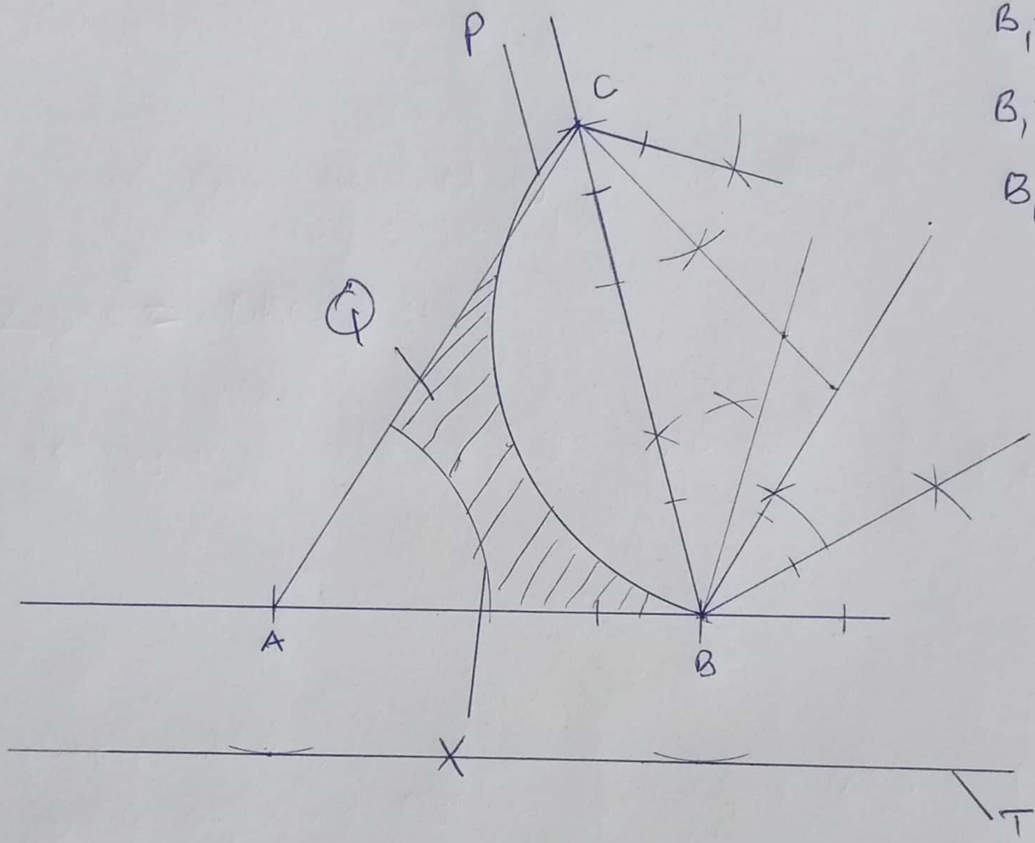
BPC = 120°

180 − 120 = 60°

60 × 2 = 120°

Construct 30°





B1 − Line AB

B1 − 75°

B1 − point C

(b) Find locus x such that AX = 3 cm. (1 Mark)

AX = 3cm B1

(c) On the same side of BC as A, construct the locus of P such that ∠BPC = 120°. (3 Marks)

Constructing 60°, bisecting to 30° both sides − B1B1 drawing P

(d) Show by the shading, the locus of Q inside triangle ABC such that BPC ≤ 120° and AX ≥ 3 cm. (1 Mark)

(e) On the opposite of C, construct the locus of T such that the area of triangle ATB = 6 cm^2 (2 Marks)

$\frac{1}{2} \times 6 \times h = 6$

$h = 2$ B1

B1 − finding h = 2

B1 − drawing Line T

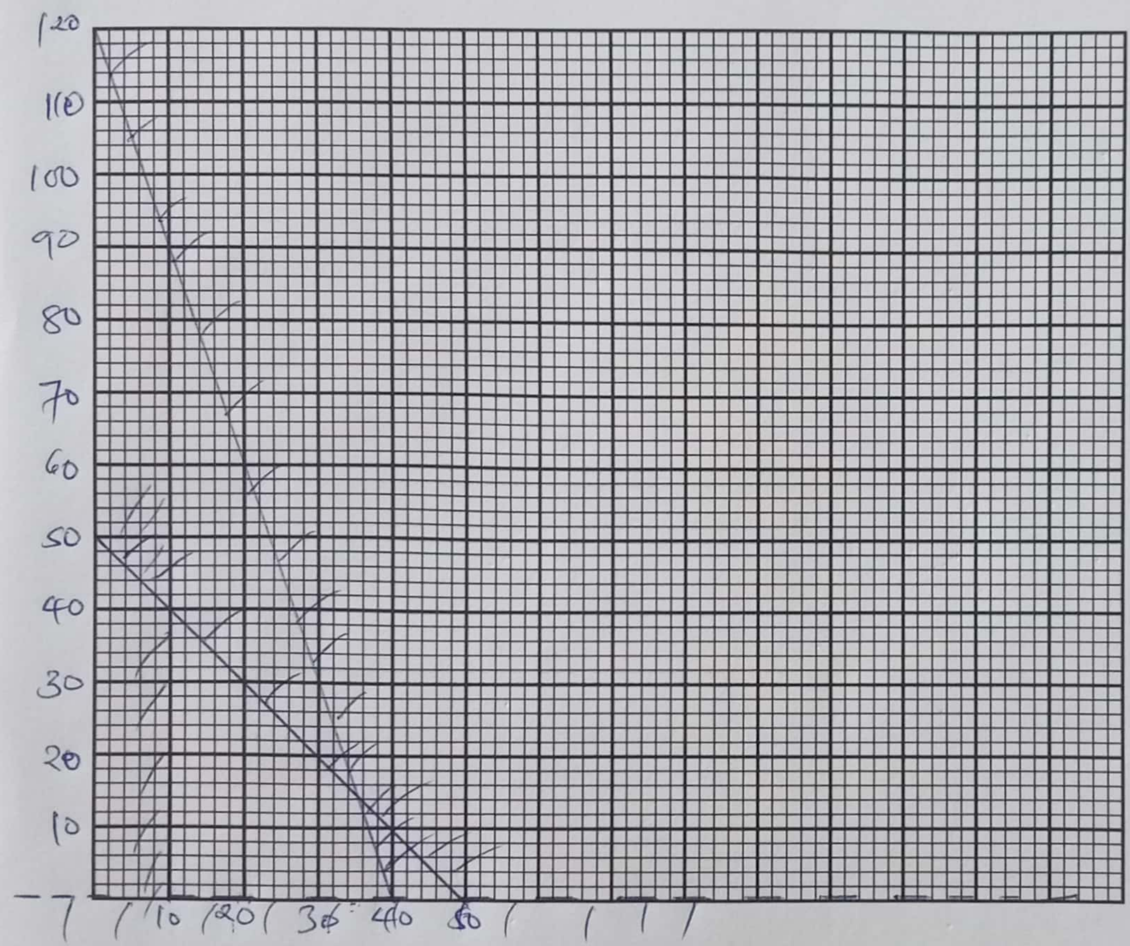
24. A farmer has 50 hectares of land in which he plants potatoes and carrots. Each hectare of potatoes require 6 men while carrots require 2 men. The farmer has 240 men available. He must plant at least 10 hectares of potatoes. The profit on potatoes is sh.1,000 per hectare and carrots is sh.1,200 per hectare. If he plants x hectares of potatoes and y hectares of carrots.

(a) Write down four inequalities to represent the given information. (4 Marks)

$x + y \leq 50$ $\quad$ $x \geq 10$ $\quad$ B1 B1 B1 B1

$6x + 2y \leq 240$ $\quad$ $y \geq 0$

(b) On the grid provided draw the inequalities. (~~3~~4 Marks)



B1 B1 B1
B1

(c) Using your graph determine the number of hectares for each vegetable which will give maximum profit. (2 Marks)

$1000x + 1200y = P$

$(30, 20)$ $\quad$ M1 $\quad$ A1

$1000(30) + 1200(20) = 54,000$