Name ....MARKING SCHEME.............ADM Number..............

Candidate's signature......................Index Number......................Class...........

121/1
MATHEMATICS
Paper 1
June/July, 2021
Time 2½ Hours

MOKASA ONE EXAMINATION

Kenya Certificate of Secondary Education

121/1
MATHEMATICS
Paper 1
June/July, 2021
2½ Hours

Instructions to candidates

a) Write your name and index number in the spaces provided above.
b) Sign and write the date of examination in the spaces provided above.
c) This paper consists of two sections: Section I and Section II.
d) Answer all the questions in Section I and only five questions from Section II.
e) Show all the steps in your calculations, giving your 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 calculator and KNEC mathematical tables may be used, except where stated otherwise.
h) Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.
i) Candidates should answer the questions in English.

For examiner's use only
Section 1

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

SECTION I (50 marks)

Answer all the questions in section I

1. Evaluate $\dfrac{\frac{3}{4} + 1\frac{5}{7} \div \frac{4}{7} \text{ of } 2\frac{1}{3}}{(1\frac{3}{7} - \frac{5}{8}) \times \frac{2}{3}}$ (3 marks)

Num- $\frac{3}{4} + \frac{12}{7} \div \frac{4}{7} \times \frac{7}{3}$

$\frac{3}{4} + \frac{9}{7}$ ✓ $= \frac{57}{28}$

Den $\left(\frac{10}{7} - \frac{5}{8}\right) \times \frac{2}{3} = \frac{15}{28}$

$\frac{57}{28} \times \frac{28}{15} = 3\frac{4}{5}$ A1

2. Simplify $\dfrac{8x^2 + 6x - 9}{16x^2 - 9}$ (3 marks)

Num $8x^2 + 12x - 6x - 9$

$4x(2x+3) - 3(2x+3)$

$(4x-3)(2x+3)$

Den $16x^2 - 9$

$(4x+3)(4x-3)$

$\dfrac{\cancel{(4x-3)}(2x+3)}{(4x+3)\cancel{(4x-3)}}$

$\dfrac{2x+3}{4x+3}$

3. Two similar solid cones made of the same material have masses of 8000g and 1000g respectively. If the base area of the smaller cone is 77cm^2, calculate;

a) The base area of the larger cone (3 marks)

$V.S.f = \frac{8000}{1000} = 8$

$L.S.f = \sqrt[3]{\frac{8000}{1000}} = \frac{2}{1}$

$A.S.f = \frac{4}{1}$

Base area $= 4 \times 77$

$= 308 cm^2$ A1

b) The radius of the larger cone (2 marks)

$\pi r^2 = 308$

$\frac{22}{7} r^2 = 308$

$r^2 = (2156 \times 7) \div 22$

$r = \sqrt{98}$

$r = 9.9 cm^2$ A1

7. State all integral values of x which satisfy the following pair of inequalities. (3 marks)

$$3 - x \le 1 - \frac{1}{2}x$$

$$\frac{1}{2}(x-5) \le 7 - x$$

$\frac{1}{2}(x-5) \geq 7 \cancel{+} x$

$3 - x \leq 1 - \frac{1}{2}x$

$6 - 2x \leq 2 - x$

$-x \leq -4$

$x \geq 4$

$x - 5 \geq -14 + 2x$

$-x \geq -9$

$x \leq 9$

$4 \leq x \leq 9$

$4, 5, 6, 7, 8, 9$

8. A man is now three times as old as his daughter. In twelve years time he will be twice as old as his daughter. Find their present ages. (3 marks)

Daughter's age $= x$ yrs

Man's age $= 3x$ yrs.

In 12yrs time $D = x + 12$

$M = 3x + 12$

$3x + 12 = 2(x + 12)$

$3x + 12 = 2x + 24$

$x = 12$

Daughter 12yrs

Man 36yrs

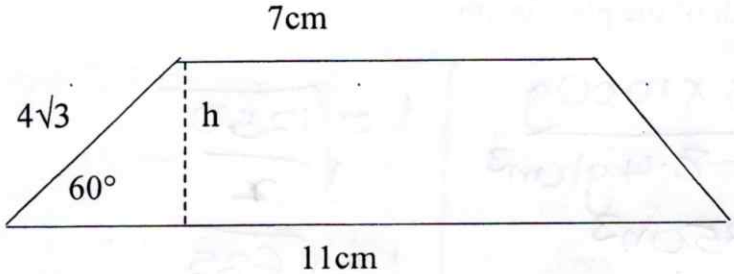
9. The point A(3, 2) is mapped onto A^1(7, 1) under a translation T. Find the co-ordinates of the image of B(4, 6) under the same translation. (3 marks)

$T = \begin{bmatrix} 7 \\ 1 \end{bmatrix} - \begin{bmatrix} 3 \\ 2 \end{bmatrix} = \begin{bmatrix} 4 \\ -1 \end{bmatrix}$

$B' = \begin{bmatrix} 4 \\ 6 \end{bmatrix} + \begin{bmatrix} 4 \\ -1 \end{bmatrix} = \begin{bmatrix} 8 \\ 5 \end{bmatrix}$

$B'(8, 5)$

10. Calculate the area of the trapezium below. (3 marks)



$\sin 60 = \frac{h}{4\sqrt{5}}$

$\frac{\sqrt{3}}{2} \times 4\sqrt{5} = h$

$h = 6$

$A = \frac{1}{2}[11+7)6$

$= 18 \times 3$

$= 54cm^2$

11. Two machines A and B working together can do some work in 6 days. After 2 days machine A breaks down and it takes machine B 10 days to finish the remaining work. How long will it take machine A alone to finish the whole work if it does not break down. (3 marks)

$A+B = 6$

$\frac{1}{A}+\frac{1}{B}=\frac{1}{6}$

Work done in 2days $= \frac{2}{6} = \frac{1}{3}$

Remaining Work $= 1-\frac{1}{3}$

$= \frac{2}{3}$

$\frac{2}{3} = 10$ days

$\quad 1$ day

$\frac{2}{3} \times 1 \times \frac{1}{10} = \frac{1}{15}$

$\therefore$ B does $\frac{1}{15}$ Work in 1day.

$\frac{1}{A}+\frac{1}{15}=\frac{1}{6}$

$\frac{1}{A} = \frac{1}{10}$ days

$A =$ 10 days

12. Solve for K in the equation. (3 marks)

$$(\log_3 K)^2 = \frac{1}{2}\log_3 K + \frac{3}{2}$$

let $\log_3 k = x$

$x^2 = \frac{1}{2}x + \frac{3}{2}$

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

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

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

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

$\log_3 k = -1$

$k = \frac{1}{3}$

$\log_3 k = \frac{3}{2}, k = 3^{\frac{3}{2}}$

$k = \sqrt{27}$

13. A square brass plate is 2mm thick and has a mass of 1.05kg. The density of the brass plate is $8.4g/cm^3$. Calculate the length of the plate in cm. (3 marks)

$$\text{Vol plate} = \frac{1.05 \times 1000g}{8.4g/cm^3}$$

$$= 125cm^3$$

$$L \times L \times L = 125$$

$$L^2 \times 0.2 = 125$$

$$L^2 = \frac{125}{0.2}$$

$$L = \sqrt{\frac{1250}{2}}$$

$$l = \sqrt{625}$$

$$L = 25cm$$

14. The sum of interior angles of two regular polygons of side n-1 and n are in the ratio 4:5. Calculate;

(i) the value of interior angle of the polygon with side (n-1) (2 marks)

$$\frac{(n-1-2)180}{(n-2)180} = \frac{4}{5}$$

$$4n-8 = 5n-15$$

$$n = 7$$

$$\frac{(6-2)180}{6} = 120$$

$$\underline{\underline{120^0}}$$

(ii) exterior angle (1 mark)

$$180^0 - 120^0 = 60^0.$$

15. Four athletes Onyango, Korir, Njuguna and Mutua can complete a 2km lap in a field in 12 minutes, 15 minutes, 18 minutes and 20 minutes respectively. If they start the race together, find the number of times the slowest athlete will be overlapped by the fastest athlete by the time they next cross the finish line simultaneously. (3 marks)

LCM

2	12	15	18	20
2	6	15	9	10
3	3	15	9	5
3	1	5	3	5
5	1	5	1	5
	1	1	1	1

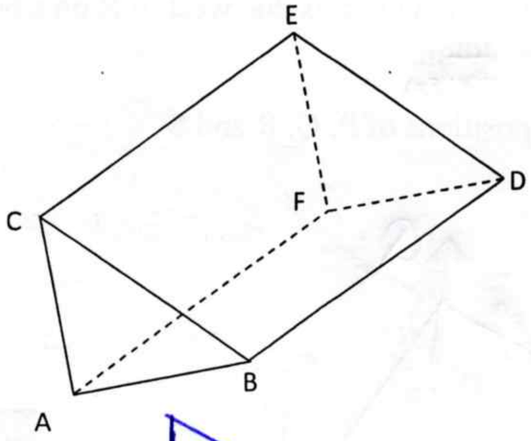
$$2^2 \times 3^2 \times 5 = 180\text{min}$$

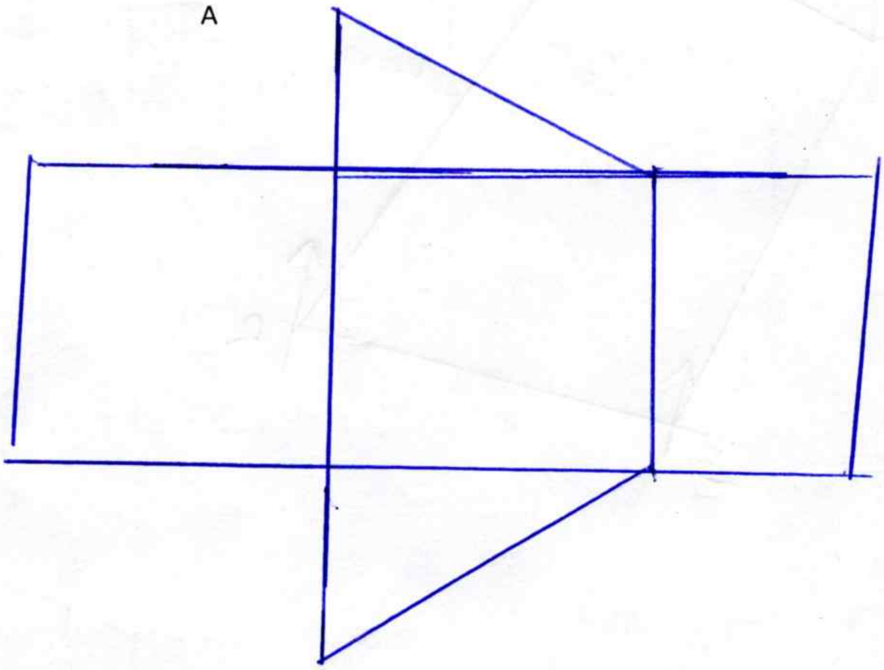
$$\frac{180}{20} = 9 \text{ times}$$

$$\frac{180}{12} = 15 \text{ times}.$$

$$15 - 9 = \underline{\underline{6 \text{ times}}}$$

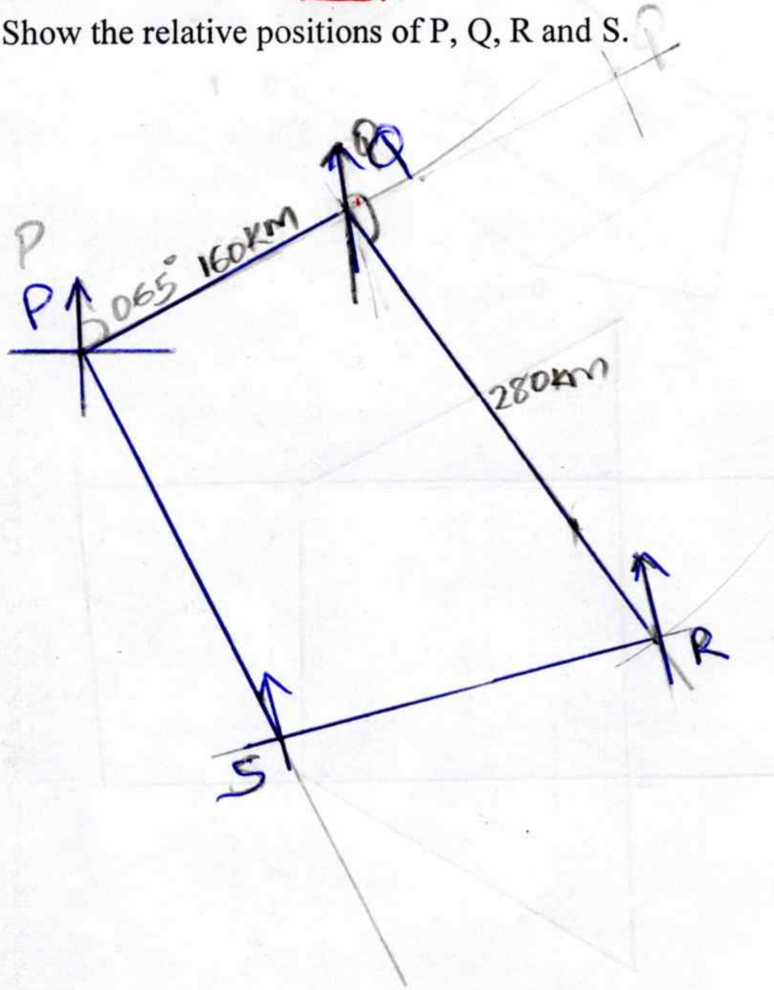
16. The figure below shows a triangular prism. Draw its net. (3 marks)

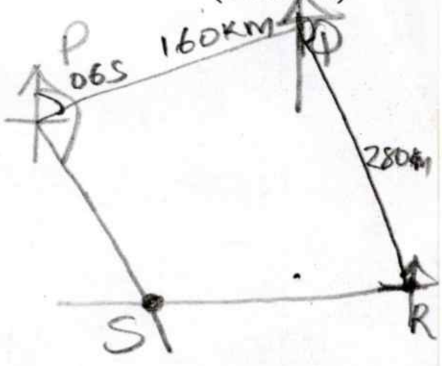




17. Four towns P, Q, R and S are such that Q is 160km from town P on a bearing of 065°. R is 280km on a bearing of 152° from Q. S is due west of R on a bearing of 155° from P. Using a scale of 1cm to represent 40km.

a) Show the relative positions of P, Q, R and S. (6 marks)





b) Find the bearing of;

(i) S from Q 198^{0} (1 mark)

(ii) P from R 304^{0} (1 mark)

c) Find the distance

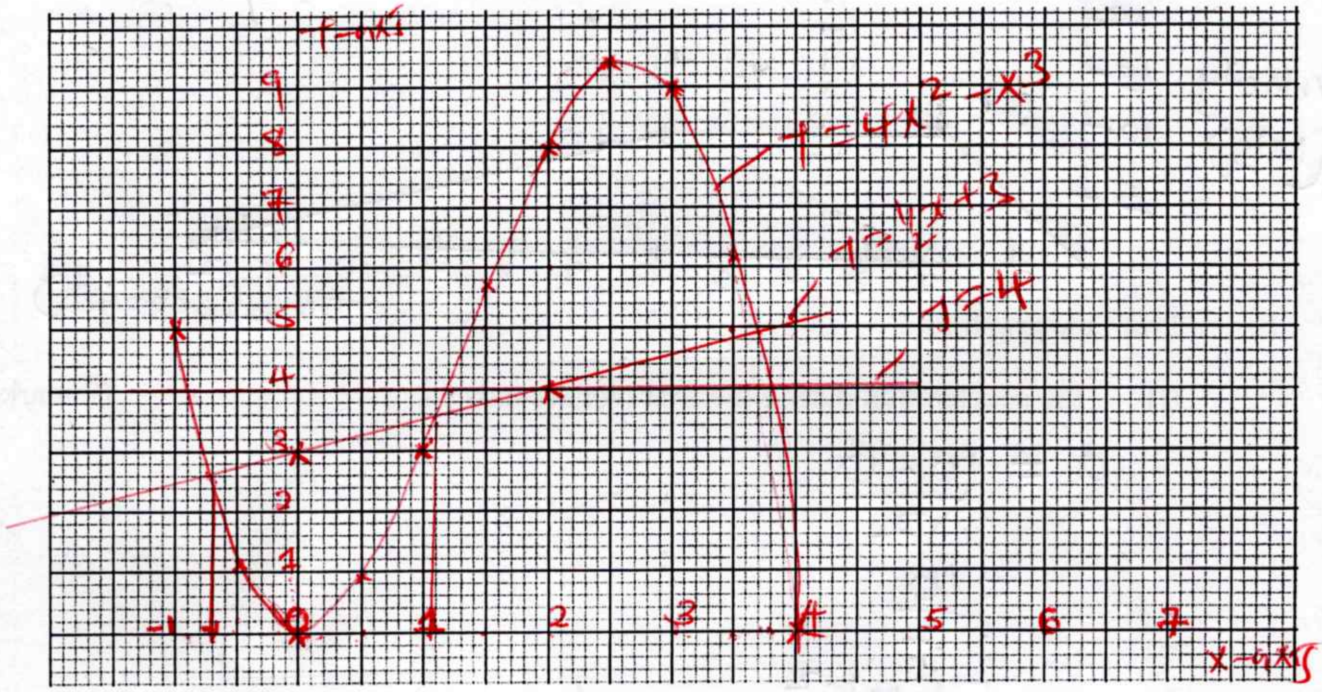
(i) PS 204KM (1 mark)

(ii) RS 184 km (1 mark)

18. a) Complete the table below for $y = 4x^2 - x^3$ (2 marks)

x	-1	-0.5	0	0.5	1	1.5	2	2.5	3	3.5	4
$y=4x^2-x^3$	5	1.1	0	0.9	3	5.7	8	9.4	9	6.1	0

b) On the grid provided, draw the graph of $y = 4x^2 - x^3$ for $-1 \leq x \leq 4$ (3 marks)



c)i) Find the roots of $x^3 - 4x^2 + 4 = 0$ (3 marks)

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

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

$y = 4$ $x = -0.9, 1.2, 3.8$

ii) On the same axis, draw the graph of $2y = x + 6$ and state the values of x for which the two graphs intersect. (3 marks)

$y = \frac{1}{2}x+3$

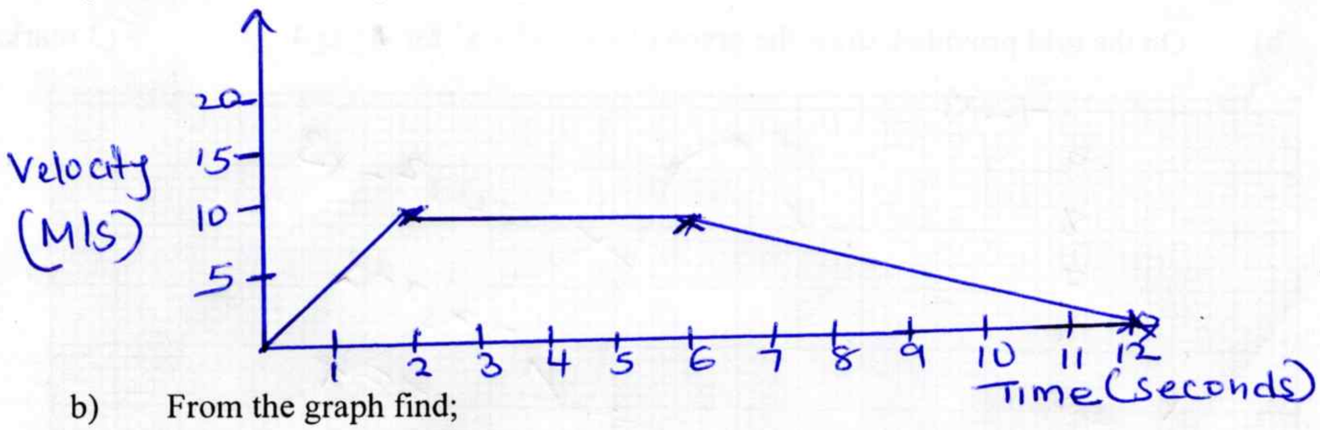
x	0	2
y	3	4

$x = -0.7, 1.1, 3.5$

~~iii) What equation has the above c(ii) values as its roots~~ (1 mark)

19. A particle moves from rest and attains a velocity of 10m/s after two seconds it then moves with 10m/s velocity for 4 seconds. It finally decelerates uniformly and comes to rest after 6 seconds.

a) Draw a velocity time graph for the motion of this particle (3 marks)



b) From the graph find;

(i) the acceleration during the first two seconds. (2 marks)

$$a = \frac{10-0}{2}$$
$$= \frac{10}{2}$$
$$= 5 m/s^2$$

(ii) the uniform deceleration during the last six seconds. (2 marks)

$$\frac{0-10}{6} = \frac{10}{6}$$
$$= -1.667 m/s^2$$

(iii) the total distance covered by the particle (3 marks)

$$A = \left[\frac{1}{2}(4+6)10\right] + \frac{1}{2} \times 6 \times 10$$
$$= 50 + 30$$
$$= \underline{\underline{80m}}$$

20. a) Find the gradient of a line L_1 perpendicular to the line whose equation is $y=4x+4$ (2 marks)

$4 \times M_2 = -1$

$\text{Grad} = -\frac{1}{4}$

b) Calculate the angle in which line L_1 is making with

(i) x-axis (2 marks)

$\tan\theta = \frac{1}{4}$

$\theta = \tan^{-1}\left(\frac{1}{4}\right)$

$\theta = 14.04^\circ$

(ii) y-axis (1 mark)

$90 - 14.04$

$= 75.96^\circ$

c) Line L_2 is passing through the x-axis at 2 and point T(-2, k) and it is parallel to line L_1. Calculate the value of K. (2 marks)

$(2,0)\ (-2,K)$

$\frac{K-0}{-2-2} = -\frac{1}{4}$

$4K = 4$

$K = 1$

d) Another line L_3 is perpendicular to line L_2 and passes through point T. Calculate the equation of line L_3 leaving your answer in the form $ax + by + c = 0$ (3 marks)

$-\frac{1}{4}M_2 = -1$

$G\ L_3 = 4$

$(-2, 1)\ (x, y)$

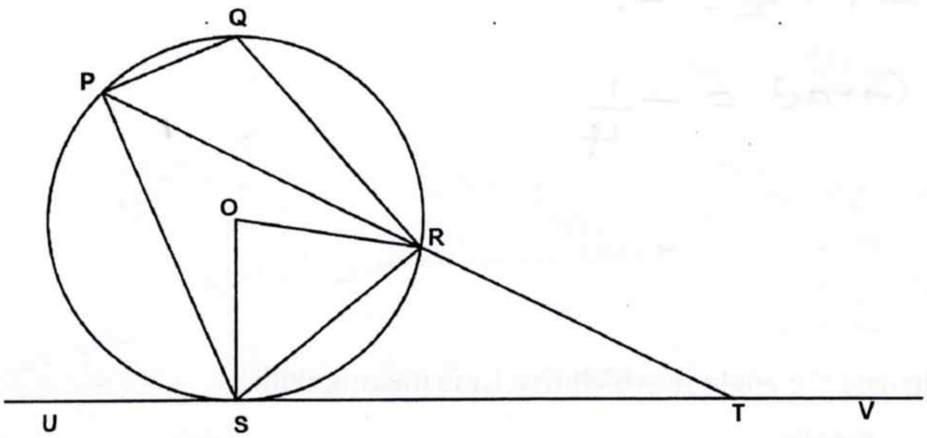
$\frac{y-1}{x+2} = \frac{4}{1}$

$y - 1 = 4x + 8$

$y = 4x + 9$

$4x - y + 9 = 0$

21. In the figure below P, Q, R and S are points on the circle centre O. PRT and USTV are straight lines. Line UV is a tangent to the circle at S. Angle RST is 50^0 and angle RTV is 150^0.



a) Calculate the size of:

i. angle ORS (2 marks)

40^0

ii. angle USP (1 mark)

80^0

iii. angle PQR (2 marks)

130^0

b) Given that RT=7cm and ST=9cm, calculate to three significant figures:

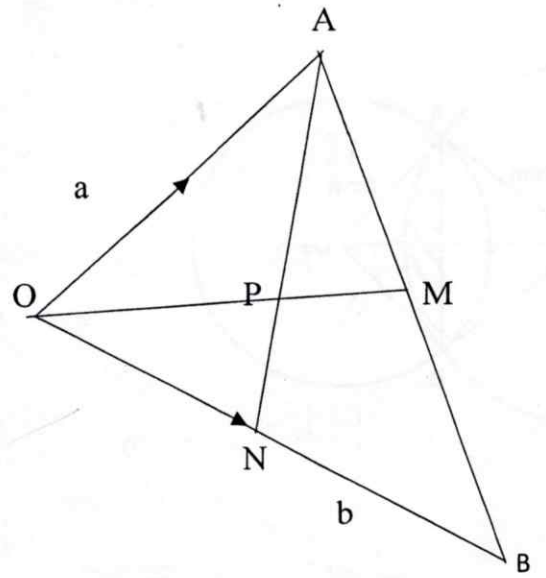
i. the length of line PR (2 marks)

4.57

ii. the radius of the circle. (3 marks)

2.98

22. In the triangle below **OA** = **a** and **OB** = b. M is the midpoint of AB and N is a point on OB such that ON = $\frac{1}{3}$OB. AN and OM intersect at P.



a) Express the following vectors in terms of **a** and **b**

(i) AB (1 mark)

$\underset{\sim}{b} - \underset{\sim}{a}$

(ii) OM (1 mark)

$\frac{1}{2}\underset{\sim}{a} + \frac{1}{2}\underset{\sim}{b}$

(iii) AN (2 marks)

$\frac{1}{3}\underset{\sim}{b} - \underset{\sim}{a}$

b) If OP = tOM and AP = sAN, express OP in two different ways hence find the value of t and s. (5 marks)

$\vec{OP} = t\vec{OM}$

$t(\frac{1}{2}\underset{\sim}{a} + \frac{1}{2}\underset{\sim}{b})$

$= \frac{1}{2}t\underset{\sim}{a} + \frac{1}{2}t\underset{\sim}{a}$.

$\vec{OP} = \underset{\sim}{a} + s(\frac{1}{3}\underset{\sim}{b} - \underset{\sim}{a})$

$= \underset{\sim}{a} + \frac{1}{3}s\underset{\sim}{b} - s\underset{\sim}{a}$.

$= \underset{\sim}{a} - s\underset{\sim}{a} + \frac{1}{3}s\underset{\sim}{b}$.

$= (1-s)\underset{\sim}{a} + \frac{1}{3}s\underset{\sim}{b}$,

$\frac{1}{2}t\underset{\sim}{a} = (1-s)\underset{\sim}{a}$

$\frac{1}{2}t = 1-s$ -- (i)

$\frac{1}{2}t = \frac{1}{3}s$ - (ii).

$t = \frac{2}{3}s$

$\frac{1}{2}(\frac{2}{3}s) = 1-s$

$s = \frac{6}{8} = \frac{3}{4}$

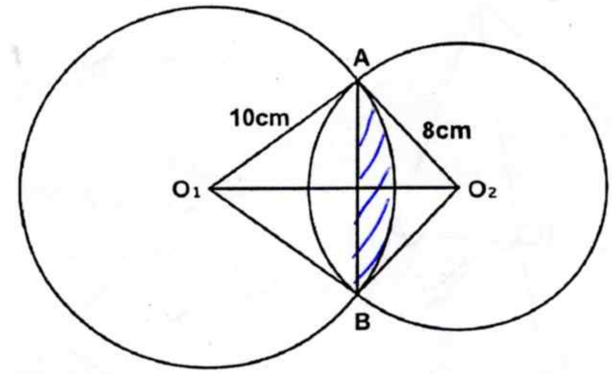
$t = \frac{2}{3} \times \frac{3}{4} = \frac{1}{2}$

c) State the ratio AN:NP (1 mark)

$AP = \frac{3}{4}AN$

$AP : PN = 3 : 1$

23. Two circles with centres O_1 and O_2 have radii 10cm and 8cm respectively and intersect at points A and B. Angle $AO_1B = 90°$ and angle $AO_2B = 124.23°$. Calculate to two decimal places;



a) The length AB (2 marks)

$\frac{AM}{10} = \sin 45^0$

$AM = 10 \sin 45^0$

$AB = 2(10 \sin 45^0)$

$AB = \underline{\underline{14.14 \text{ cm}}}$

b) The length O_1O_2 (2 marks)

$\frac{O_1M}{10} = \cos 45^0$

$O_1M = 10 \cos 45^0$

$= 7.072 \text{cm}$

$\frac{O_2M}{8} = \cos 62.115^0$

$O_2M = 8 \cos 62.115^0$

$= 3.742 \text{cm}$

$O_1O_2 = 7.072 + 3.742$

$= \underline{\underline{10.81 \text{ cm}}}$

c) Area of minor segment centre O_1 (3 marks)

$\frac{90}{360} \pi r^2 - \frac{1}{2} \times 10 \times 10$

$\frac{1}{4} \times 3.142 \times 100 - 50$

$78.55 - 50$

$= \underline{\underline{28.55 \text{ cm}}}$

d) Area of quadrilateral O_1AO_2B (3 marks)

$\frac{1}{2} \times 10 \times 10 \sin 90^0 + \frac{1}{2} \times 8 \times 8 \sin 124.23^0$

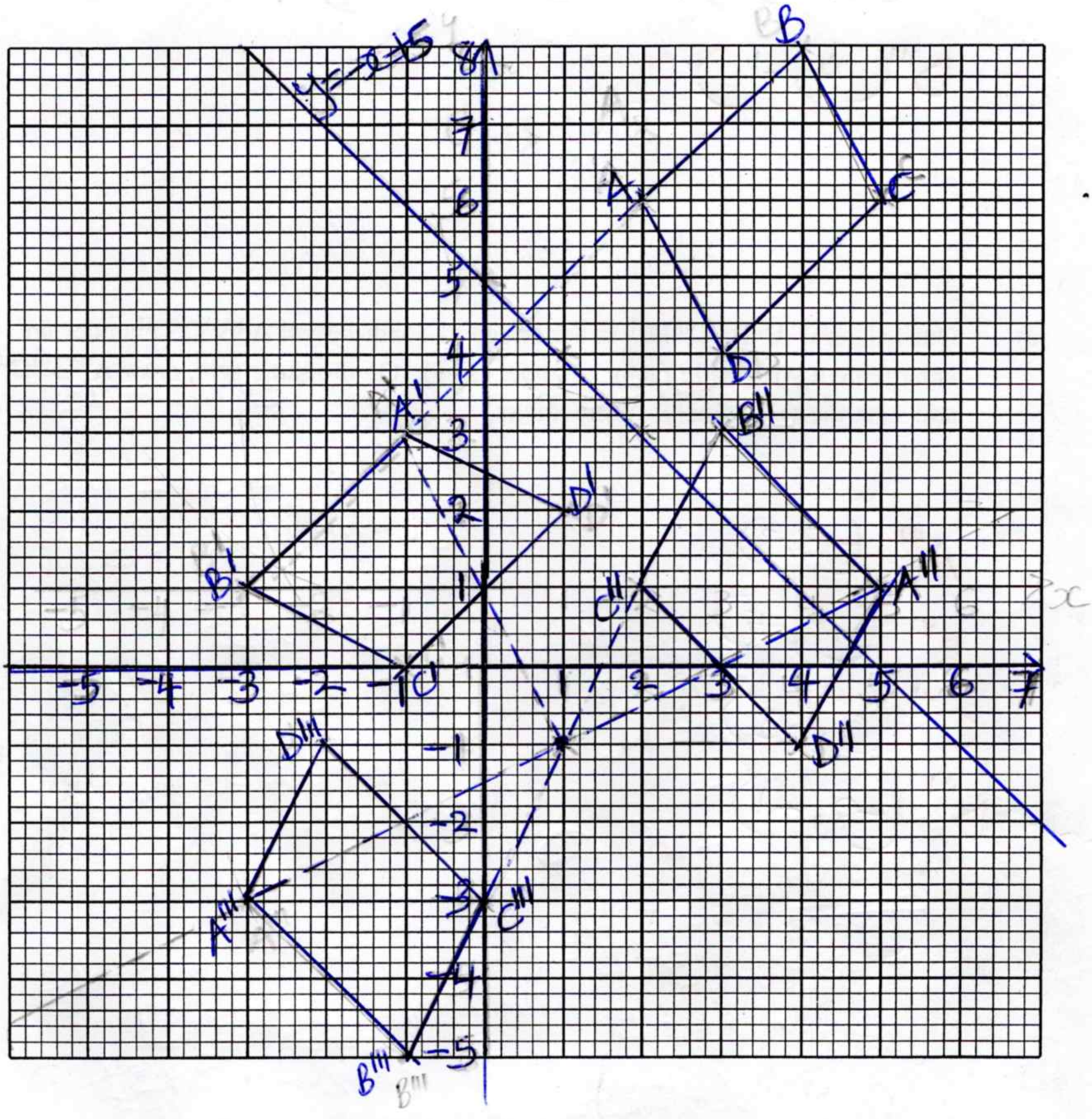
$50 + 32 \sin 124.23^0$

76.457

$\underline{\underline{76.46 \text{ cm}}}$

24. A quadrilateral ABCD with vertices A(2, 6), B(4, 8), C(5, 6) and D(3, 4) is mapped onto quadrilateral $A^I B^I C^I D^I$ by a reflection in the line y = -x+5.

a) On the grid provided draw the quadrilateral ABCD and its image $A^1 B^1 C^1 D^1$ under reflection in the line y= -x+5 (5 marks)



y = -x+5

x	0	2	1
y	5	3	4

y = -x+5

x	0	2	1
y	5	3	4

b) Quadrilateral $A^{II}B^{II}C^{II}D^{II}$ is the image of quadrilateral $A^{I}B^{I}C^{I}D^{I}$ under a ~~positive~~ negative quarter turn about (1, -1). On the same grid, draw quadrilateral $A^{II}B^{II}C^{II}D^{II}$ (3 marks) and state the co-ordinates of the image.

$A''(5,1)$, $B''(3,3)$, $C''(2,1)$

$D'''(4,-1)$

c) Quadrilateral $A^{III}B^{III}C^{III}D^{III}$ is the image of quadrilateral $A^{II}B^{II}C^{II}D^{II}$ under an enlargement with scale factor -1 about (1,-1). On the same grid, draw $A^{III}B^{III}C^{III}D^{III}$ and state the co-ordinates of the image. (2 marks)

$A'''(-3,-3)$

$B'''(-1,-5)$

$C'''(0,-3)$

$D'''(-2,-1)$