

NAIROBI SCHOOL

Opener Exam, Term 2

121

MATHEMATICS

Question Paper

July. 2022— 150 minutes

Form 4



FILL IN YOUR PERSONAL DETAILS HERE

Student Name:

Admission Number:

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Class:

4	
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Instructions to candidates

- (a) Write your name, admission number and class in the spaces provided above.
- (b) This paper consists of two sections; **Section I** and **Section II**.
- (c) Answer **all** the questions in **Section I** and **any five** questions from **Section II**.
- (d) **Show all the steps in your calculations, giving your answers at each stage in the spaces provided below each question.**
- (e) **KNEC Mathematical tables** may be used, except where stated otherwise.
- (f) **Non-programmable** silent electronic calculators **must not** be used, except where stated otherwise.
- (g) This paper consists of **16** printed pages.
- (h) Remember to tick the questions you have attempted in **Section II**

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 (Please tick the questions you have attempted)

17	18	19	20	21	22	23	24	TOTAL
								✓

GRAND TOTAL

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TURN OVER

SECTION ONE - 50 MARKS

Answer all questions from this section in the spaces provided.

1). Solve $2 \sin^2 \theta + 3 \cos \theta = -1$ for $0^\circ \leq \theta \leq 360^\circ$ (3 marks)

2). Given that $A = \sqrt[4]{\frac{d - c^2g}{b + c^2f}}$ make c the subject of the formula. (3 marks)

3). A sum of Ksh. 8000 was partly lent at 10% p.a simple interest and 12.5% p.a simple interest. The total interest after 2 years was Ksh. 1775. How much was lent at 10% simple interest? (3 marks)

4). Solve the following simultaneous equations

(4 marks)

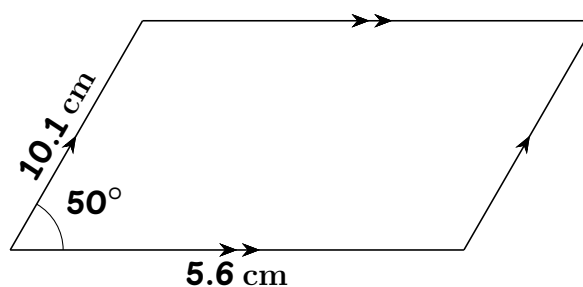
$$\log_3(3x + 4y) = 2$$

$$\log_2(2x + y) = 1$$

5). The position vectors for points **P** and **Q** are $6\mathbf{i} - 3\mathbf{j} + 9\mathbf{k}$ and $3\mathbf{i} - 6\mathbf{j} - 3\mathbf{k}$ respectively. **R** divides line **PQ** in the ratio **1 : 2**. Find the position vector of **R** and express it in terms of unit vector **i**, **j** and **k**.

(3 marks)

6). The parallelogram below has adjacent sides of lengths **5.6 cm** and **10.1 cm** respectively while the angle between them is **50°**.



Calculate the percentage error of finding its area.

(3 marks)

7). Simplify completely $\frac{9x^2 - 16x + 7}{162x^2 - 98}$ (3 marks)

8). Without using mathematical tables or a calculator, express $\sin 45^\circ$ in surd form. Hence simplify $\frac{\sqrt{8}}{1 + \sin 45^\circ}$ leaving your answer in surd form. (3 marks)

9). (a) Expand $\left(1 - \frac{1}{4}x\right)^5$ up to the 4th term. (2 marks)

(b) Use the expansion in part (a) above to find the approximate value of $(1.25)^5$. (2 marks)

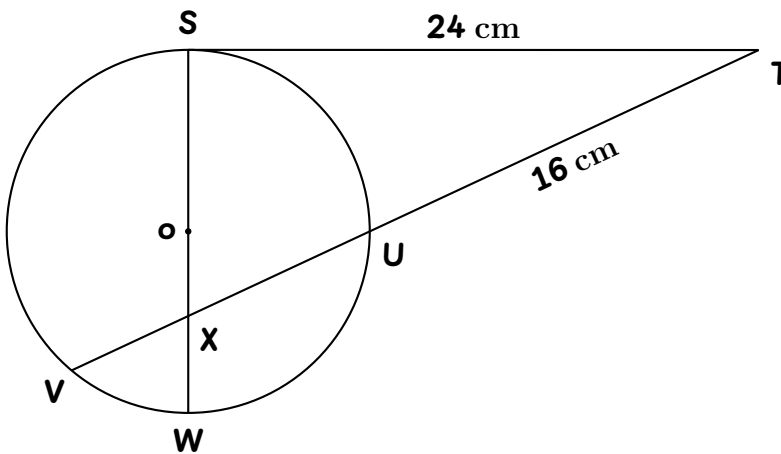
10). A bus travelling at an average speed of x km/h left a station at **8.15** a.m . A car, travelling at an average speed of **80** km/h left the same station at **9.00** a.m. and caught up with the bus at **10.45** a.m. Find the value of x . (3 marks)

11). The data below represents the ages in months at which **6** babies started walking; **9, 11, 12, 13, 11** and **10**. Without using a calculator, find the exact value of the variance of the data. (3 marks)

12). A triangle **PQR** has an area of **3.2** cm² .It's image under a transformation matrix $\begin{pmatrix} 4x^2 & 5 \\ -x & 1 \end{pmatrix}$ has an area of **19.2** cm² .Find the value of x (3 marks)

- 13). The scale of a map is given as **1 : 50,000**. Find the actual area in hectares of the region represented by a rectangle of sides **6 cm** by **7 cm**. **(3 marks)**

- 14). In the figure below, the tangent **ST** meets chord **VU** produced at **T**. chord **SW** passes through the centre **O** of the circle and intersects chord **VU** at **X**. line **ST = 24 cm** and **UT = 16 cm**.



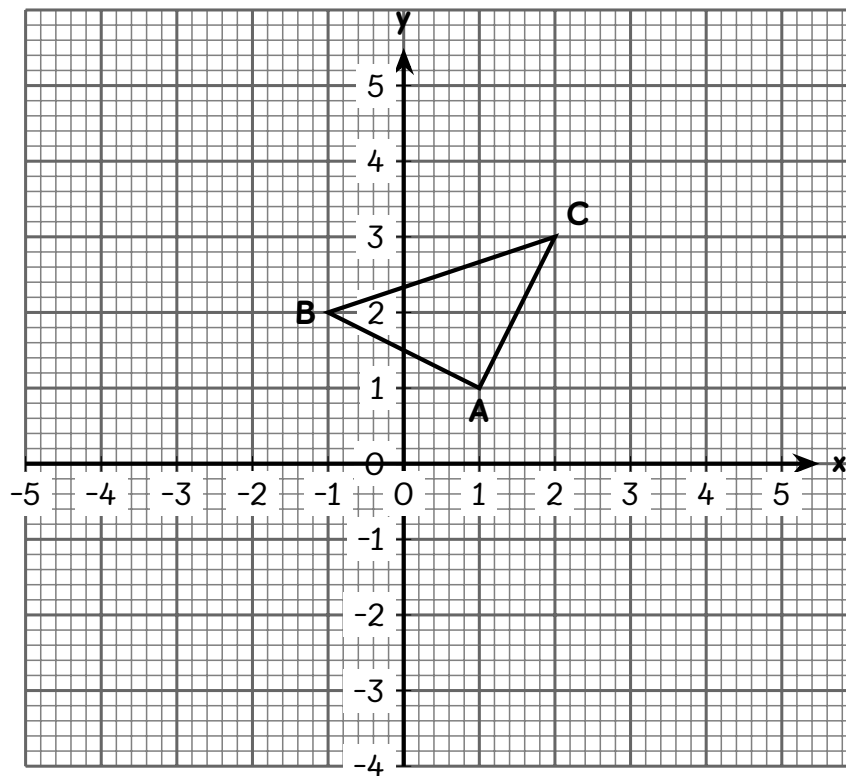
- (a) Calculate the length of chord **VU**. **(1 mark)**

- (b) If **WX = 6 cm** and **VX : XU = 2 : 3** find **SX** **(2 marks)**

15). Find the value of x in the following equation, $2^{2x-1} + 4^{x+1} = 36$

(3 marks)

16). Triangle ABC is shown on the coordinate plane below. Given that $A(1, 1)$ is mapped onto $A'(1, -1)$ by a shear with the y - axis invariant, draw triangle $A'B'C'$ the image of triangle ABC under the shear. (3 marks)



SECTION TWO – 50 Marks

Answer any **five** questions from this section in the spaces provided.

- 17).** (a) The probability that Nina goes to bed on time is $\frac{3}{4}$. If she goes to bed on time, the probability that she wakes up on time is $\frac{2}{3}$, otherwise the probability that she wakes up on time is $\frac{1}{4}$. If she wakes up late, her probability of getting to class on time is $\frac{1}{5}$ otherwise her probability of getting to class on time is $\frac{4}{5}$. Find the probability that:
- (i) She wakes up late. **(3 marks)**
- (ii) She gets to class on time **(3 marks)**
- (b) A die and a coin are cast simultaneously.
- (i) Draw a table to show all the possible outcomes **(2 marks)**
- (ii) What is the probability of a tail and a number less than 4 showing up. **(2 marks)**

18). (a) The first term of an arithmetic progression (AP) is **6**. The sum of the first **7** terms of the AP is **126**.

(i) Find the common difference of the AP **(2 marks)**

(ii) Find the **19th** term of the AP. **(1 mark)**

(b) The **2nd**, **3rd** and **11th** terms of an increasing arithmetic progression (AP) form the first **3** terms of a geometric progression (GP). The first term of the AP is **-2**.

(i) Find the common difference of the AP and the common ratio (r) of the GP. **(4 marks)**

(ii) Find the sum of the first **5** terms of the geometric progression (GP). **(3 marks)**

19). An aircraft leaves town **P**(30°S , 17°E) and flies due north to **Q**(60°N , 17°E). It then flies at an average speed of **300** knots for **8** hours due west to town **R**. Determine:

(a) The distance **PQ** in nautical miles. **(2 marks)**

(b) The position of town **R**. **(4 marks)**

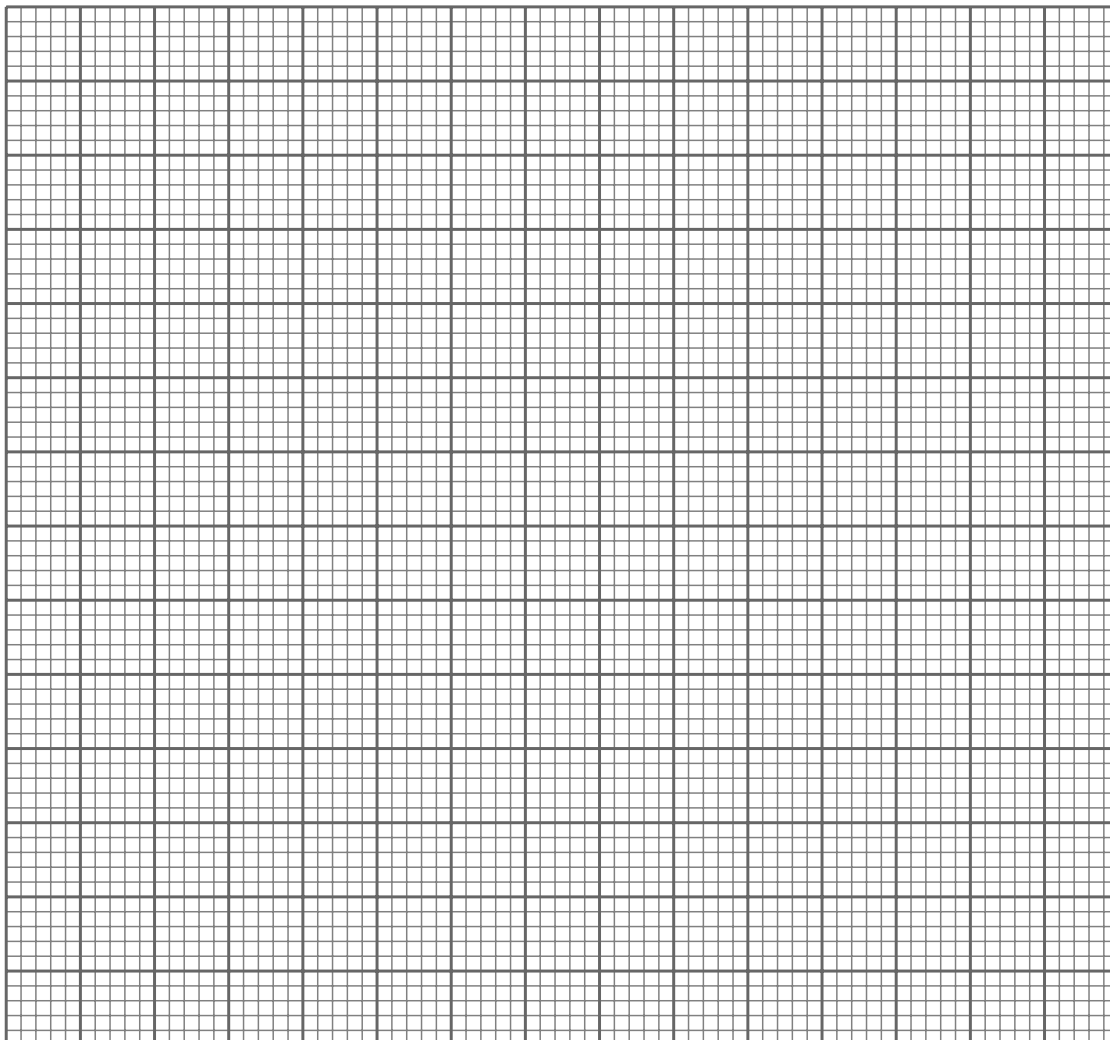
(c) The local time at **R** if the local time at **Q** is **3.12** pm. **(2 marks)**

(d) The distance travelled by the aircraft from **Q** to **R** to the nearest kilometre.
(**1 km = 0.539957** nm) **(2 marks)**

- 20). (a) Complete the table below, giving the values correct to 2 decimal places. (2 marks)

x	0°	30°	60°	90°	120°	150°	180°	210°	240°	270°	300°	330°	360°
$\sin 2x$	0		0.87		-0.87		0	0.87	0.87				0
$3 \cos x - 2$	1	0.60		-2	-3.5			-4.60			-0.5		1

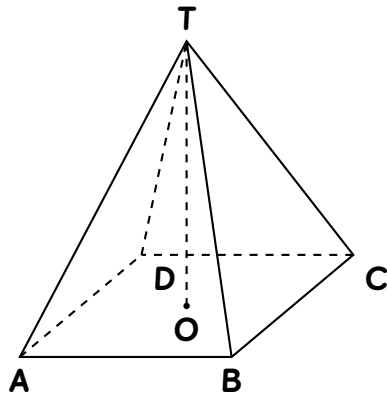
- (b) On the grid provided, draw the graphs of $y = \sin 2x$ and $y = 3 \cos x - 2$ for $0^\circ \leq x \leq 360^\circ$ on the same axes. Use a scale of 1 cm to represent 30° on the x-axis and 2 cm to represent 1 unit on the y-axis. (5 marks)



- (c) Use the graph in (b) above to solve the equation $3 \cos x - \sin 2x = 2$. (2 marks)

- (d) State the amplitude of $y = 3 \cos x - 2$. (1 mark)

- 21). The figure below is of a right pyramid on a rectangle base. $TC = TB = TA = TD = 17$ cm, and $TO = 15$ cm. AB is twice BC .



Calculate:

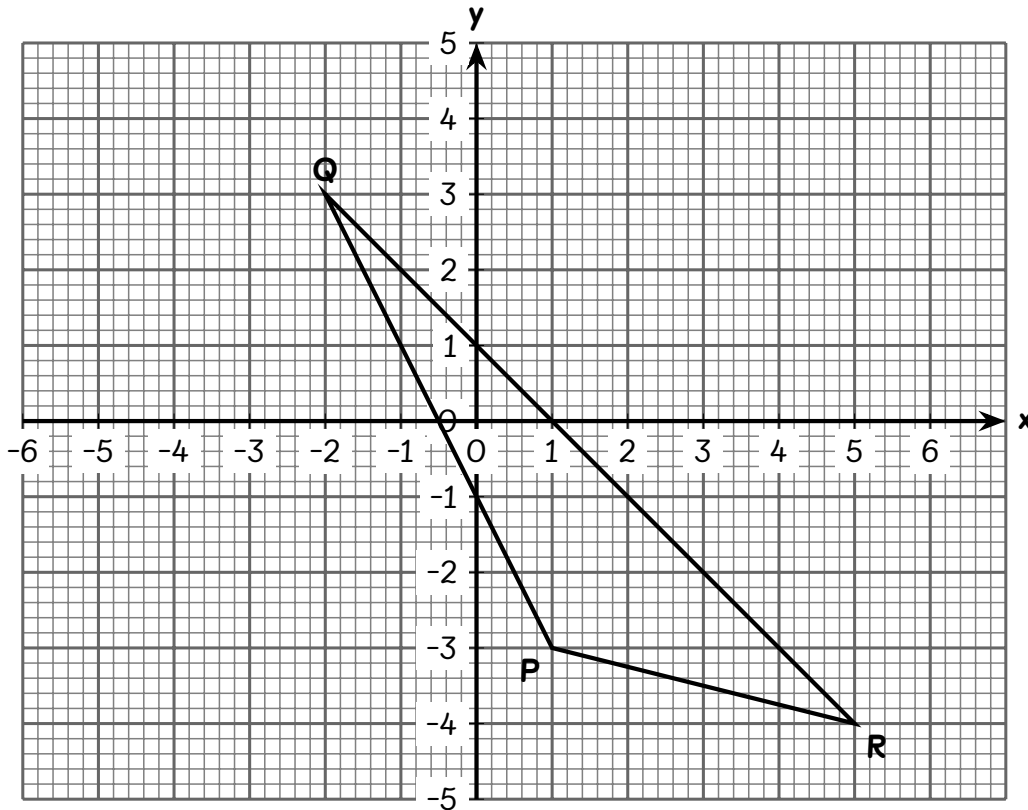
- (i) The length AB (4 marks)

- (ii) The angle between TC and plane $ABCD$ (2 marks)

- (iii) The angle between TD and plane TAC (2 marks)

- (iv) The angle between TAB and $ABCD$ (2 marks)

- 22). (a) Given that point $Q(-2, 3)$ is mapped onto $Q'(4, 3)$ by a shear with x – axis invariant,



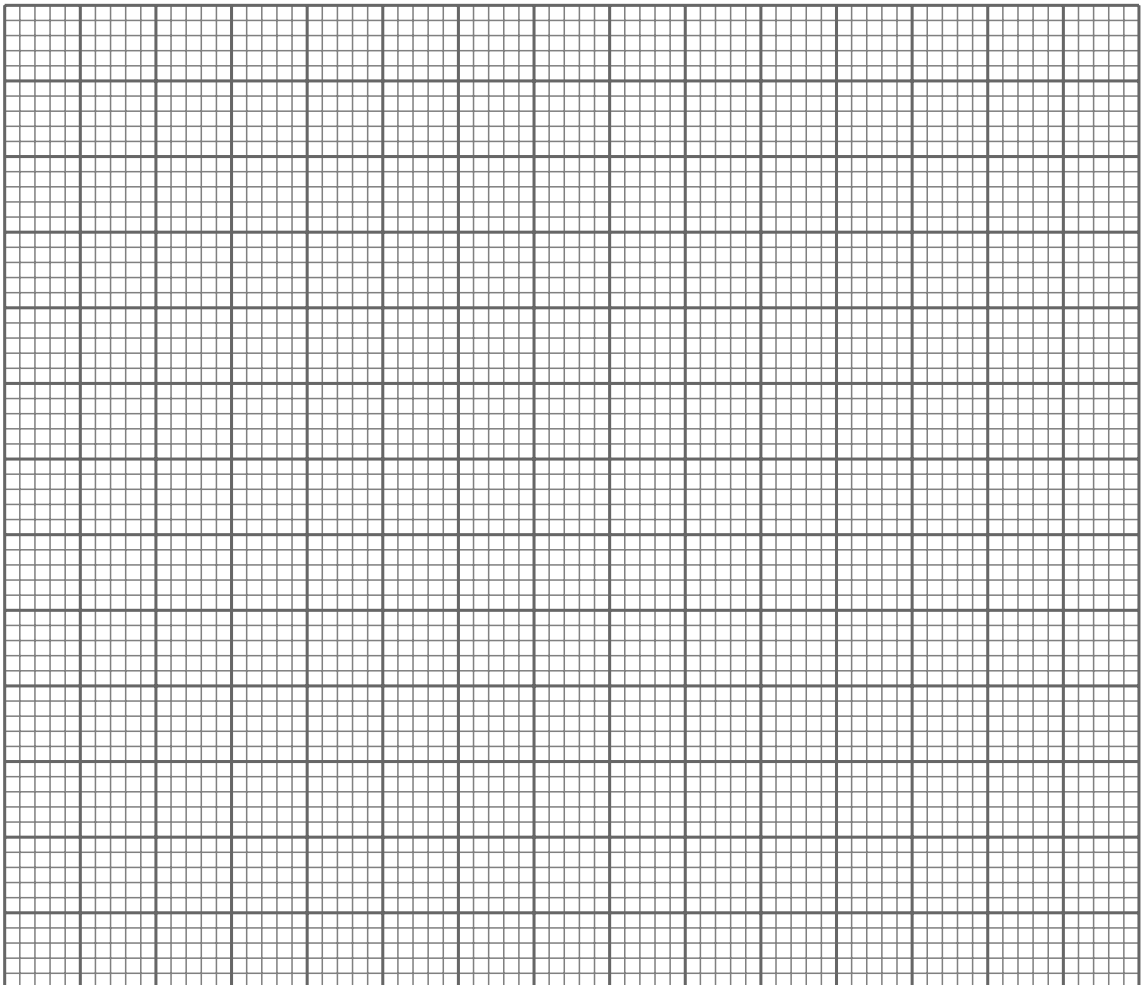
- (i) Draw triangle $P'Q'R'$, the image of PQR under the shear. (3 marks)
- (ii) Determine the matrix representing the shear. (2 marks)
- (b) Triangle $P'Q'R'$ is mapped onto triangle $P''Q''R''$ by a transformation defined by the matrix $\begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$
- (i) Draw triangle $P''Q''R''$ (3 marks)
- (ii) Find a combined matrix that maps PQR onto $P''Q''R''$ (2 marks)

23). The table below shows the masses in kg of **50** animals selected at random in a farm.

60	25	37	50	62	39	47	64	70	58
66	48	28	47	43	56	59	53	77	46
47	59	40	78	45	51	61	73	33	70
69	61	52	53	36	48	74	58	82	54
54	68	41	59	45	69	83	50	91	63

- (a) Starting with the mass of **25** and using equal class intervals of **10**, make a frequency distribution table for the data. **(2 marks)**

- (b) On the grid provided draw a cumulative frequency curve for the data. **(4 marks)**



(c) Use the graph in **(b)** above to determine:

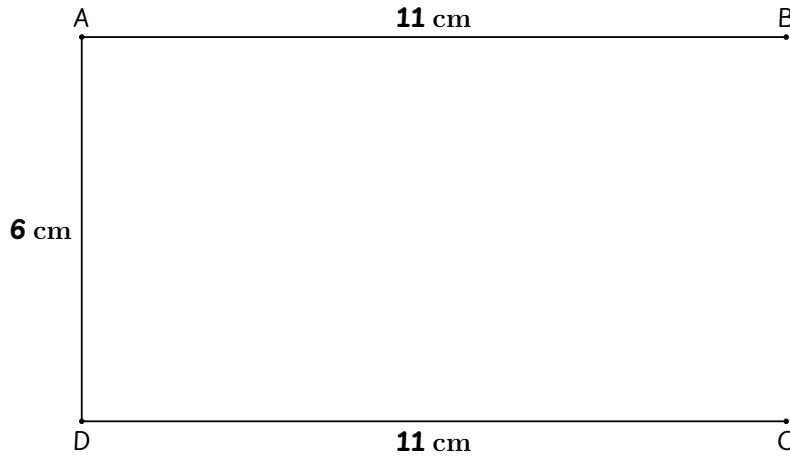
(i) The median mass.

(2 marks)

(ii) The quartile deviation.

(2 marks)

- 24). The diagram below is a scale drawing of a piece of land. Three boundaries **AB**, **AD** and **DC** of the land are given. The fourth boundary is not given but it is known that the area of the land is greater than that of rectangle **ABCD**.



Use a ruler and pair of compasses only in this question.

- (a) Construct the locus of all points equidistant from points **B** and **C**. (1 mark)
- (b) The locus of any point **P** lying on the fourth boundary is such that $\angle BPC = 45^\circ$.
Draw the fourth boundary. (4 marks)
- (c) Shade the region within the scale drawing in which a variable point **X** must lie giving that **X** satisfies the following conditions. (5 marks)
- (i) **X** is at least **1 cm** from each of the four boundaries
 - (ii) **X** is at least **6 cm** from **A**
 - (iii) Area of $\triangle AXD \geq 15 \text{ cm}^2$