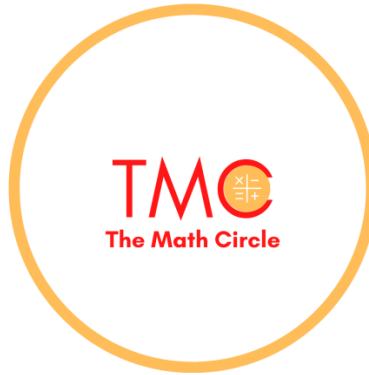


THE MATH CIRCLE



O-LEVEL

Paper 1

Locus

WorkSheet

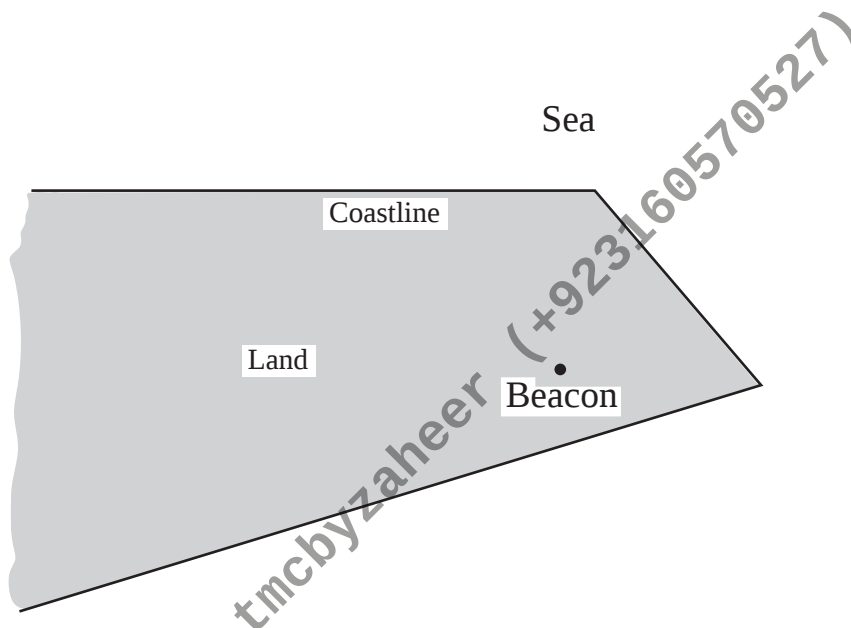
Compiled By: Mr. M. Zaheer ul Islam

Contact: +923160570527

- 1 The diagram in the answer space is a map showing a section of coastline and a beacon on land. Fishing boats can only operate when they are
- I not more than 6.5 km from the beacon,
 - II at least 2 km from the coastline.
- The scale of the map is 1 cm to 1 km.

Construct the boundaries of the region where fishing can take place.
Label this region *F*.

Answer



2 In triangle ABC , $AB = 15$ cm, $BC = 8$ cm and $AC = 11$ cm.

The side AB is drawn in the answer space.

- (a) Using ruler and compasses only, complete the triangle.
- (b) Measure the largest angle of the triangle.
- (c) Draw the locus of **all** points **within the triangle** that are
 - (i) 5 cm from C ,
 - (ii) equidistant from BA and BC .
- (d) The point P , within the triangle, is such that $PC = 5$ cm and P is equidistant from BA and BC .

Label the point P and measure the distance PA .

Answer (a) and (c)

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- 3 In triangle PLQ , $PL = 14$ cm, $PQ = 10$ cm and $LQ = 7$ cm.
The line PL is drawn in the answer space.

- (a) Using ruler and compasses only, complete triangle PLQ where Q is above PL .
- (b) Measure and write down $\hat{PQL}$.
- (c) Draw a semicircle with PL as diameter.
The line LQ produced meets the semicircle at M .
Measure and write down the length of QM .
- (d) (i) Explain why PM is perpendicular to LM .
(ii) Hence write down the value of $\cos \hat{PQL}$.

Answer (a)

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- 4 The diagram below is a scale drawing representing three coastguard stations, A , B and C .
In the drawing, 1 cm represents 20 km.

- (a) (i) Express the scale in the form 1 : n .
(ii) Find the distance between the coastguard stations A and B .

Answer (a)(i) 1 : [1]

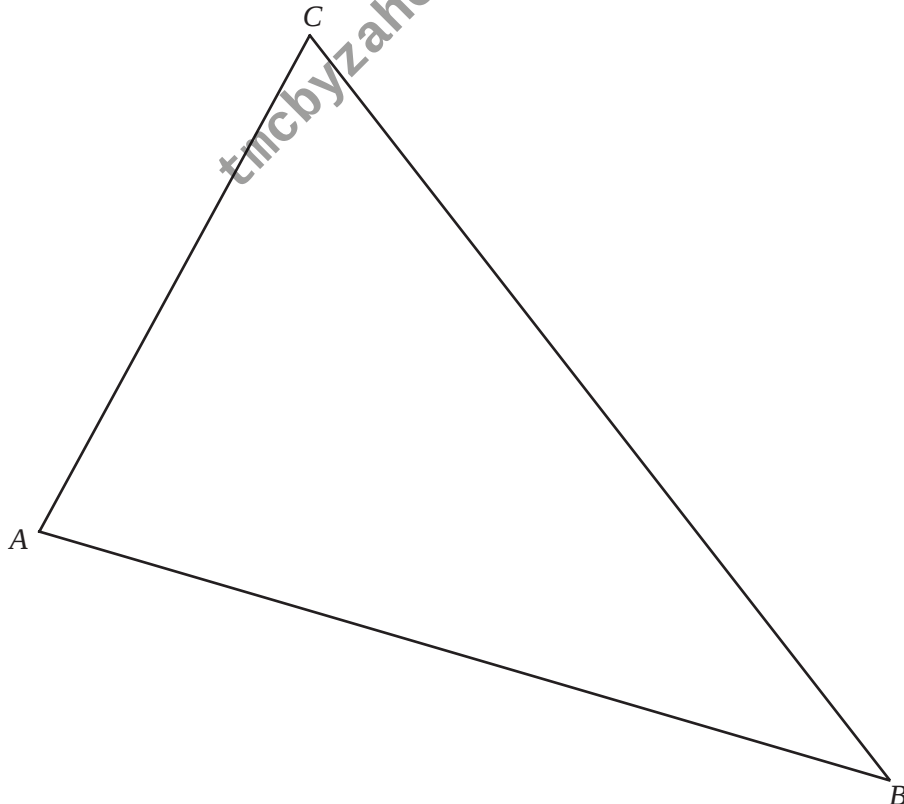
(ii)km [1]

- (b) It is known that a ship is

- I** equidistant from CA and CB ,
- II** nearer to C than A ,
- III** less than 200 km from B .

By constructing 3 loci corresponding to **I**, **II** and **III**, find the possible positions of the ship and label the extreme positions S and P .

Answer (b)



[4]

- 5 A map is drawn using a scale of 1 cm to 5 m.

The position of A is shown in the answer space below.

- (a) The point B is 70 m due East of A .
Draw the line representing AB .
- (b) The point C is North of AB and equidistant from A and B .

Angle $BAC = 40^\circ$.

- (i) By drawing appropriate lines, find and label the point C .
- (ii) Find the actual distance AC .
- (iii) State the size of the reflex angle BAC .

Answer (a) and (b)(i)



[3]

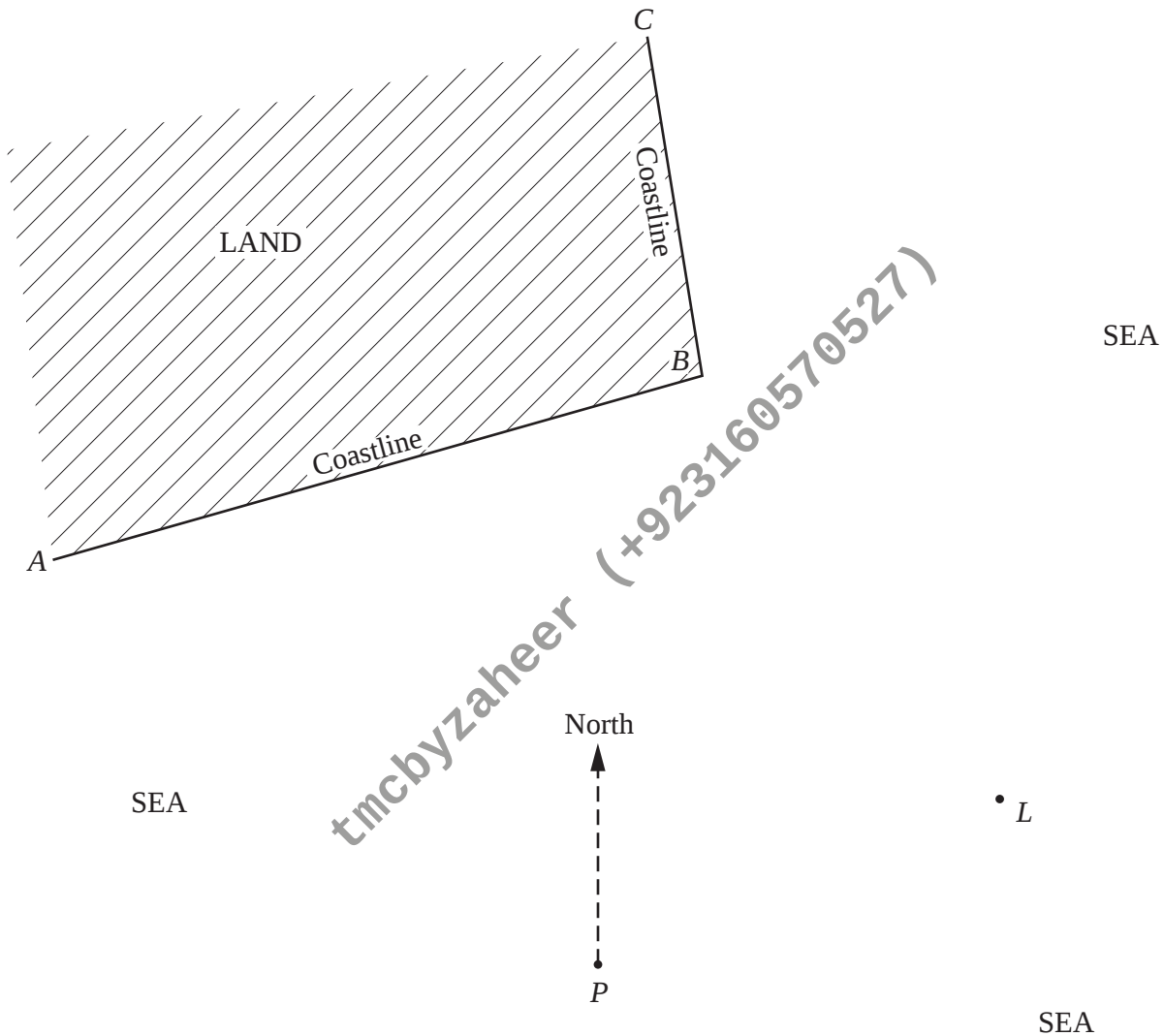
Answer (b)(ii) m [1]

(iii) reflex $\hat{BAC} = \dots\dots\dots$ [1]

- 6 The diagram below is a map showing a coastline ABC , a lighthouse L and a point P .
The map is drawn to a scale of 1 cm to 100 m.
Ships must not sail within 200 m of the coastline nor within 200 m of the lighthouse.

- (a) Construct the locus of points 200 m from the lighthouse L .
(b) Construct the locus of points 200 m from the coastline ABC .

Answer (a) (b)



SEA

SEA

$\bullet$ L

SEA

[3]

- (c) A ship sailed from the point P on a bearing of θ° .
It passed between B and L .
Complete the statement in the answer space.

Answer (c) $< \theta < \dots\dots\dots$ [2]

7 The plan of a field has a scale of 1 cm to 5 metres.

- (a) Express this scale in the form 1 : n .

Answer (a)[1]

- (b) The plan was made by measuring angles from two points, A and B , 50 m apart.
The line AB is drawn to scale in the answer space below.

- (i) A tree is at the point T in the field.
 $\hat{BAT} = 35^\circ$ and $\hat{ABT} = 70^\circ$.

Locate and label T on the plan.

- (ii) Given that A is due west of B , state the bearing of T from B .

- (iii) By making an appropriate measurement, find the actual distance, in metres, of the tree from B .

Answer (b)(i)



A



B

[1]

Answer (b)(ii) [1]

(iii) m [1]

8 The diagram at the bottom of the page shows a triangle ABC .

- (a) By measuring an angle, find reflex angle ACB .

Answer (a)[1]

- (b) The point D is on the opposite side of AC to B .

$AD = 6$ cm and $CD = 9$ cm.

Construct triangle ACD .

- (c) On the diagram, construct the locus of points, **inside** the quadrilateral $ABCD$, which are

I equidistant from A and C ,

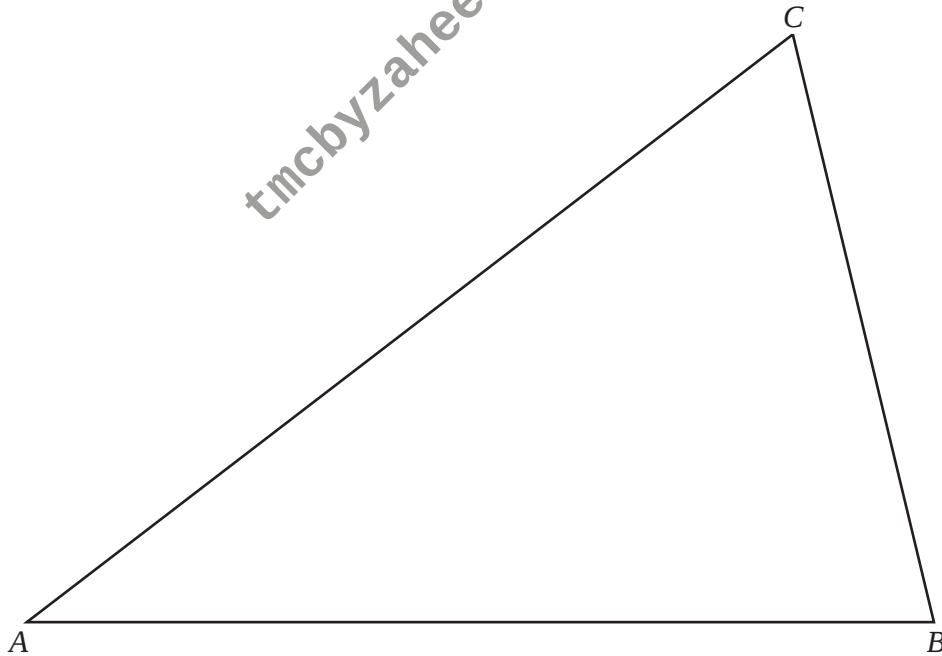
II 5 cm from the line AB .

- (d) The point P is inside quadrilateral $ABCD$,
equidistant from A and C ,
5 cm from the line AB .

(i) Mark and label the position of P .

(ii) Measure CP .

Answer (b)(c)(d)(i)



[3]

Answer (d)(ii) $CP =$ cm [1]

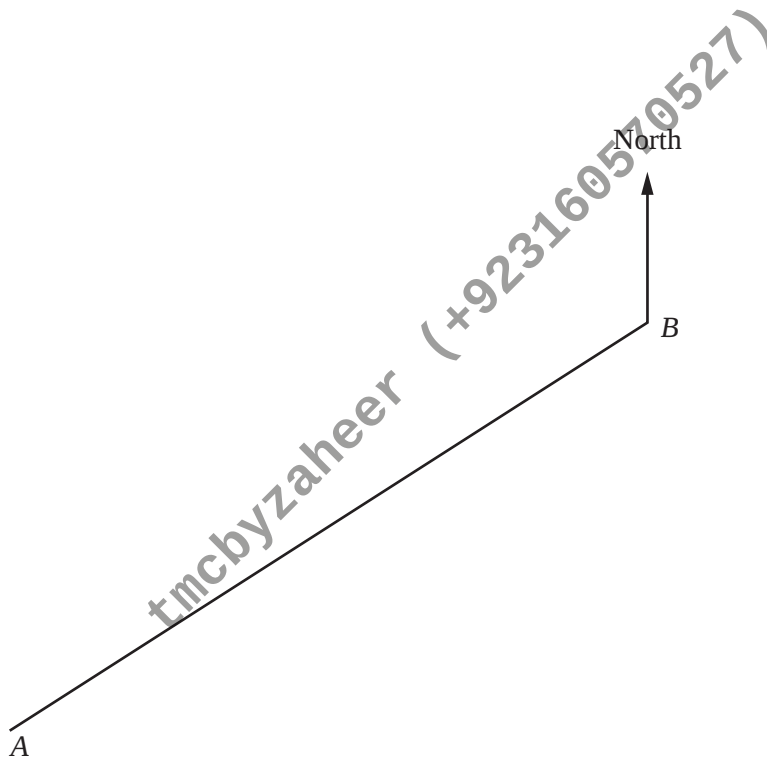
- 9 A map is drawn to a scale of 1 cm to 3 km.
The diagram below shows the positions of two villages A and B on the map.

- (a) (i) Write the scale in the form 1 : n .
(ii) Find the actual distance, in kilometres, between the villages A and B.

Answer (a)(i) 1 :[1]

(ii) km [1]

Answer (b), (c), (d)



[4]

- (b) A third village, C, lies north of the line AB.
It is 21 km from A and 18 km from B.
Using ruler and compasses only, construct triangle ABC.
- (c) Construct the perpendicular bisector of AB.
- (d) A petrol station is to be built so that it is equidistant from A and B and 9 km from C.
Mark with letters F and G the two possible positions of the petrol station.
-

- 10** A family wants to move to a new house.
 The area where they are going to look depends on the positions of the children's school, S , the father's place of work, F , and the market, M .
 The diagram in the answer space is drawn to a scale of 1 cm to 1 km.
 It shows the positions of S , F and M .

The house needs to be:

- I within 4 km of the children's school,
- II nearer to the market than to the father's place of work.

- (a) Use I and II to construct the appropriate loci.
- (b) Shade the region of your diagram that represents the possible positions of the house.
- (c) Find the greatest possible distance between the house and the market.

Answer (a) (b)

Scale 1 cm to 1 km

M •

• F

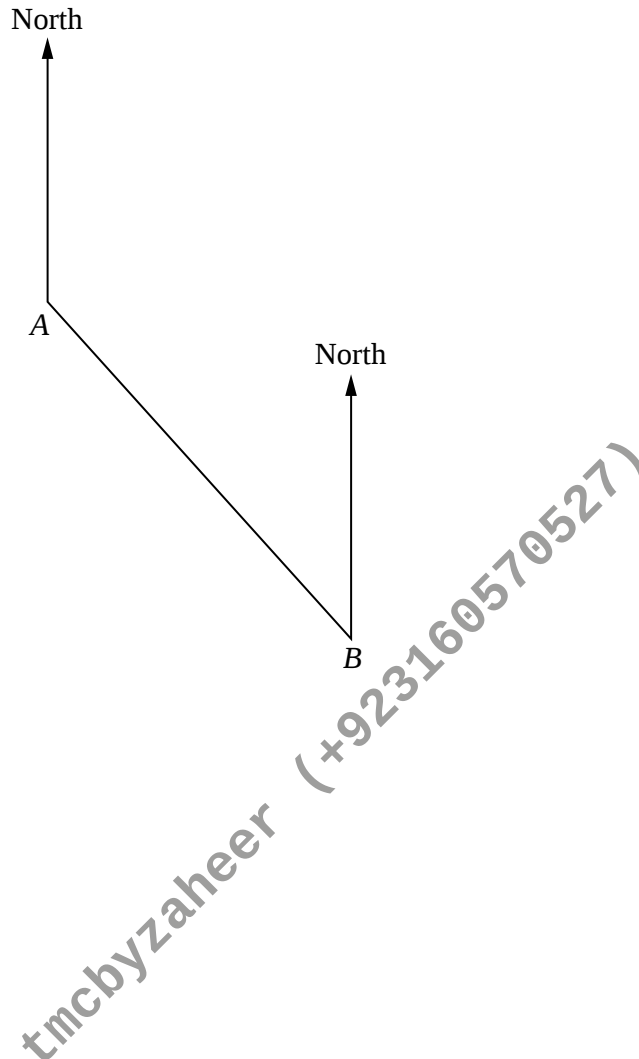
• S

[3]

Answer (c) km [1]

- 11** A sailing club has five moorings in the river at A , B , C , D and E .
 A and B are 12 metres apart.
 The positions of A and B are shown in the scale drawing below.

Answer (b), (c), (d)



- (a) Write the scale in the form $1 : n$.

Answer (a) $1 : \dots\dots\dots$ [1]

- (b) C is due west of B and on a bearing of 210° from A .

Find and label the position of C . [2]

- (c) D lies north of the line AB .
 The triangle ABD is equilateral.

Using ruler and compasses only, construct triangle ABD .
 Show your construction arcs clearly. [1]

- (d) The bearing of E from A is the same as the bearing of B from A .

Given that $AB : AE = 3 : 5$, find and label the position of E . [2]

- 12** The scale drawing below shows the positions of two towns, F and G .
It is drawn to a scale of 1 cm to 3 km.

Answer (b)



(a) Find

- (i)** the distance, in kilometres, between towns F and G ,

Answer (a)(i) km [1]

- (ii)** the bearing of G from F .

Answer (a)(ii) [1]

- (b)** Town H is to the North of the line FG .
It is 19.5 km from F and 15 km from G .
On the diagram above, find and label the position of H .

[1]

- 13** A map is drawn to a scale of 1 cm to 5 km.
The diagram below shows the positions of two radio masts *A* and *B* on the map.

Answer (a), (b)



- (a)** A third radio mast, *C*, is north of the line *AB*.
It is 40 km from *A* and 50 km from *B*.

Using ruler and compasses, construct triangle *ABC*.

[2]

- (b)** A house *D*, inside the triangle, is more than 35 km from *B* and closer to *B* than to *A*.

Shade the region on your diagram that represents the possible positions of the house *D*.

[3]

14 The diagram below shows triangle ABC .

(a) Measure $\hat{ABC}$.

Answer (a) $\hat{ABC} = \dots\dots\dots$ [1]

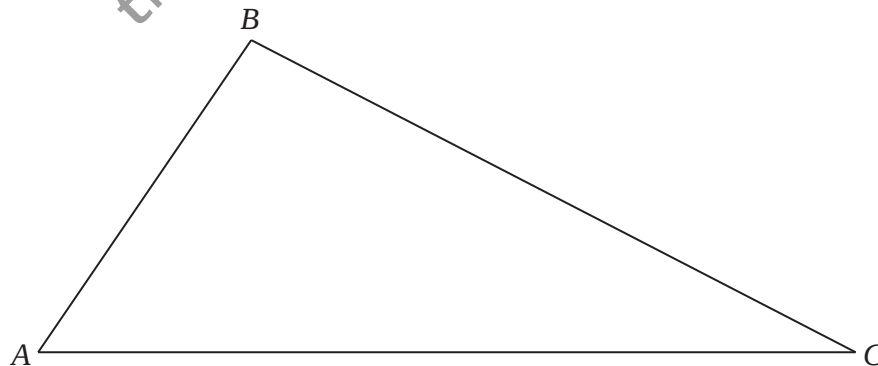
(b) On the diagram, construct the locus of points inside the triangle that are

(i) 8 cm from C , [1]

(ii) equidistant from AB and AC . [1]

(c) On the diagram, shade the region inside the triangle containing the points that are more than 8 cm from C and nearer to AB than to AC . [1]

Answer (b),(c)



- 15 (a) Construct, using ruler and compasses only, triangle ABC with sides $AB = 9\text{ cm}$, $BC = 8\text{ cm}$ and $AC = 6\text{ cm}$.
The line AB has been drawn for you.



[2]

- (b) Construct the locus of points, inside the triangle ABC , which are

(i) equidistant from AB and BC , [1]

(ii) 4 cm from A . [1]

- (c) Shade the region, inside triangle ABC , containing the points that are nearer to BC than AB **and** more than 4 cm from A . [1]
-

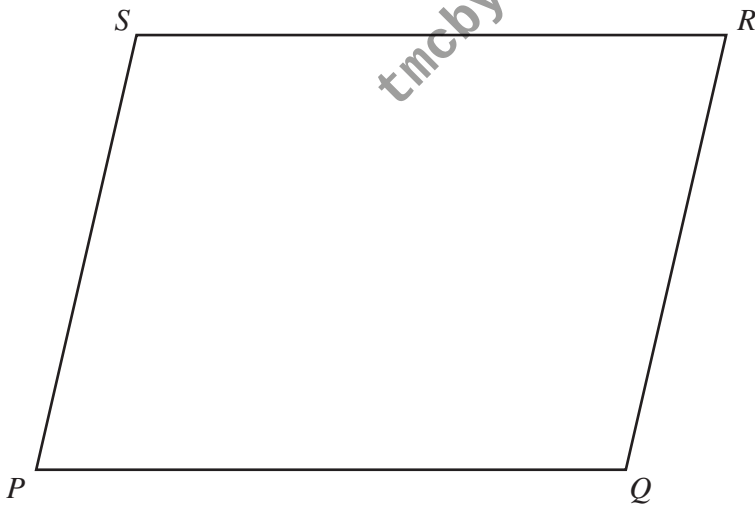
16 The diagram below shows the quadrilateral $PQRS$.

(a) On the diagram, construct

(i) the bisector of $\angle P$, [1]

(ii) the perpendicular bisector of QR . [1]

(b) On the diagram, shade the region inside the quadrilateral containing the points that are closer to PQ than to PS and nearer to Q than to R . [1]



17 The diagram below shows quadrilateral $ABCD$.

(a) Measure $\hat{ABC}$.

Answer $\hat{ABC} = \dots\dots\dots$ [1]

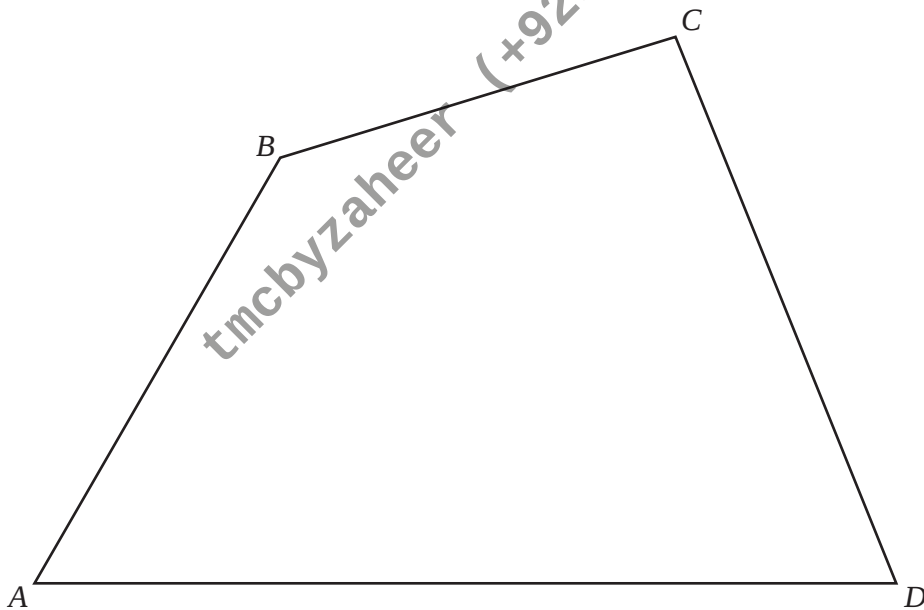
(b) On the diagram, construct the locus of points, **inside** the quadrilateral, that are

I 4 cm from AD ,

II equidistant from A and D . [2]

(c) On the diagram, shade the region **inside** the quadrilateral, containing the points that are more than 4 cm from AD and nearer to D than to A . [1]

(d) The point P is 4 cm from AD and as near as possible to C . Mark, and label, the position of P on the diagram. [1]



18 The diagram below shows triangle ABC .



- (a) The point D is on the opposite side of AC to B .
 $AD = 6\text{ cm}$ and $CD = 8\text{ cm}$.

Construct triangle ADC .

[1]

- (b) On the diagram, construct the locus of points **inside** the quadrilateral $ABCD$ that are

(i) 2.5 cm from AC ,

[1]

(ii) equidistant from AB and BC .

[1]

- (c) The points P and Q are 2.5 cm from AC and equidistant from AB and BC .

Mark and label P and Q .

Measure PQ .

Answer $PQ = \dots\dots\dots\text{ cm}$ [1]

19 The diagram at the bottom of the page shows the lines AB and BC .

(a) By measuring an angle, find reflex angle ABC .

Answer [1]

(b) The point D is on the opposite side of AC to B .
 $CD = CB$ and $AD = 10$ cm.

On the diagram, construct quadrilateral $ABCD$. [1]

(c) On the diagram, construct the locus of points, **inside** the quadrilateral $ABCD$, that are

(i) equidistant from A and B , [1]

(ii) equidistant from BC and BA . [1]

(d) On the diagram, shade the region **inside** the quadrilateral $ABCD$ containing the points that are

nearer to A than to B and
 nearer to BC than to BA .

[1]



20 The diagram at the bottom of the page shows the lines AB and BC .

(a) Measure $\hat{ABC}$.

Answer [1]

(b) The point D is above AB .

AD and CD are each equal to AB .

On the diagram, construct quadrilateral $ABCD$.

[1]

(c) On the diagram, construct the locus of points, **inside** the quadrilateral $ABCD$, that are

(i) 7 cm from C ,

[1]

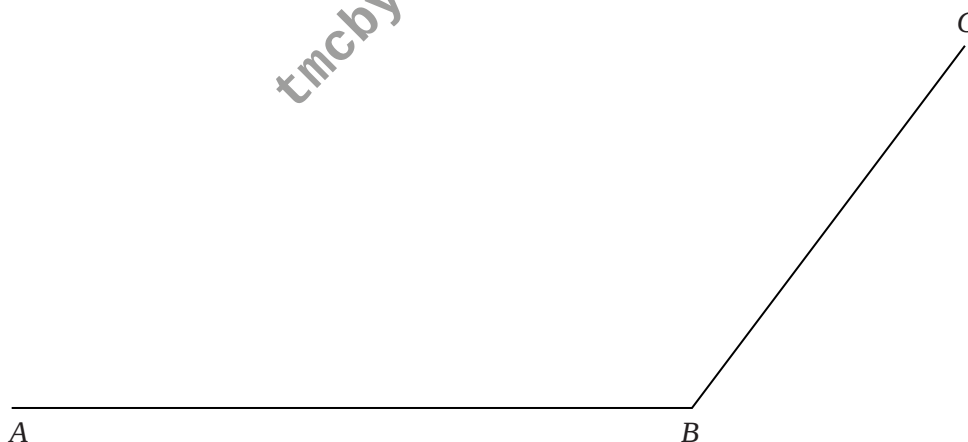
(ii) equidistant from AB and BC .

[1]

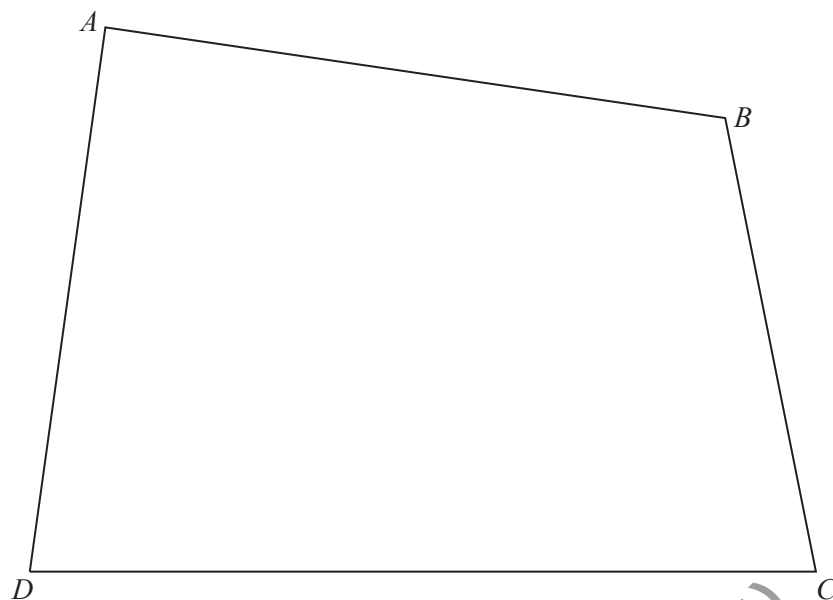
(d) These two loci meet at the point P .

Label the point P on the diagram and measure DP .

Answer $DP =$ cm [1]



21



- (a) Construct the locus of all points, **inside** the quadrilateral $ABCD$, which are
- (i) equidistant from DA and DC , [1]
 - (ii) 5 cm from B . [1]
- (b) On the diagram, shade the region **inside** the quadrilateral containing the points that are nearer to DA than DC **and** more than 5 cm from B . [1]
-

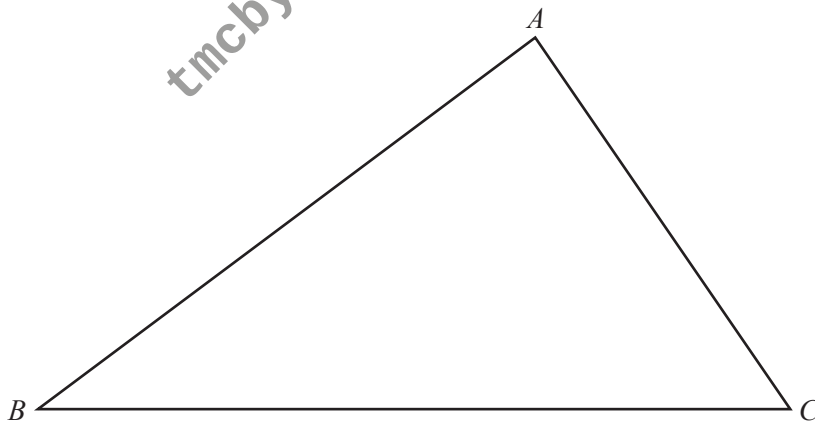
22 The diagram below shows triangle ABC .

- (a) Construct the perpendicular bisector of AB .

[1]

- (b) Shade the region inside the triangle containing points that are closer to A than to B and **more than** 6 cm from C .

[2]



23 The diagram at the bottom of the page shows triangle ABC .

(a) Measure $\hat{BAC}$.

Answer [1]

(b) On the diagram, construct the locus of points, **inside** the triangle ABC , that are

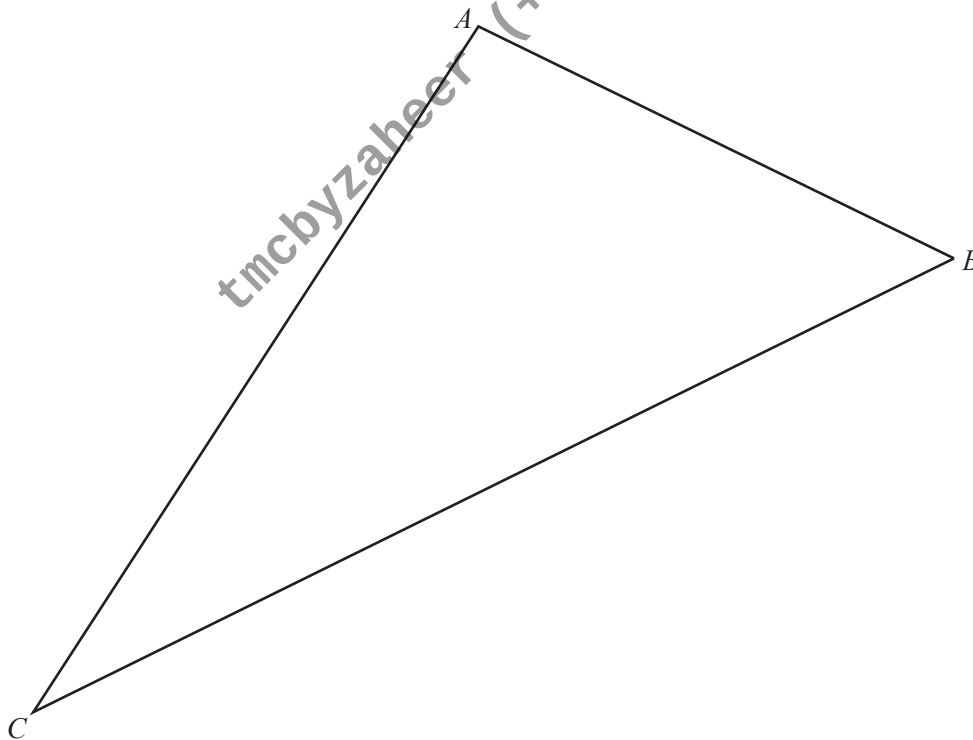
(i) equidistant from A and B , [1]

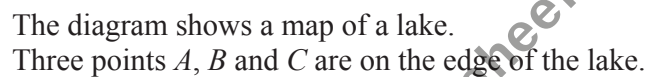
(ii) equidistant from AB and BC . [1]

(c) These two loci meet at the point P .

Label the point P on the diagram and measure CP .

Answer $CP =$ cm [1]





- Write down the bearing of B from A .

(b) A yacht sails from A to C .

Measure and write down the bearing of C from A .

(c) A cruiser sails from C to D on a bearing of 105° .

Work out the bearing of C from D .

Answer [1]

- 25 (a) Construct, using ruler and compasses only, an equilateral triangle ABC .
The side AB has been drawn for you.



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- [1]
- (b) Construct the locus of points, inside triangle ABC , which are
- (i) equidistant from A and C , [1]
 - (ii) 4 cm from A . [1]
- (c) A point X lies within triangle ABC , is nearer to A than to C and is less than 4 cm from A .
On your diagram shade the region in which X must lie. [1]
-

- 26 (a) Draw triangle ABC with $AB = 8$ cm, $AC = 7$ cm and $\angle C \hat{A} B = 130^\circ$.
 AB has been drawn for you.



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[2]

- (b) By making suitable measurements, find the area of triangle ABC .

Answer cm^2 [2]

- 27 The diagram shows the positions, on a map, of three boats A , B and C .
The map has a scale of 1 cm to 1 km.

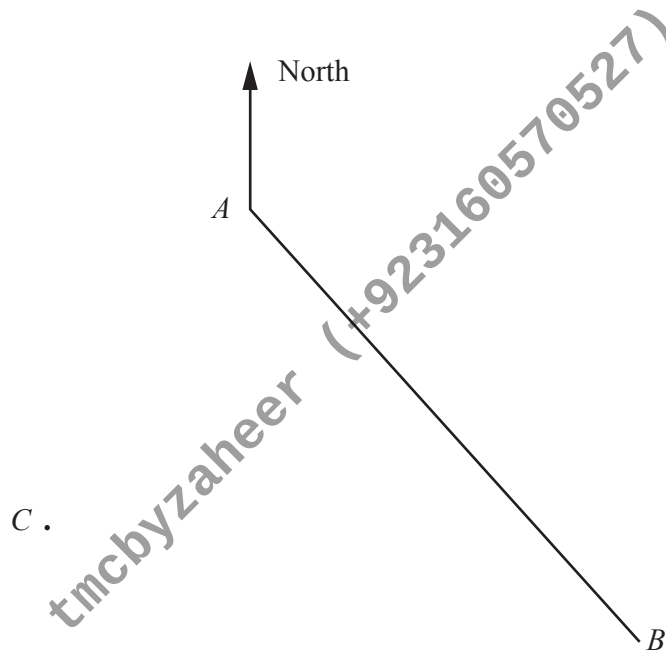
(a) Find the bearing of B from A .

Answer [1]

(b) A fourth boat, D , is

- closer to B than to A ,
- less than 4 km from C .

By drawing appropriate loci find, and shade, the region in which D is situated. [3]



28 The diagram shows the lines AB and BC .

- (a) The point D is 11 cm from A and 9 cm from C .

On the diagram, construct the quadrilateral $ABCD$. [1]

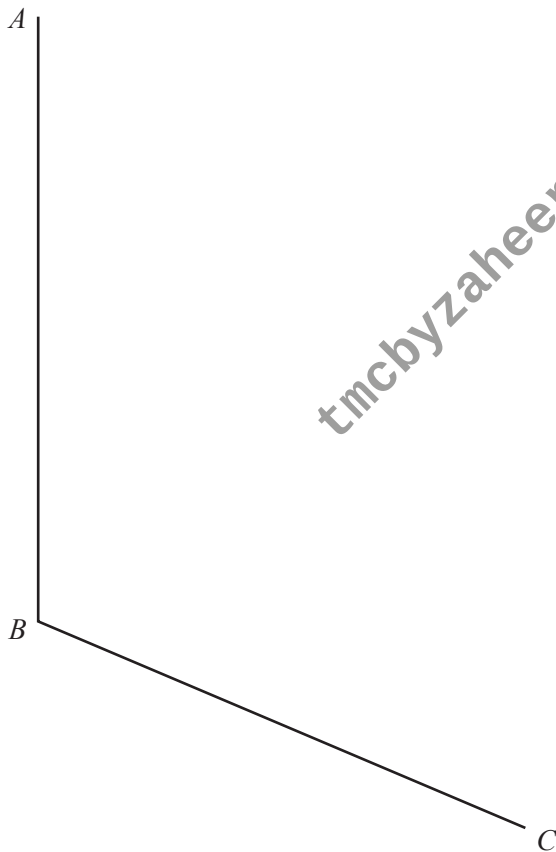
- (b) On the diagram, construct the locus of points, **inside** quadrilateral $ABCD$, that are

(i) equidistant from B and C , [1]

(ii) equidistant from AB and BC . [1]

- (c) These two loci meet at the point P .

Label the point P on the diagram and measure DP .



Answer $DP = \dots\dots\dots$ cm [1]

29 In triangle ABC , $AB = 5\text{ cm}$ and $AC = 6\text{ cm}$.

- (a) Construct triangle ABC .
Line BC is drawn for you.

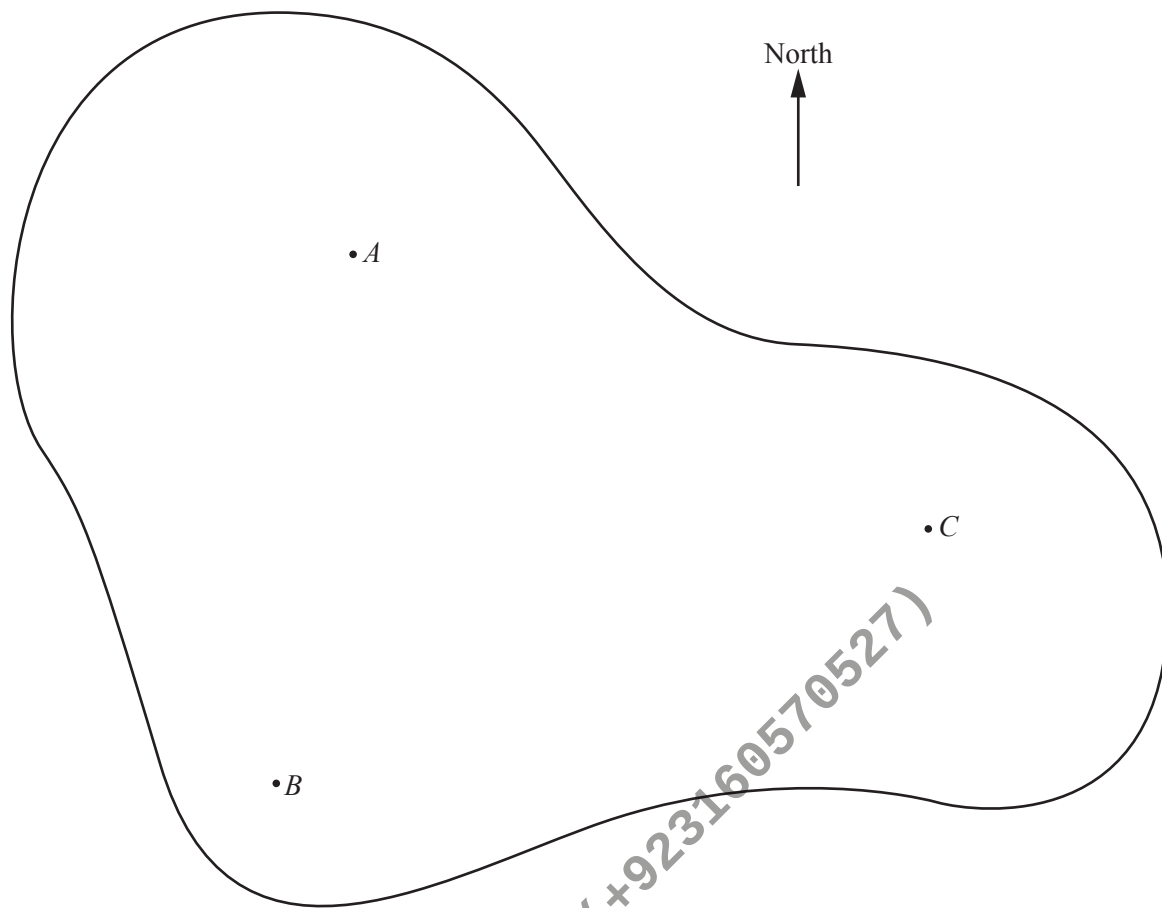
B ————— C

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[2]

- (b) Measure $\hat{BAC}$ in your triangle.

Answer [1]



The land region shown has wheat storage depots at A , B and C .

- (a) Given that the bearing of C from A is 115° , find the bearing of A from C .

Answer [1]

- (b) Local farmers take their wheat to the nearest depot.

By drawing suitable accurate constructions, find and shade the region which is served by the depot at B .

[2]

- 31** The diagram shows the positions of three ships A , B and C .
It is drawn to a scale of 1 cm to 20 km.

(a) Find, by measurement, the bearing of C from A .

Answer [1]

(b) On the diagram construct the locus of points, inside triangle ABC , that are

(i) equidistant from B and C , [1]

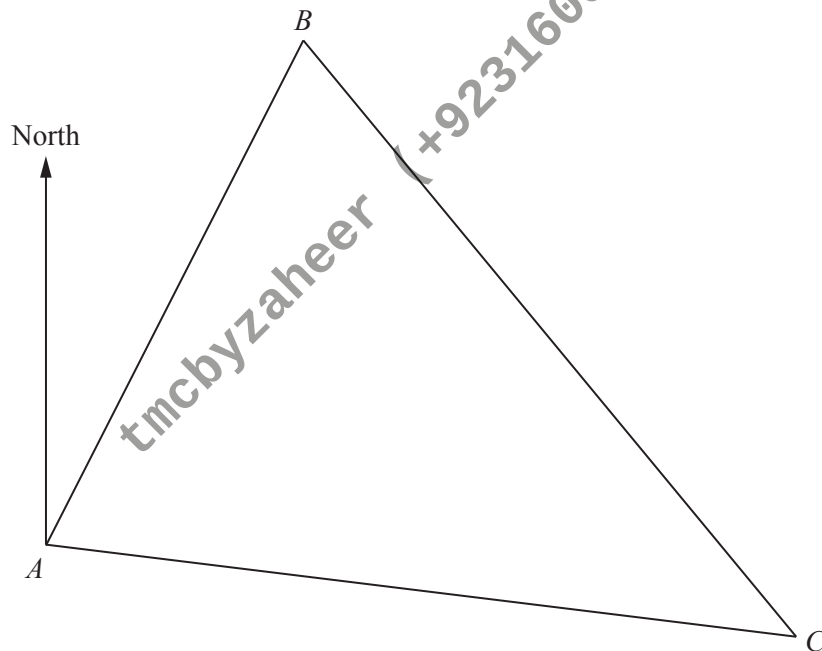
(ii) equidistant from AB and BC . [1]

(c) A ship D is

- equidistant from B and C ,
- and
- equidistant from AB and BC .

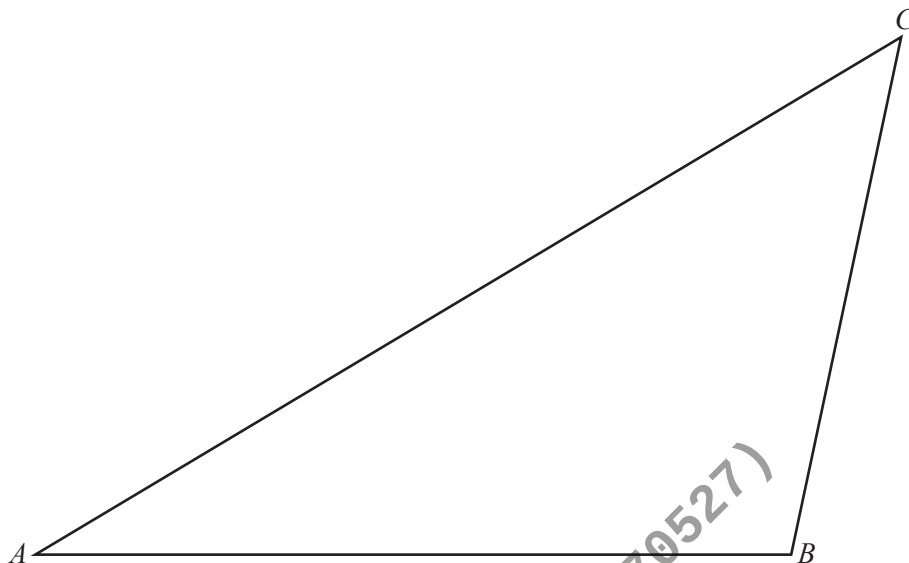
Label the position of D on the diagram and find the actual distance of D from A .

Scale: 1 cm to 20 km



Answer $DA =$ km [1]

32 The diagram shows triangle ABC .



(a) Measure $\hat{ABC}$.

Answer $\hat{ABC} = \dots\dots\dots$ [1]

(b) On the diagram, construct the locus of points, **inside** triangle ABC , that are

(i) 4 cm from B , [1]

(ii) 2 cm from AC . [1]

(c) The point P is
 4 cm from B ,
 2 cm from AC ,
and nearer to A than to C .

Label the position of P on the diagram and find the length of AP .

Answer $AP = \dots\dots\dots$ cm [1]

- (a) On the diagram construct the locus of points inside the triangle that are
- (i) 3.5 cm from A , [1]
- (ii) equidistant from AC and BC . [1]
- (b) On the diagram, shade the region inside the triangle containing the points that are more than 3.5 cm from A **and** closer to AC than to BC . [1]

34 The diagram shows the quadrilateral $ABCD$.

(a) Measure $\hat{DCB}$.

Answer $\hat{DCB} = \dots\dots\dots$ [1]

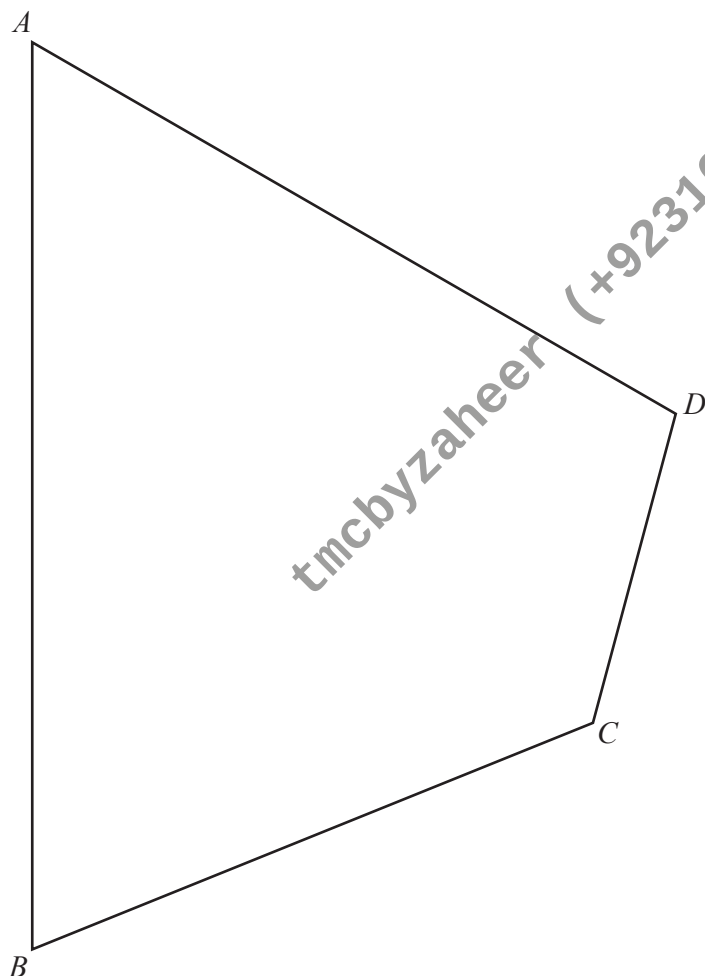
(b) (i) Construct the locus of points, **inside** the quadrilateral, that are 8 cm from B . [1]

(ii) Construct the locus of points, **inside** the quadrilateral, that are 5 cm from AB . [1]

(iii) These two loci meet at P .

Mark, and label, the point P on the diagram and measure PD .

Answer $\dots\dots\dots$ cm [1]

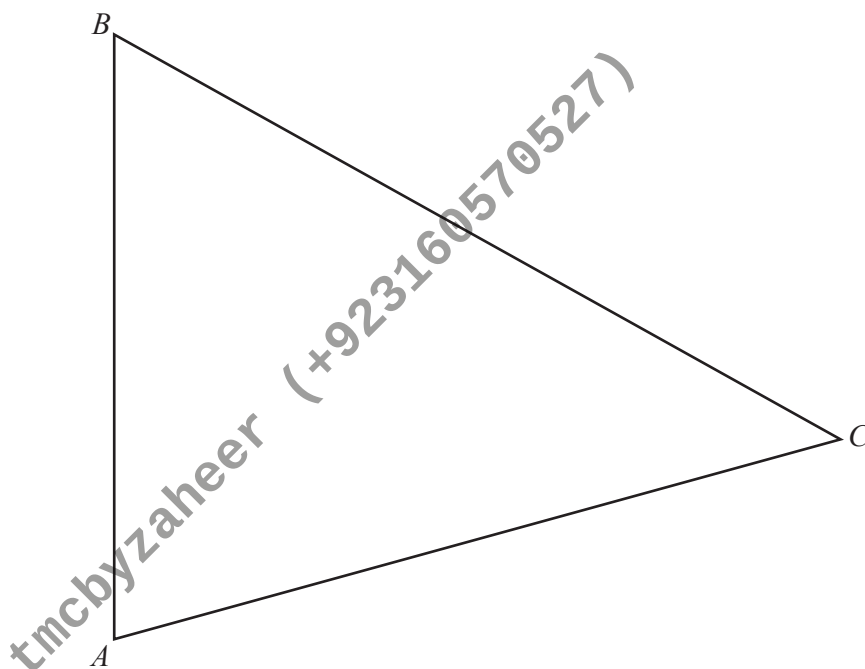


35 The diagram shows triangle ABC .

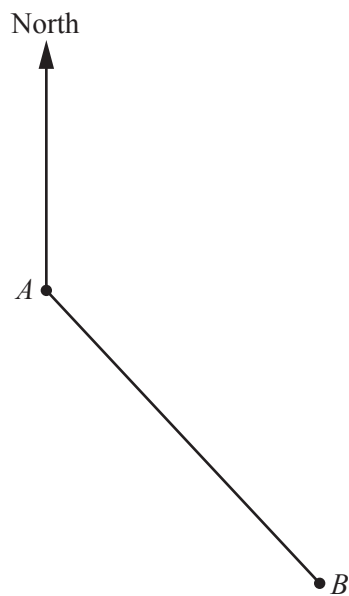
(a) Construct the locus of points, **inside** triangle ABC , that are equidistant from A and B . [1]

(b) Construct the locus of points, **inside** triangle ABC , that are equidistant from AB and BC . [1]

(c) On the diagram, shade the region **inside** triangle ABC which contains the points that are nearer to A than to B and nearer to BC than AB . [1]



- 36** The diagram shows the position of two villages A and B .



- (a)** Measure the bearing of B from A .

Answer [1]

- (b)** The bearing of village C from A is 265° .

Work out the bearing of A from C .

Answer [1]
