Loci & Constructions
2002 - 2011

9
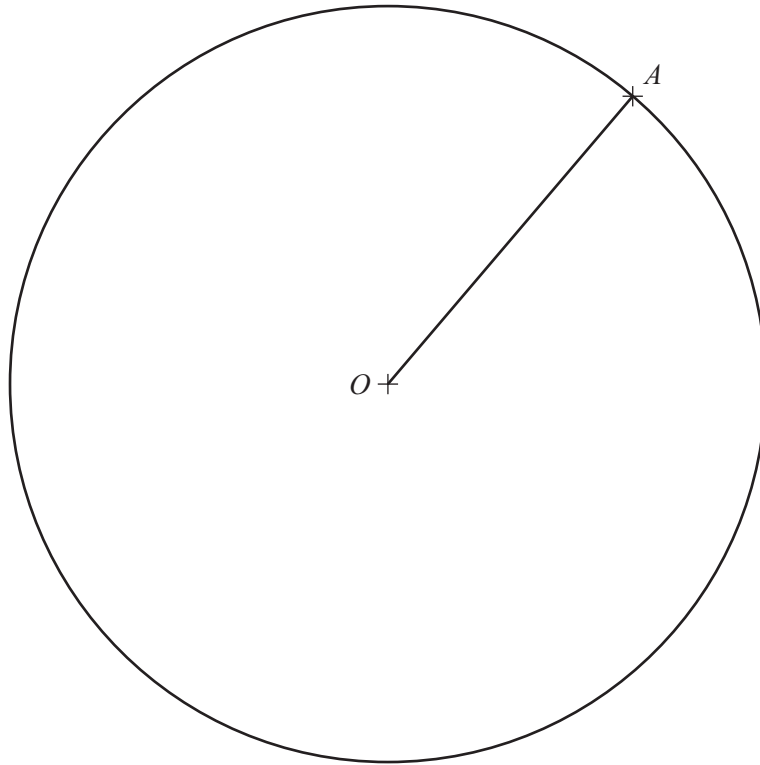
The point *A* lies on the circle centre *O*, radius 5 cm.

(a) **Using a straight edge and compasses only,** construct the perpendicular bisector of the line *OA*.
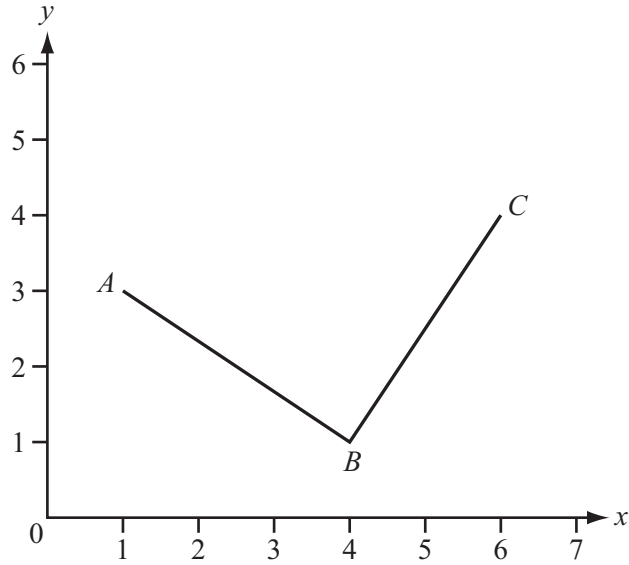
[2]

(b) The perpendicular bisector meets the circle at the points *C* and *D*.

Measure and write down the size of the angle *AOD*.

Answer(b) Angle *AOD* = ... [1]

19

$A(1, 3)$, $B(4, 1)$ and $C(6, 4)$ are shown on the diagram.

(a) **Using a straight edge and compasses only,** construct the angle bisector of angle ABC. [2]
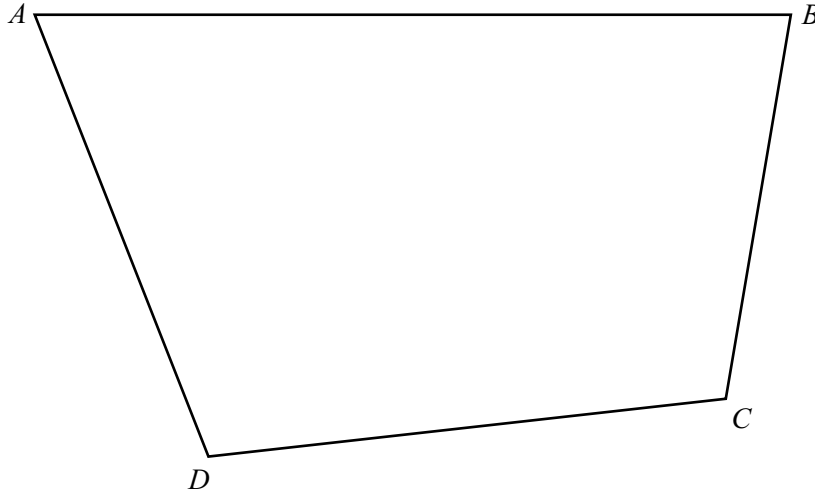
(b) Work out the equation of the line BC.

Answer(b) .... [3]

(c) ABC forms a **right-angled isosceles** triangle of area $6.5 \, \text{cm}^2$.

Calculate the length of AB.

Answer(c) AB = ... cm [2]

18 The diagram is a scale drawing of a field. The actual length of the side *AB* is 100 metres.

(a) Write the scale of the drawing in the form 1 : *n*, where *n* is an integer.

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

(b) In this part use a straight edge and compasses only. Leave in your construction lines.

    (i) A tree in the field is equidistant from the point *A* and the point *D*. Construct the line on which the tree stands. [2]

    (ii) The tree is also equidistant from the sides *BC* and *CD*. After constructing another line, mark the position of the tree and label it *T*. [3]
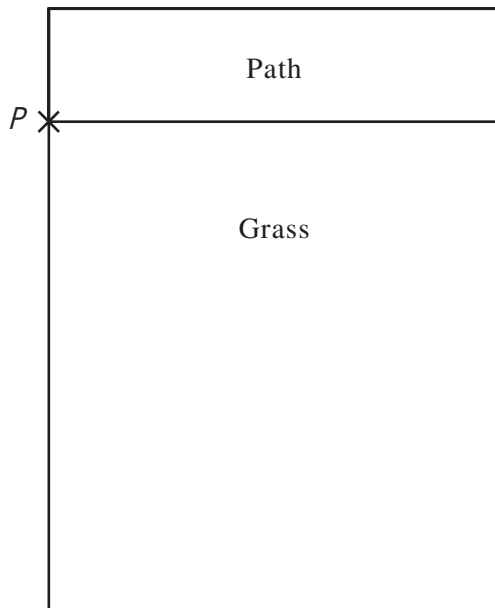
13 Make *d* the subject of the formula

$$c = kd^2 + e.$$

Answer d = ... [3]

14
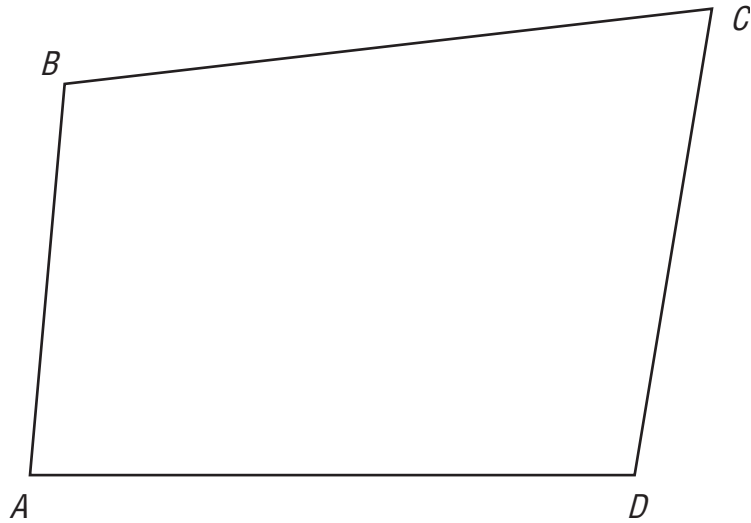

The diagram, drawn to a scale of 1 cm to 1 m, shows a garden made up of a path and some grass. A goat is attached to a post, at the point *P*, by a rope of length 4 m.

(a) Draw the locus of all the points in the **garden** that the goat can reach when the rope is tight. [1]

**(b)** Calculate the area of the **grass** that the goat can eat.

Answer(b) .... m^2 [2]

17

In this question show clearly all your construction arcs.

(a) Using a straight edge and compasses only, construct on the diagram above,

    (i) the perpendicular bisector of *BD*, [2]

    (ii) the bisector of angle *CDA*. [2]

(b) Shade the region, inside the quadrilateral, which is nearer to *D* than *B* **and** nearer to *DC* than *DA*. [1]

4

North

NOT TO
SCALE
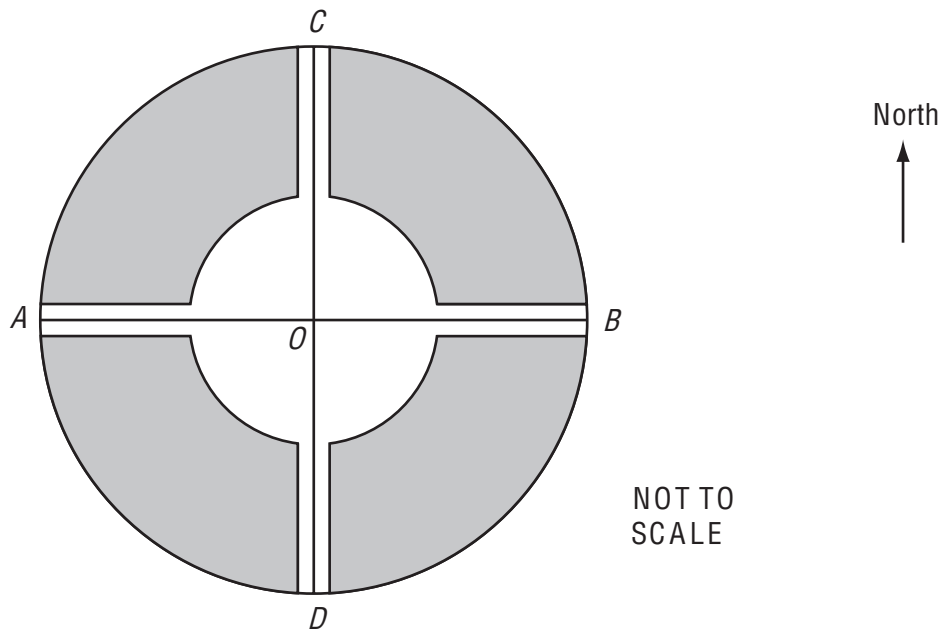
The diagram shows a plan for a new city.
It is to be built inside a circle of radius 5 km.
The areas where homes can be built are shaded on the diagram.
The homes must be at least 2 km from the centre of the city, *O*.
The homes must also be at least 0.5 km from two main roads *CD* and *AB*, which are in North-South and West-East directions.

(a) Using 1 cm to represent 1 km, make an **accurate** scale drawing showing the areas for the homes.
(You do not need to shade these areas.) [4]

(b) The town hall, *T*, will be built so that it is equidistant from the roads *OA* and *OC*.
It will be 1 km from *O* **and** West of *CD*.

   (i) On your scale drawing, using a straight edge and compasses only, draw the locus of points, inside the town, which are equidistant from *OA* and *OC*. [2]

   (ii) Mark and **label** the point *T*. [1]

(c) The police station, *P*, will be built so that it is equidistant from *T* and *B*.
It will be 3 km from *O* **and** North of *AB*.
Showing all your construction lines, find and **label** the point *P*. [3]

(d) What will be the actual straight line distance between the town hall and the police station? [1]

20

LAND

P

LAND

A x

B

LAND

SEA

x D
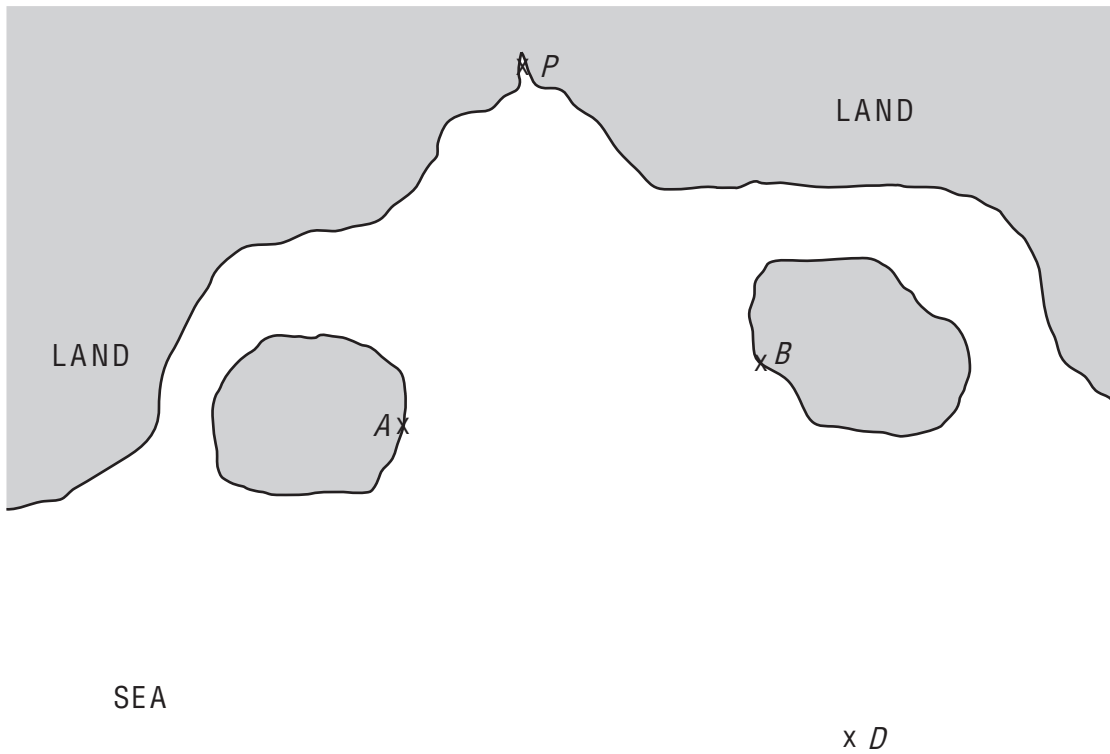
The diagram shows a map of part of a coastline.
1 centimetre represents 40 metres.

(a) A ferry leaves a port *P* and travels between two islands so that it is always equidistant
from *A* and *B*.
Using a straight edge and compasses only, draw this locus. [2]

(b) For safety reasons the ferry must be at least 120 metres from a ship at *D*.
Draw the locus of the points which form the boundary of safety around *D*. [1]

(c) When the ferry is 120 metres from *D* it must change direction.
How far is the ferry from the port *P* then?

Answer(c) .... m [1]

9

NOT TO SCALE
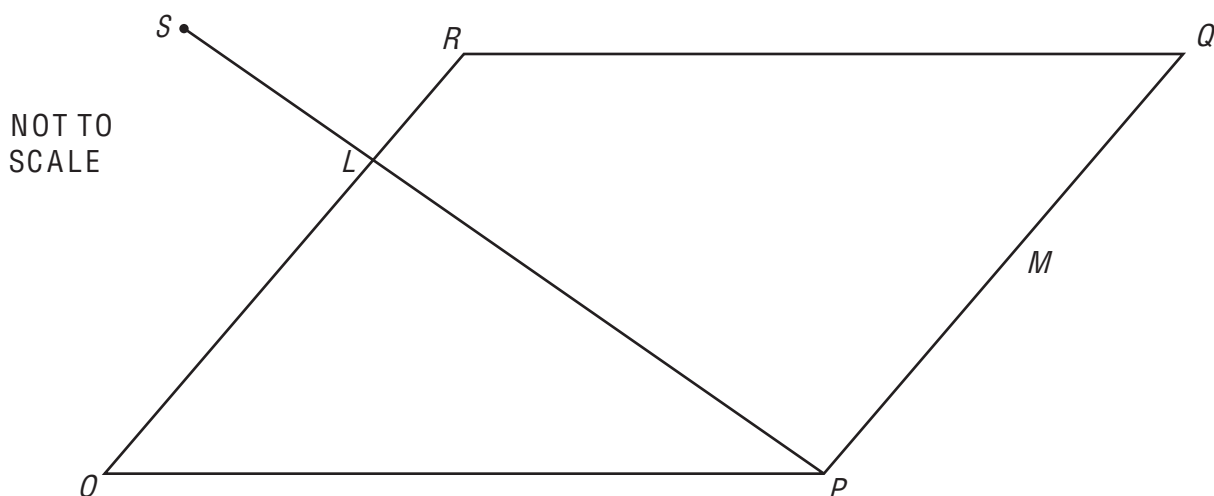
OPQR is a parallelogram.
O is the origin.
$\overrightarrow{OP}$= **p** and $\overrightarrow{OR}$= **r**.
M is the mid-point of *PQ* and *L* is on *OR* such that *OL* : *LR* = 2 : 1.
The line *PL* is extended to the point *S*.

(a) Find, in terms of **p** and **r**, in their simplest forms,

    (i) $\overrightarrow{OQ}$,   [1]

    (ii) $\overrightarrow{PR}$,   [1]

    (iii) $\overrightarrow{PL}$,   [1]

    (iv) the position vector of *M*.   [1]

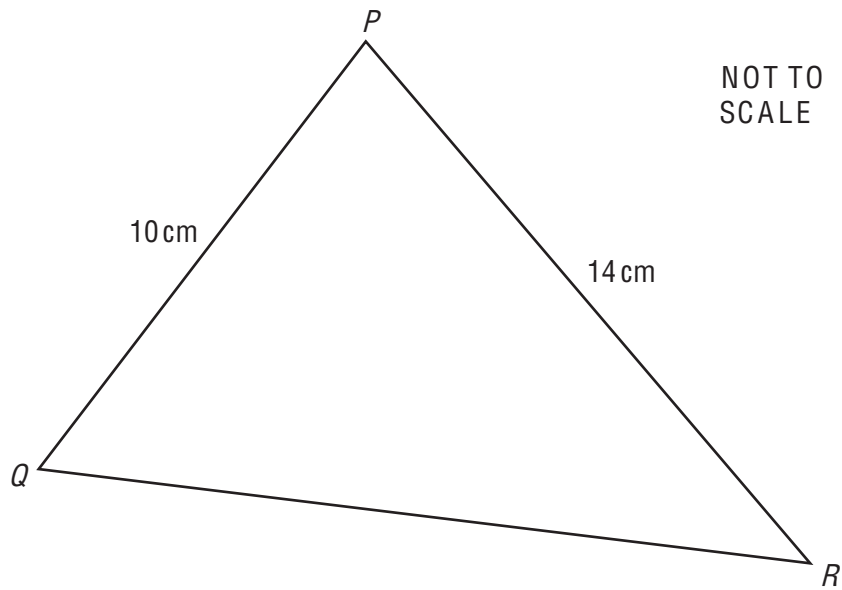**(b)** *PLS* is a straight line and $PS = \dfrac{3}{2} PL$.

    Find, in terms of **p** and / or **r**, in their simplest forms,

    (i) $\overrightarrow{PS}$,   [1]

    (ii) $\overrightarrow{QS}$.   [2]

(c) What can you say about the points *Q*, *R* and *S*?   [1]

3

NOT TO SCALE

10 cm

14 cm

P

Q

R

In triangle *PQR*, angle *QPR* is acute, *PQ* = 10 cm and *PR* = 14 cm.

(a) The area of triangle *PQR* is 48 cm².

Calculate angle *QPR* and show that it rounds to 43.3°, correct to 1 decimal place.
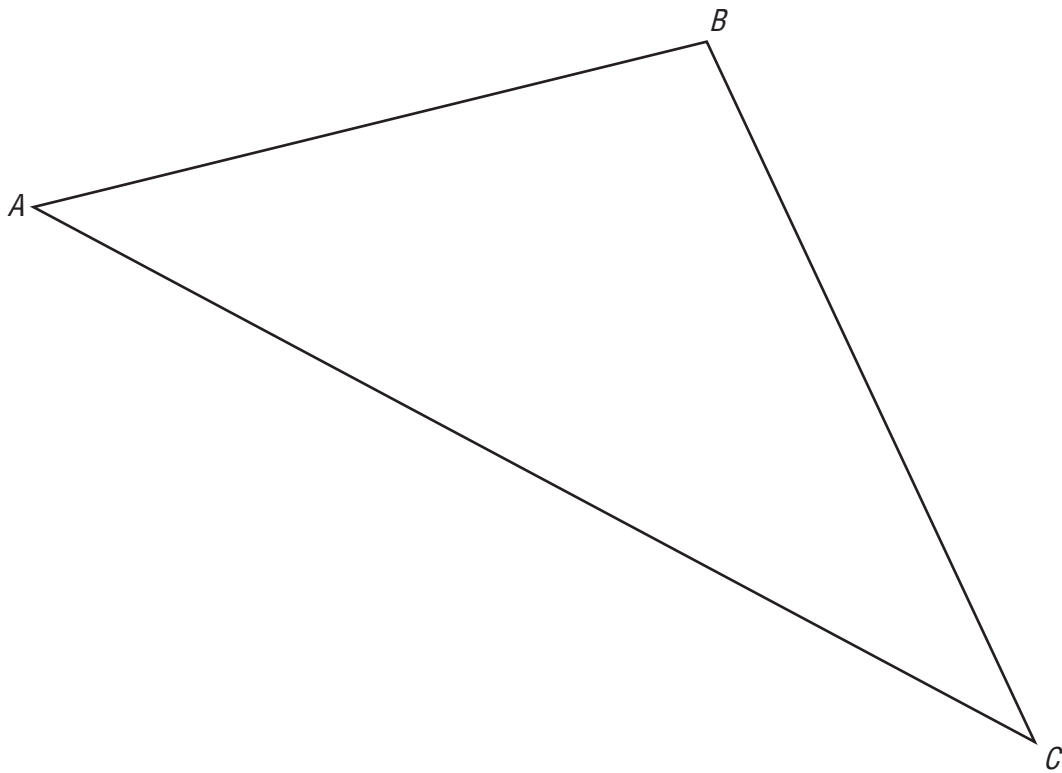You must show all your working.

Answer (a)

[3]

(b) Calculate the length of the side *QR*.

Answer(b) QR = ... cm [4]

22

The diagram shows a farmer's field *ABC*.

The farmer decides to grow potatoes in the region of the field which is
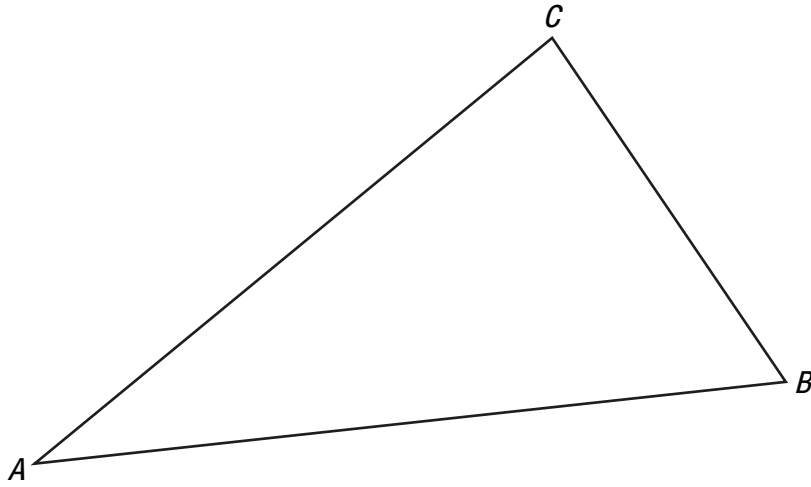
- nearer to *A* than to *C*

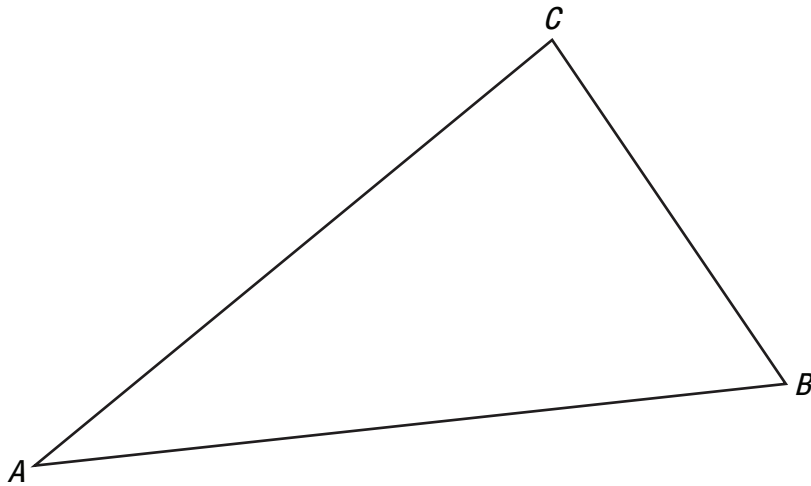**and**

- nearer to *AB* than to *AC*.

Using **a straight edge and compasses only**, construct two loci accurately and shade this region on the diagram.

[5]

18

(a) On the diagram above, **using a straight edge and compasses only**, construct

    (i) the bisector of angle *ABC*, [2]

    (ii) the locus of points which are equidistant from *A* and from *B*. [2]

(b) Shade the region inside the triangle which is nearer to *A* than to *B* **and** nearer to *AB* than to *BC*.
[1]

20

(a) On the diagram above, **using a straight edge and compasses only**, construct

    (i) the bisector of angle *ABC*,   [2]

    (ii) the locus of points which are equidistant from *A* and from *B*.   [2]

(b) Shade the region inside the triangle which is nearer to *A* than to *B* **and** nearer to *AB* than to *BC*.

                                                                                                 [1]

9 **(a)** In the space below, construct the triangle *ABC* with *AB* = 10 cm and *AC* = 12 cm.
Leave in your construction arcs.
The line *BC* is already drawn.

B ———————————————————————— C

[2]

(b) Measure angle *ABC*.

Answer(b) Angle *ABC* = ... [1]

(c) (i) Using a straight edge and compasses only, and leaving in your construction arcs, construct the perpendicular bisector of *BC*. [2]

    (ii) This bisector cuts *AC* at *P*.

    Mark the position of *P* on the diagram and measure *AP*.

Answer(c)(ii) *AP* = ... cm [1]

(d) Construct the locus of all the points inside the triangle which are 5 cm from *A*. [1]

**(e)** Shade the region inside the triangle which is

            •   nearer to *B* than to *C*

     and

            •   less than 5 cm from *A*. [2]

2

P ————————————————————————————— Q

(a) In the space above, construct triangle *PQR* with *QR* = 9 cm and *PR* = 7 cm.
Leave in your construction arcs.
The line *PQ* is already drawn. [2]

(b) **Using a straight edge and compasses only**, construct

   (i) the perpendicular bisector of *PR*, [2]

   (ii) the bisector of angle *QPR*. [2]

(c) Shade the region inside the triangle *PQR* which is

   nearer to *P* than to *R*   **and**   nearer to *PQ* than to *PR*. [1]

(d) Triangle *PQR* is a scale drawing with a scale 1 : 50 000.

   Find the **actual** distance *QR*.
   Give your answer in kilometres.

*Answer(d)* .... km [2]

8
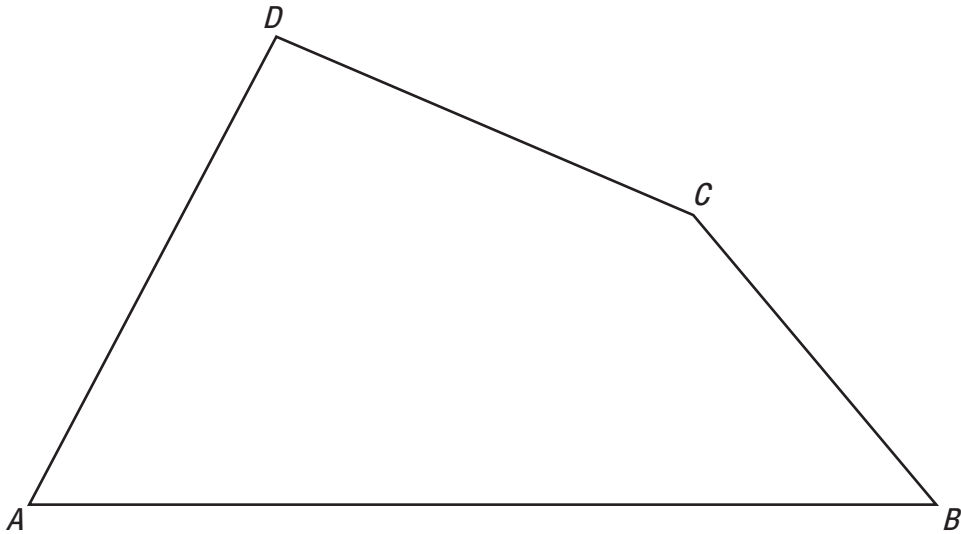
(a) Draw accurately the locus of points, inside the quadrilateral *ABCD*, which are 6 cm from the point *D*. [1]

(b) **Using a straight edge and compasses only,** construct

    (i) the perpendicular bisector of *AB*, [2]

    (ii) the locus of points, inside the quadrilateral, which are equidistant from *AB* and from *BC*. [2]

(c) The point *Q* is equidistant from *A* and from *B* **and** equidistant from *AB* and from *BC*.

    (i) Label the point *Q* on the diagram. [1]

    (ii) Measure the distance of *Q* from the line *AB*.

Answer(c)(ii) .... cm [1]

(d) On the diagram, shade the region inside the quadrilateral which is

    • less than 6 cm from *D*
      and
    • nearer to *A* than to *B*
      and
    • nearer to *AB* than to *BC*. [1]

18
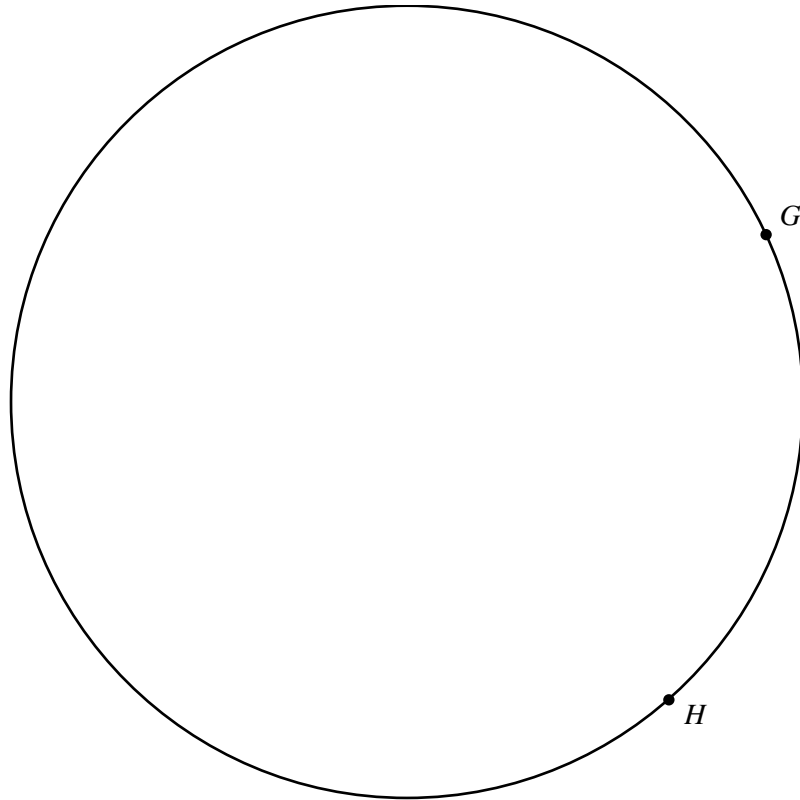
Find, by using **accurate** constructions, the region inside the circle which contains the points more than 5 cm from *G* **and** nearer to *H* than to *G*. Shade this region.   [4]

15
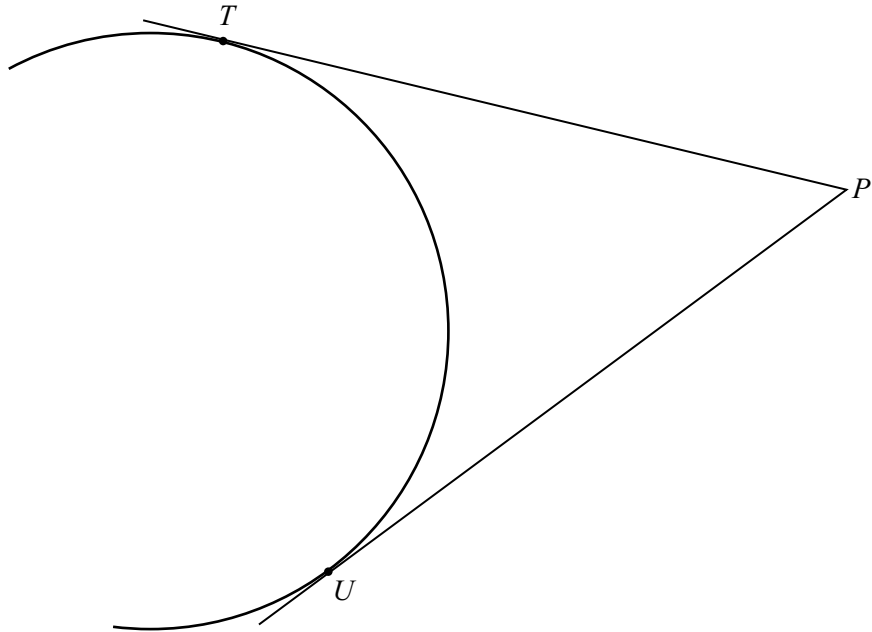
PT and *PU* are tangents to an arc of a circle at *T* and *U*.

(a) Using a straight edge and compasses only, construct the bisector of angle *TPU*.   [2]

(b) By **drawing another line accurately**, find the centre of the circle and label it *O*.   [2]

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16 The straight line graph of $y = 3x - 6$ cuts the *x*-axis at *A* and the *y*-axis at *B*.

(a) Find the coordinates of *A* and the coordinates of *B*.

Answer (a) *A* (.............., ...)

B (.............., ...) [2]

(b) Calculate the length of *AB*.

Answer (b) .... [2]

(c) *M* is the mid-point of *AB*.
Find the coordinates of *M*.

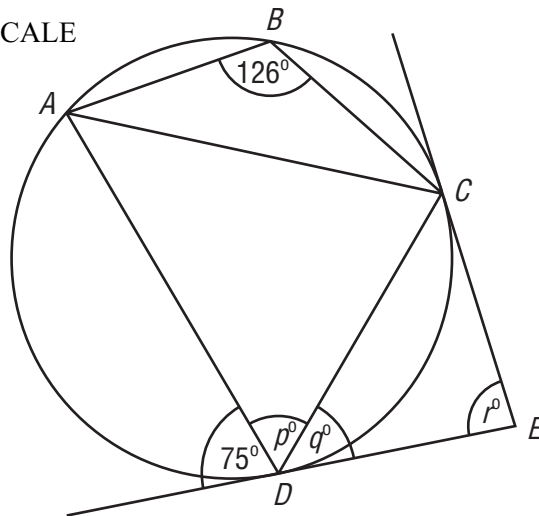*Answer (c)* (................, ...) [1]

15
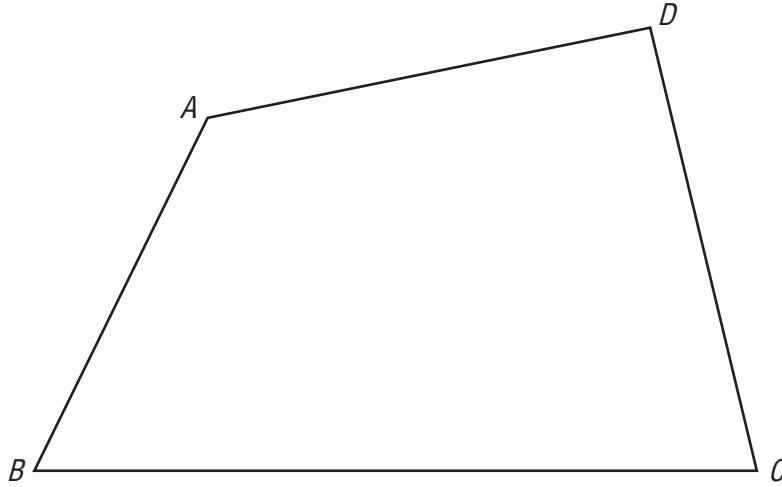
The diagram shows a quadrilateral *ABCD*.

(a) Draw the locus of points in the quadrilateral which are 5 cm from *A*. [1]

(b) Using a straight edge and compasses only, draw the locus of all points inside the quadrilateral which are equidistant from *C* and *D*.
Show all your construction lines. [2]

(c) Shade the region which contains points in the quadrilateral that are more than 5 cm from *A* and nearer to *D* than to *C*.
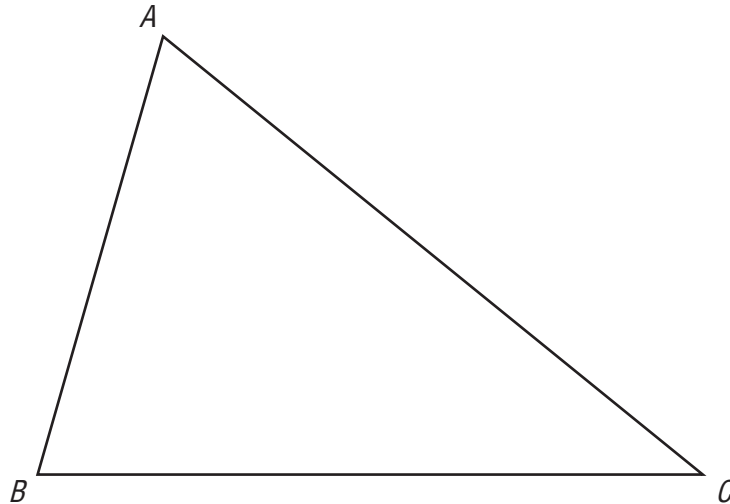
[1]

16

NOT TO SCALE

ABCD is a cyclic quadrilateral.
The tangents at *C* and *D* meet at *E*.
Calculate the values of *p*, *q* and *r*.

Answer p = ... [1]

q = ... [1]

r = ... [2]

22

(a) In this part of the question use a straight edge and compasses only.

Leaving in your construction lines,

(i) construct the angle bisector of angle ACB, [2]

(ii) construct the perpendicular bisector of AC. [2]

(b) Draw the locus of all the points inside the triangle ABC which are 7 cm from C. [1]

(c) Shade the region inside the triangle which is nearer to A than C, nearer to BC than AC and less than 7 cm from C. [1]
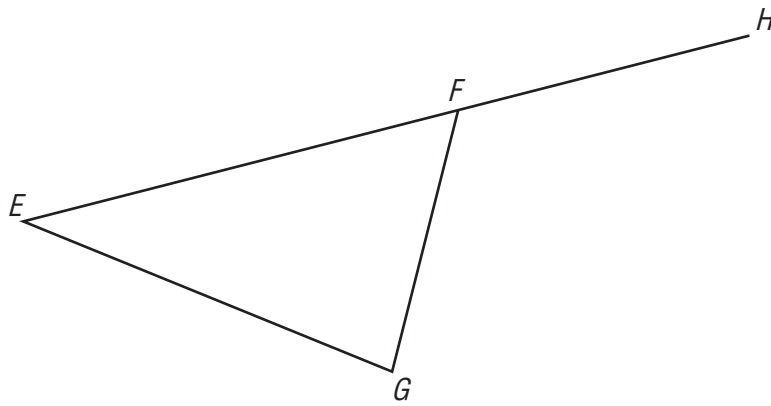
23 **Showing all your working**, solve

(a) $\dfrac{5x}{2} - 9 = 0,$

Answer(a) x = ... [2]

(b) $x^2 + 12x + 3 = 0,$ giving your answers correct to 1 decimal place.

*Answer(b) x =* .... or *x =* .... [4]

18

The diagram shows a triangle *EFG*. The side *EF* is extended to *H*.

(a) Using a straight edge and compasses only, **showing your construction arcs**, draw

    (i) the locus of points that are equidistant from *E* and *G*,   [2]

    (ii) the locus of points that are equidistant from *FG* and *FH*.   [2]

(b) Measure accurately and write down the acute angle between the two lines drawn in **part (a)**.

*Answer(b)* .... [1]

6
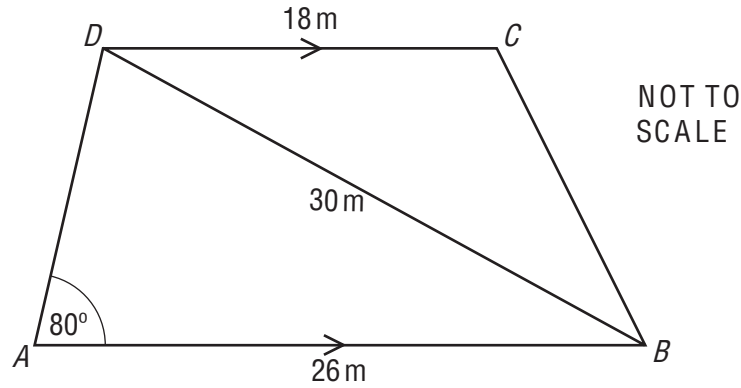
The diagram shows the plan of a garden.

The garden is a trapezium with AB = 26 metres, DC = 18 metres and angle DAB = 80°.

A straight path from B to D has a length of 30 metres.

(a) (i) Using a scale of 1 : 200, draw an **accurate** plan of the garden. [3]

   (ii) **Measure** and write down the size of angle ADB and the size of angle DCB. [2]

   (iii) A second path is such that all points on it are equidistant from AB and from AD.

   Using a straight edge and compasses only, construct this path on your plan. [2]

   (iv) A third path is such that all points on it are equidistant from A and from D.

   Using a straight edge and compasses only, construct this path on your plan. [2]

   (v) In the garden, vegetables are grown in the region which is nearer to AB than to AD **and** nearer to A than to D.

   Shade this region on your plan. [1]

(b) Use trigonometry, showing all your working, to calculate

   (i) angle ADB, [3]

   (ii) the length of BC, [4]

   (iii) the area of the garden. [3]
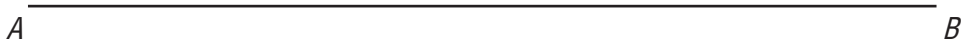
4

NOT TO
SCALE

C

140 m   180 m
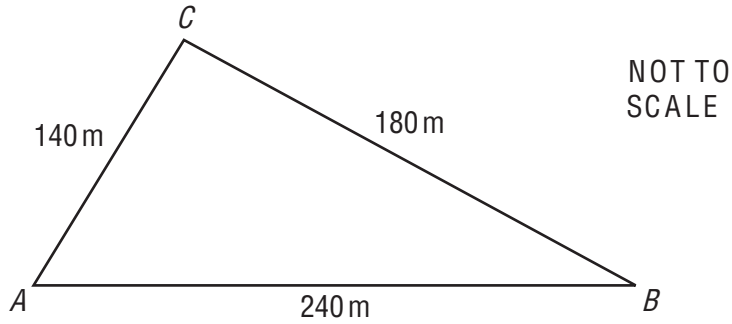
A   240 m   B

The boundary of a park is in the shape of a triangle *ABC*.
AB = 240 m, *BC* = 180 m and *CA* = 140 m.

In part (a), show clearly all your construction arcs.

(a) (i) Using a scale of 1 centimetre to represent 20 metres, **construct** an **accurate** scale drawing of triangle *ABC*. The line *AB* has already been drawn for you.

A   B

[2]

 (ii) Using a straight edge and compasses only, **construct** the bisector of angle *ACB*.

Label the point *D*, where this bisector meets *AB*. [2]

(iii) Using a straight edge and compasses only, construct the locus of points, inside the triangle, which are equidistant from *A* and from *D*. [2]

(iv) Flowers are planted in the park so that they are nearer to *AC* than to *BC* **and** nearer to *D* than to *A*.

Shade the region inside your triangle which shows where the flowers are planted. [1]

In part (b), use trigonometry.
You must show your working and must NOT use any measurements from your construction in part (a).

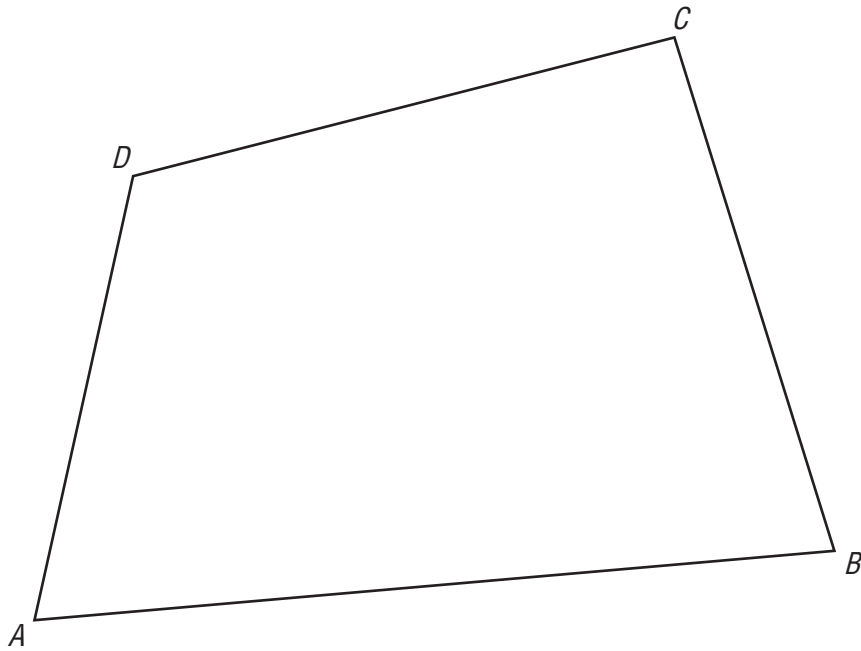**(b) (i)** Show clearly that angle *ACB* is 96.4°.

Answer(b)(i)

[3]

(ii) Calculate the area of the park.

Answer(b)(ii) .... m² [2]

(iii) Use the sine rule to calculate angle *ABC*.

Answer(b)(iii) Angle *ABC* = ... [3]

5

The diagram shows an area of land *ABCD* used for a shop, a car park and gardens.

(a) **Using a straight edge and compasses only**, construct

    (i) the locus of points equidistant from *C* and from *D*,   [2]

    (ii) the locus of points equidistant from *AD* and from *AB*.   [2]

(b) The shop is on the land nearer to *D* than to *C* **and** nearer to *AD* than to *AB*.

    Write the word SHOP in this region on the diagram.   [1]

(c) **(i)** The scale of the diagram is 1 centimetre to 20 metres.
        The gardens are the part of the land less than 100 m from *B*.
        Draw the boundary for the gardens.   [1]

    (ii) The car park is the part of the land not used for the shop and not used for the gardens.
        Shade the car park region on the diagram.   [1]

17

A

C

B
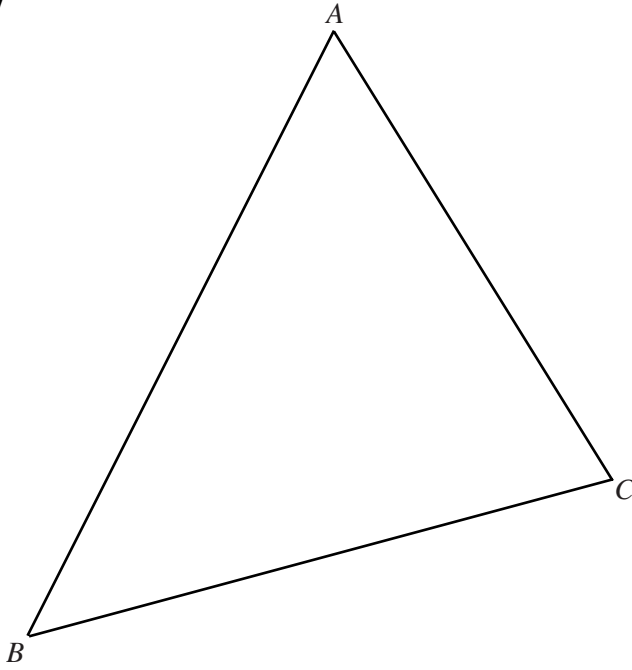
(a) Draw accurately the locus of points inside the triangle

(i) 6 cm from *B*, [1]

(ii) equidistant from *AC* and *BC*. [1]

(b) Shade the region inside the triangle which is more than 6 cm from *B* **and** nearer to *BC* than to *AC*. [1]