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Loci and Construction

Worked Solutions

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Full worked solutions for the free Loci and Construction worksheet, GCSE and iGCSE Maths



Tap a section to jump straight to it

Full worked solutions for every question on the Loci and Construction worksheet, in the same order and with the same question numbers.

How to mark your work. Tick each step you got right, not just the final answer. In the exam, method marks are given for correct working even when the final answer is wrong. If you lost marks, find the *first* line where your working is different from ours. That is the thing to fix.

In Section E: **M** = method mark, **P** = process mark, **A** = accuracy mark, **B** = independent mark, **C** = communication mark.

Question sheet

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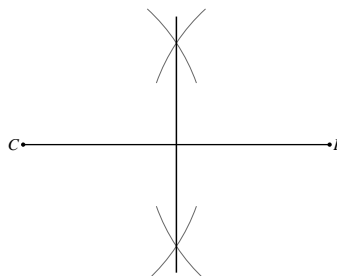
A**Your turn answers**

Solution diagrams are reduced in size. Check that your construction arcs are shown: marks are lost without them.

FOUNDATION

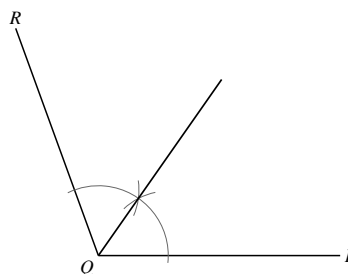
- A1** Arcs from C and D with the same radius (more than 3.25 cm), above and below. The line through the crossings cuts CD at its midpoint, 3.25 cm from each end, at 90°

the bisector, shown



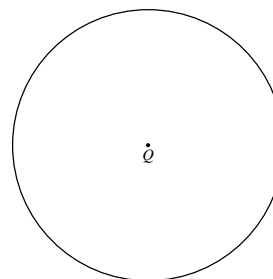
- A2** Arc from Q cutting both arms, then equal arcs from those points. Each half is 55°

the bisector, shown



- A3** A circle of radius 3 cm, centre Q (not shaded: *exactly* 3 cm)

the circle, shown

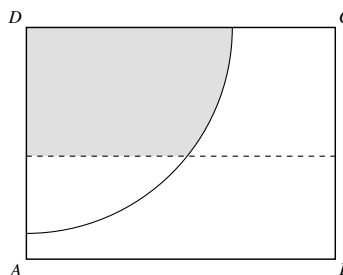
**HIGHER**

- A4** The arcs from A and B have equal radius, so a crossing point X has $XA = XB$. For any point Y on the line XM (where M is the midpoint), triangles AMY and $BM Y$ have $AM = BM$, MY common and the right angles at M equal, so they are congruent (SAS) and $YA = YB$



- A5** Arc of radius 4 cm about D , and the line 2 cm above AB . Shade inside the arc and above the line.

the region, shown



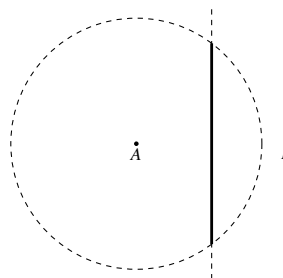
- A6** Two lines 1.5 cm either side of AB , joined by semicircles of radius 1.5 cm at A and B

the region, shown



- A7** The perpendicular bisector of AB , 1.5 cm from A , and a circle of radius $25 \div 10 = 2.5$ cm about A . The positions are the part of the bisector inside the circle, 4 cm long.

the thick segment



B

Fluency solutions

Accurate to within 2 mm and 2° . Construction arcs must be visible.

FOUNDATION

- B1** Each bisector crosses at the midpoint: 4 cm from E and 2.5 cm from G , at 90° *Keep the compasses wider than half the line.*
- B2** (a) Each half is 25° (b) Each half is 60°
- B3** (a) The largest angle, opposite the 8 cm side, is about 75.5° (b) The third side is about 5.4 cm
- B4** (a) Arc from P cutting the line twice; bisect between those points. The distance is 3 cm (b) Arcs either side of Q , then bisect them.

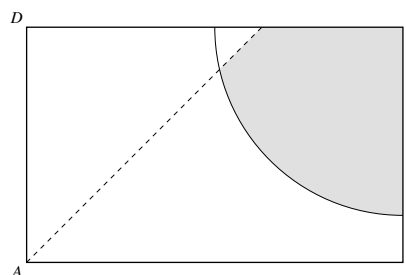


- B5** (a) a circle of radius 4 cm, centre O (b) the perpendicular bisector of AB
 (c) the bisectors of the angles between the lines

- B6** (a) A circle of radius 2.5 cm about P (b) the perpendicular bisector of PQ , 3 cm from each
 (c) a circle of radius 4 cm about Q (d) the part of that circle on P 's side of the bisector, between 2 cm and 3 cm from P along PQ

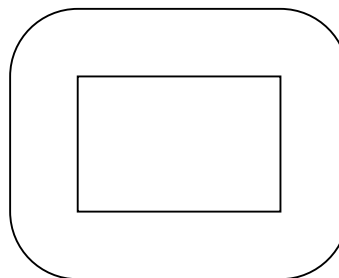
HIGHER

- B7** (a) the bisector of angle A
 (b) an arc of radius 4 cm about C
 (c) below the bisector and inside the arc
 the region, shown



- B8** The positions are where circles of radius 5 cm about A and B meet, on the perpendicular bisector,
 $\sqrt{25 - \left(\frac{AB}{2}\right)^2}$ from AB
 (a) 2, 6 cm apart (b) 2, 8 cm apart (c) 1: the midpoint (d) 0: the circles do not meet

- B9** (a) straight sides 1 cm out, quarter circles at the corners
 (b) $6 + 2 \times 3 \times 1 + 2 \times 2 \times 1 + \pi \times 1^2 = 16 + \pi$:
 19.1 cm²
 (c) $2(3 + 2) + 2\pi \times 1 = 10 + 2\pi$: 16.3 cm



- B10** (a) an equilateral triangle on AB gives 60° (b) bisect the 60° (c) a perpendicular at A (d) bisect the 90°



C

Reasoning solutions

Your wording can be different. Check that your reason makes the same point.

FOUNDATION

- C1** $2 + 2 = 4$ cm is less than 6 cm, so arcs from each end cannot reach each other. The radius must be more than half the line, more than 3 cm.
- C2** They form a straight line: the perpendicular bisector of AB . A circle is the points a fixed distance from *one* point.
- C3** Beside the segment, the nearest point is straight across, giving parallel lines 3 cm away. Beyond each end, the nearest point is the end itself, giving a semicircle of radius 3 cm.
- C4** The crossing point must be the same distance from both arm points, so the two triangles are congruent and the angle is split equally. Changing the width breaks that.

HIGHER

- C5** Let M be the midpoint of AB and Y any point on the bisector. $AM = BM$, MY is common and angles $AMY = BMY = 90^\circ$, so triangles AMY and $BM Y$ are congruent (SAS). Therefore $YA = YB$
- C6** Where two bisectors cross, the point is the same distance from all three vertices, so it is also on the third bisector. It is the centre of the circle through all three vertices.
- C7** Near the middle of each side, the locus is 2 cm out in straight lines, but round each corner the points 2 cm from the corner form a quarter circle, so the corners are rounded.
- C8** (a) **a line parallel to both, halfway between them**, 3 cm from each
- (b) The points are on that line and 4 cm from P , which is 3 cm from it: each is $\sqrt{4^2 - 3^2} = \sqrt{7}$ along the line from the foot of P distance **$2\sqrt{7}$** cm



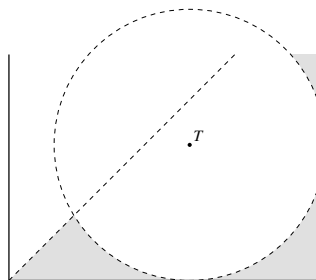
D**Problem solving solutions**

There is often more than one correct method. Any complete, correct method scores full marks.

FOUNDATION

- D1** 6 km = 3 cm. Circles of radius 3 cm about A and B ; shade the overlap, which exists because $3 + 3 > 5$
- D2** The perpendicular bisector of AB and an arc of radius 5 cm about A meet twice, each $\sqrt{5^2 - 4^2} = 3$ km from AB **6** km apart

- D3** Bisect the angle between the fences: nearer X is below the bisector. Draw a circle of radius 3 cm about T . Shade below the bisector and outside the circle.



- D4** Draw 5 cm. Construct perpendiculars at both ends, mark 5 cm up each with compasses, and join.

HIGHER

- D5** Three quarters of a circle of radius 4 m: 12π . Round the 3 m side, 1 m of rope left: a quarter circle, $\frac{1}{4}\pi$. Round the 2 m side, 2 m left: $\frac{1}{4}\pi \times 4 = \pi$
Total $12\pi + \frac{1}{4}\pi + \pi = 13.25\pi = 41.62\dots$ **41.6** m²
- D6** Construct the perpendicular bisectors of two sides; they meet at the mast. It is about 3.8 cm from each village: **3.8** km
- D7** The line 2 cm above AB , the perpendicular bisector of BD (nearer D is on D 's side), and an arc of radius 5 cm about A . Shade where all three hold.
- D8** Put the corner at O . The foot is at $(a, 0)$ and the top at $(0, b)$, with $a^2 + b^2 = 16$. The midpoint is $(\frac{a}{2}, \frac{b}{2})$, and its distance from O is $\frac{1}{2}\sqrt{a^2 + b^2} = \frac{1}{2} \times 4 =$ **2** m
The locus is **a quarter circle of radius 2 m, centre the corner**

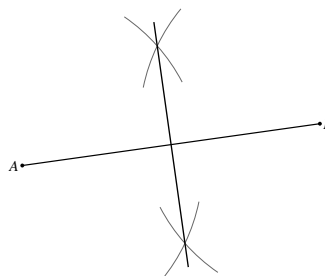


E**Exam practice solutions**

Marks are shown on the right of each line.

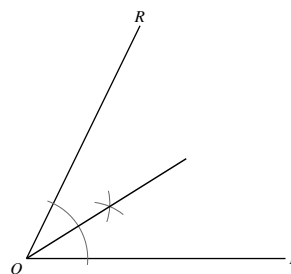
FOUNDATION*Foundation and Higher crossover*

- E1** Arcs from A and B that cross, above and below
Line through the crossings



M1 A1

- E2** Arc from Q cutting both arms, equal arcs crossing
Bisector drawn: each half 32°



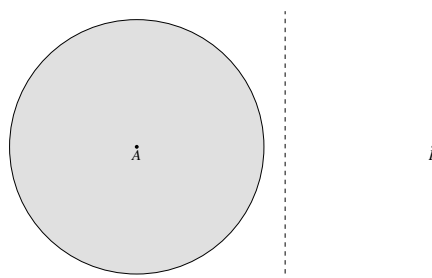
M1 A1

- E3** One side drawn, arcs of 8 cm and 9 cm from its ends
Triangle completed with arcs showing

M1

A1

- E4** Circle of radius 3 cm about A
Perpendicular bisector of AB
Correct region shaded



B1 M1 A1

- E5** (a) Arcs from P cutting the line; perpendicular constructed
(b) 4 cm

M1 A1

B1

- E6** A circle of radius 2 cm about the centre, shaded
The centre is 2 m from AB and DC and 3 m from AD and BC : it just reaches AB and DC

M1 A1

B1

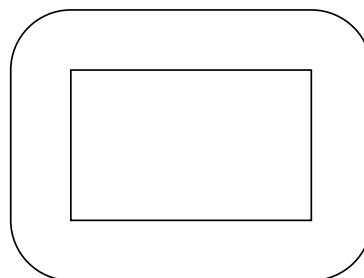


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HIGHER

- E7** Straight sides 1 cm out
Quarter circles of radius 1 cm at the corners



B1 B2

- E8** Bisector of angle A M1
Arc of radius 4 cm about A M1
The region between AB and the bisector, inside the arc, shaded A1

- E9** The arc from P cuts the line at X and Y , so $PX = PY$ B1
The crossing point Z below has $XZ = YZ$ (equal arcs), and PZ is common M1
So triangles PXZ and PYZ are congruent (SSS) M1
Then triangles PXM and PYM are congruent (SAS), so the angles at M are equal and add to 180° : each is 90° C1

- E10** (a) P and Q are on the perpendicular bisector, $\sqrt{13^2 - 5^2} = 12$ cm from AB M1
 $PQ = 24$ cm A1
(b) $AP = PB = BQ = QA = 13$ cm, so all four sides are equal C1
Area = $\frac{1}{2} \times 10 \times 24$ M1
 120 cm² A1

