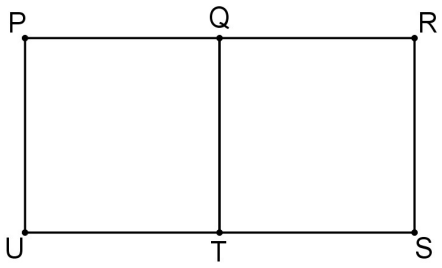
Stage 3 ★
Mixed Selection 1

1. Right-angled request

The figure shows a rectangle $PRSU$ with a line QT which divides the rectangle into two squares.

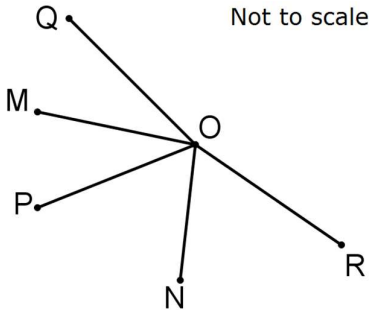
How many right-angled triangles can be drawn using any three points P, Q, R, S, T, U as corners?



2. Angular reflection

In the diagram, $\angle MON = 130°$. The reflection of OP in OM is OQ and the reflection of OP in ON is OR.

What is the size of $\angle QOR$?



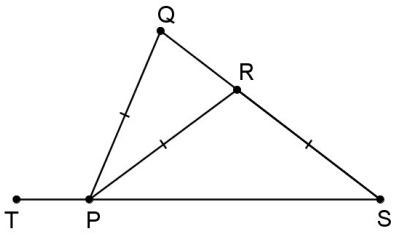
3. Homely angles

A square is labelled anticlockwise $ABCD$. The point E is outside the square so that CDE is an equilateral triangle. Find angle BED.

4. Isosceles Meld

In the diagram R is on the line QS, P is on the line TS, and $PQ = PR = RS$.

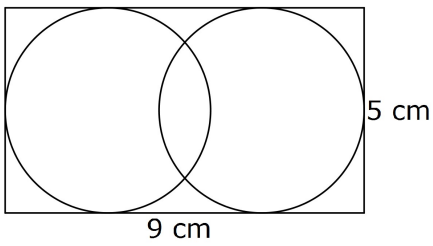
If angle QPR is 36 degrees, find the size of angle QPT?



5. Central distance

The diagram shows two circles enclosed in a rectangle measuring 9cm by 5cm.

What is the distance between the centres of the circles?



These problems are adapted from UKMT Mathematical Challenge problems (ukmt.org.uk)

Stage 3 ★
Mixed Selection 2

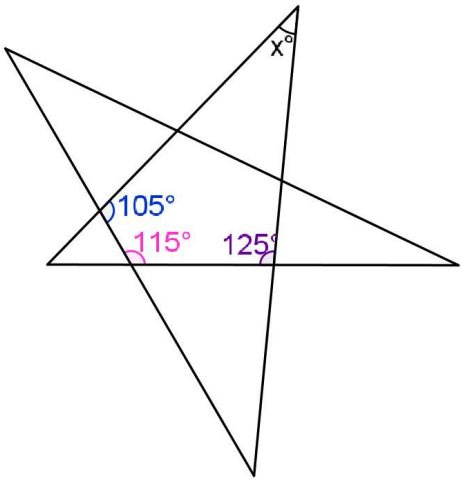
1. Robo-turn

A robot, which is initially facing North, is programmed to travel 5m then turn through $10°$ clockwise, travel 5m then turn through $20°$ clockwise, travel 5m then turn through $30°$ clockwise, and so on. Each move consists of moving 5m in a straight line and then turning clockwise through an angle which increases by $10°$ at each move.

How far has it travelled by the time it is first facing due East at the end of a move?

2. Stellar angles

What is the value of x in the diagram?



3. Two exterior triangles

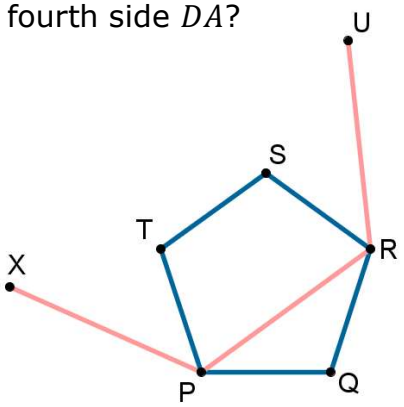
A square is labelled clockwise $ABCD$. P and Q are points outside the square such that triangles ABP and BCQ are both equilateral. How big is angle PQB?

4. As long as possible

The length of each side of a quadrilateral $ABCD$ is a whole number of centimetres. Given that $AB = 4\,\text{cm}$, $BC = 5\,\text{cm}$, and $CD = 6\,\text{cm}$, what is the maximum possible length of the fourth side DA?

5. Polygon cradle

The figure shows a regular pentagon $PQRST$ together with three sides XP, PR, RU of a regular hexagon with vertices $PRUVWX$. What is the size of the angle SRU?



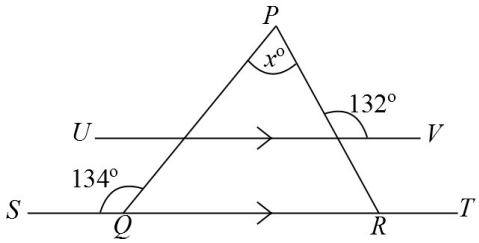
These problems are adapted from UKMT Mathematical Challenge problems (ukmt.org.uk)

Stage 3 ★
Mixed Selection 3

1. Parallel base

In the diagram ST is parallel to UV.

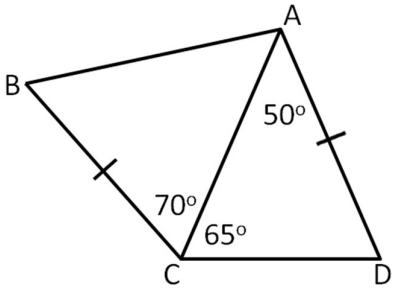
What is the value of x?



2. Other side

The diagram shows a quadrilateral $ABCD$, in which $AD = BC$, $\angle CAD = 50°$, $\angle ACD = 65°$ and $\angle ACB = 70°$.

What is the size of $\angle ABC$?



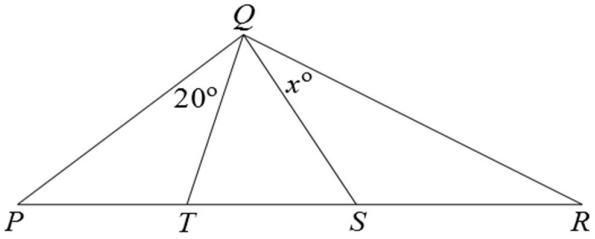
3. Half past two

What is the angle between the two hands of a clock at 2:30?

4. Tent poles

In the diagram, $PT = QT = TS$, $QS = SR$, $\angle PQT = 20°$.

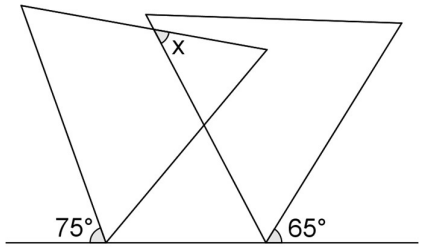
What is the value of x?



5. Angle of overlap

The diagram shows two equilateral triangles.

What is the value of x?

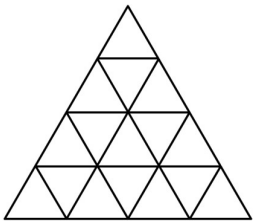


These problems are adapted from UKMT Mathematical Challenge problems (ukmt.org.uk)

Stage 3 ★
Mixed Selection 4

1. Isometric rhombuses

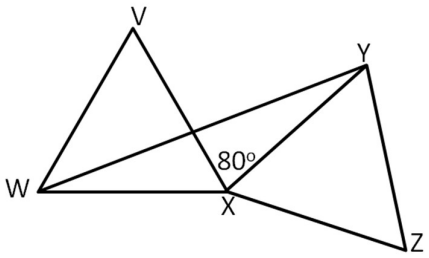
The diagram shows a grid of 16 identical equilateral triangles.



How many rhombuses made up of two adjacent small triangles are there?

2. Equilateral pair

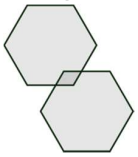
In the diagram, VWX and XYZ are congruent equilateral triangles, and $+\angle VXY$ is $80°$.



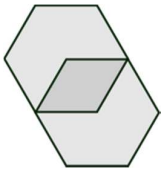
What is the size of $\angle VWY$?

3. Overlapping beer mats

Two beer mats, each the shape of a regular hexagon with area $36cm^2$, are placed on top of each other, as shown .

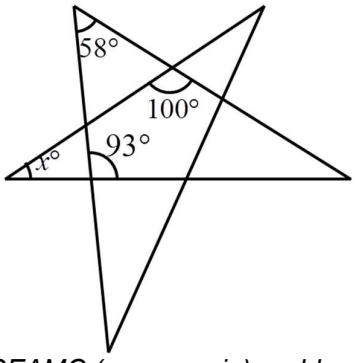


If they are placed so that the corner of the lower beer mat is in the centre of the higher beer mat, as shown below, what is the area of the overlap?



4. Angle please

In the diagram, what is the value of x?



These problems are adapted from UKMT (ukmt.org.uk) and SEAMC (seamc.asia) problems.