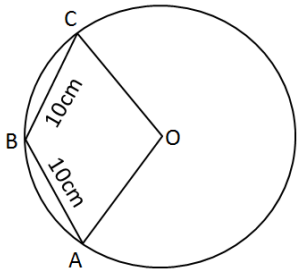
JMO Geometry Questions

Level: Junior Ref No: J03 **Puzz Points: 12**

[JMO 2002 B3] In the diagram, O is the centre of the circle. The lengths of AB and BC are both 10cm. The area of quadrilateral OABC is 120cm^2. Calculate the radius of the circle.



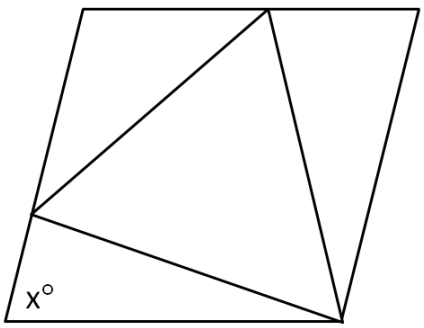
Level: Junior Ref No: J05 **Puzz Points: 13**

[JMO 2002 B5] ABCDE is a pentagon in which triangles ABC, AED and CAD are all isosceles, AC = AD, ∠CAD is acute. Interior angles ABC and AED are both right angles.

Draw a sketch of pentagon ABCDE, marking all the equal sides and equal angles. Show how to fit four such identical pentagons together to form a hexagon. Explain how you know the pentagons will fit exactly.

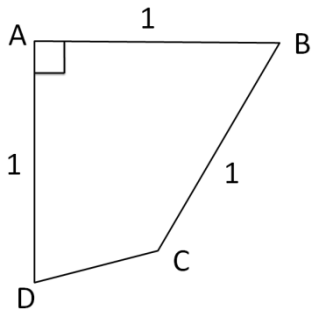
Level: Junior Ref No: J09 **Puzz Points: 12**

[JMO 2000 B3] The diagram shows an equilateral triangle inside a rhombus. The sides of the rhombus are equal in length to the sides of the triangle. What is the value of x?



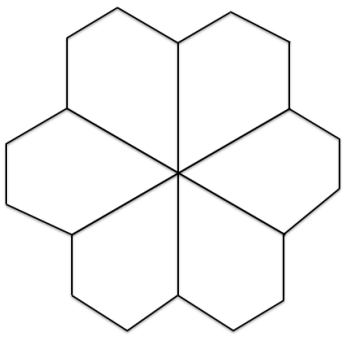
Level: Junior Ref No: J14 **Puzz Points: 11**

[JMO 2007 B2] The diagram shows a quadrilateral ABCD in which AB, BC and AD are all of length 1 unit, $\angle BAD$ is a right angle and $\angle ABC$ is 60°. Prove that $\angle BDC = 2 \times \angle DBC$.



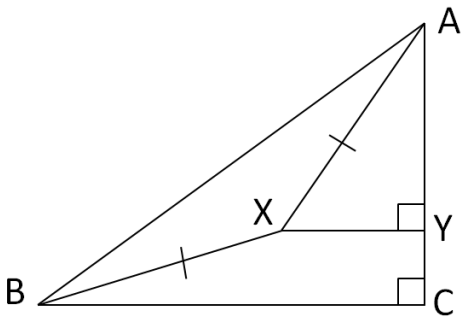
Level: Junior Ref No: J17 **Puzz Points: 14**

[JMO 2007 B5] A window is constructed of six identical panes of glass. Each pane is a pentagon with two adjacent sides of length two units. The other three sides of each pentagon, which are on the perimeter of the window, form half of the boundary of a regular hexagon. Calculate the exact area of the glass in the window.



Level: Junior Ref No: J21 **Puzz Points: 12**

[JMO 2006 B3] In this diagram, Y lies on the line AC, triangles ABC and AXY are right angled and in triangle ABX, AX = BX. The line segment AX bisects angle BAC and angle AXY is seven times the size of angle XBC. What is the size of angle ABC?



Level: Junior Ref No: J22 **Puzz Points: 13**

[JMO 2006 B4] Start with an equilateral triangle angle of side 2 units, and construct three outward-pointing squares ABPQ, BCTU, CARS and the three sides AB, BC, CA. What is the area of the hexagon PQRSTU?

Level: Junior Ref No: J27 **Puzz Points: 12**

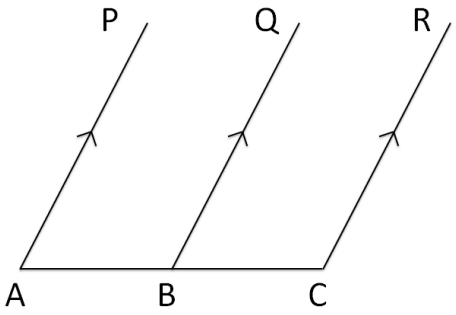
[JMO 2001 B3] In the diagram, B is the midpoint of AC and the lines AP, BQ and CR are parallel. The bisector of $\angle PAB$ meets BQ at Z.

Draw a diagram to show this, and join Z to C.

(i) Given that $\angle PAZ = x°$, find $\angle ZBC$ in terms of x.

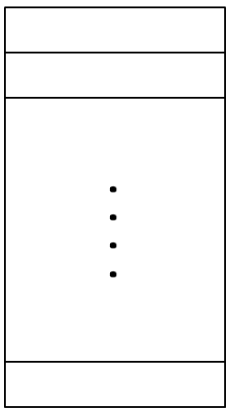
(ii) Show that CZ bisects $\angle BCR$.

(You must give full reasons to justify your answer)



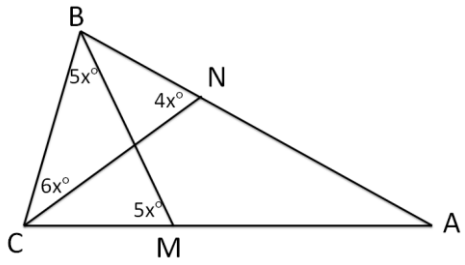
Level: Junior Ref No: J28 **Puzz Points: 13**

[JMO 2001 B4] The diagram shows a large rectangle whose perimeter is 300cm. It is divided up as shown into a number of identical rectangles, each of perimeter 58cm. Each side of these rectangles is a whole number of centimetres. Show that are exactly two possibilities for the number of smaller rectangles and find the size of the large rectangle in each case.



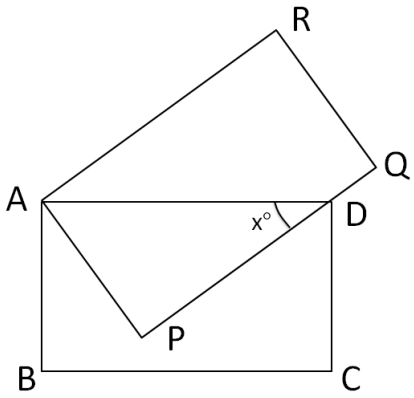
Level: Junior Ref No: J34 **Puzz Points: 13**

[JMO 2011 B4] In a triangle ABC, M lies on AC and N lies on AB so that $\angle BNC = 4x°$, $\angle BCN = 6x°$ and $\angle BMC = \angle CBM = 5x°$. Prove that triangle ABC is isosceles.



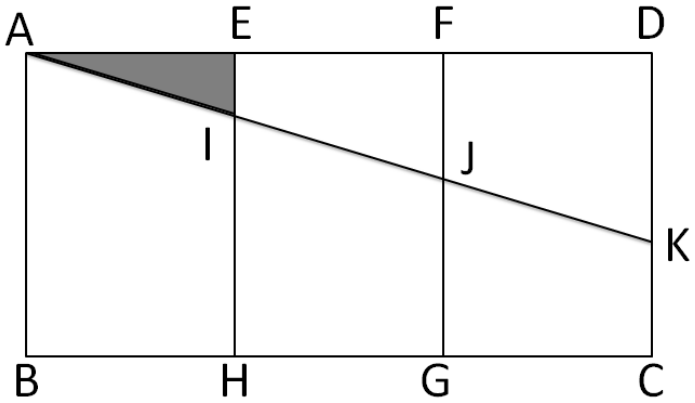
Level: Junior Ref No: J39 **Puzz Points: 12**

[JMO 2008 B3] In the diagram ABC and APQR are congruent triangles. The side PQ passes through the point D and $\angle PDA = x°$. Find an expression for $\angle DRQ$ in terms of x.



Level: Junior Ref No: J41 **Puzz Points: 14**

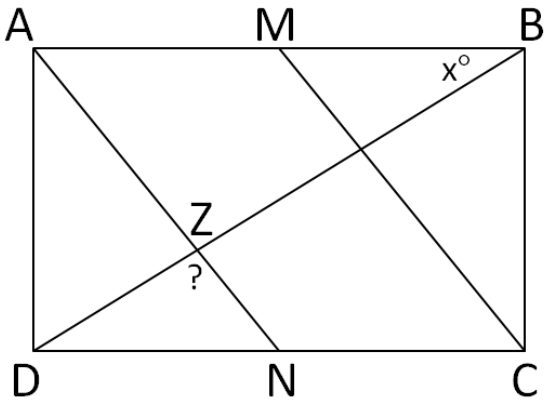
[JMO 2008 B5] In the diagram, the rectangle ABCD is divided into three congruent rectangles. The line segment JK divides CDFG into two parts of equal area. What is the area of triangle AEI as a fraction of the area of ABCD?



Level: Junior Ref No: J43 **Puzz Points: 10**

[JMO 2004 B1] In the rectangle ABCD, M and N are the midpoints of AB and CD respectively; AB has length 2 and AD has length 1.

Given that $\angle ABD = x°$, calculate $\angle DZN$ in terms of x.



Level: Junior Ref No: J44 **Puzz Points: 11**

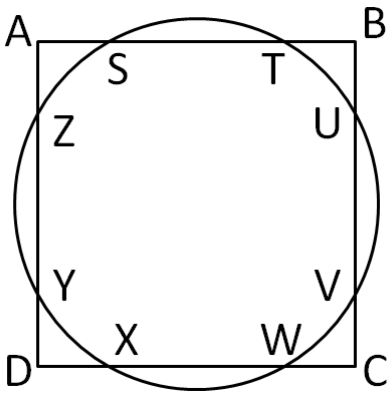
[JMO 2004 B2] Three identical rectangular cards can be placed end to end (with their short sides touching) to make rectangle A, and can be placed side by side (with their long sides touching) to make rectangle B. The perimeter of rectangle A is twice the perimeter of rectangle B.

Find the ratio of the length of a short side to the length of a long side of each card.

Level: Junior Ref No: J46 **Puzz Points: 13**

[JMO 2004 B4] In the square ABCD, S is the point one quarter of the way from A to B and T is the point one quarter of the way from B to A. The points U, V, W, X, Y and Z are defined similarly. The eight points S, T, U, V, W, X, Y, Z lie on a circle, whose centre is at the centre of the square.

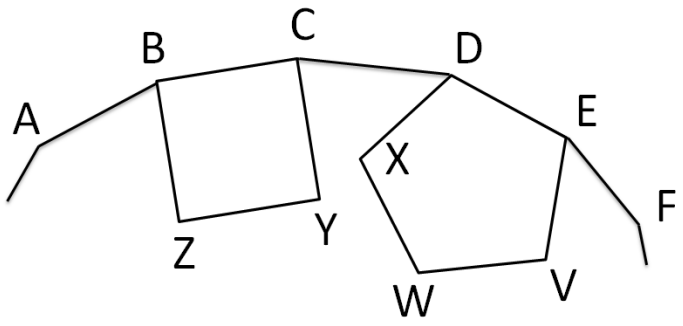
Determine which has the larger area: the square ABCD, or the circle.



Level: Junior Ref No: J53 **Puzz Points: 14**

[JMO 2010 B5] The diagram, shows part of a regular 20-sided polygon (an icosagon) ABCDEF..., a square BCYZ and a regular pentagon DEVWX.

Show that the vertex X lies on the line DY.



Level: Junior Ref No: J56 **Puzz Points: 11**

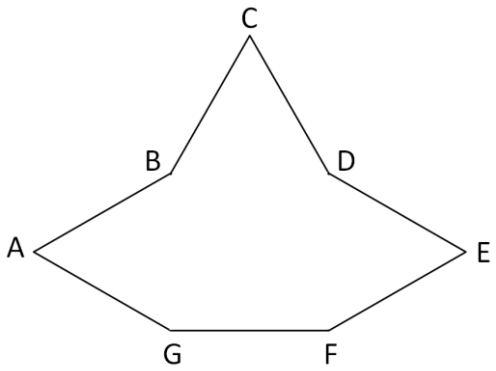
[JMO 2009 B2] *ABCD* is a square. The point *E* is outside the square so that *CDE* is an equilateral triangle.

Find angle *BED*.

Level: Junior Ref No: J58 **Puzz Points: 13**

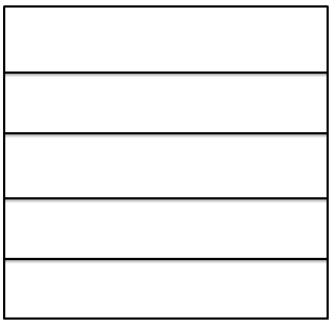
[JMO 2009 B4] The diagram shows a polygon $ABCDEFG$, in which $FG = 6$ and $GA = AB = BC = CD = DE = EF$. Also $BDFG$ is a square. The area of the whole polygon is exactly twice the area of $BDFG$.

Find the length of the perimeter of the polygon.



Level: Junior Ref No: J62 **Puzz Points: 11**

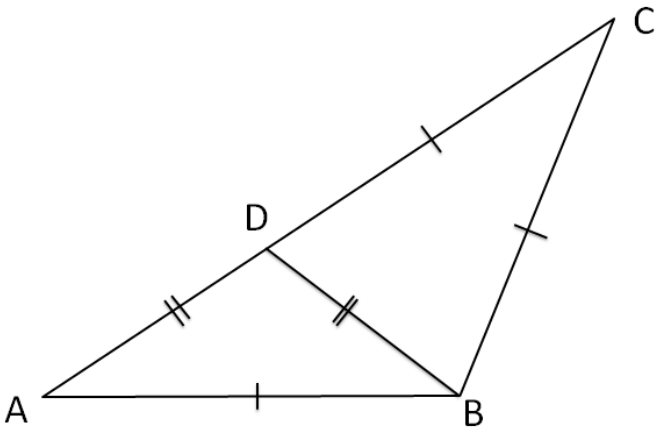
[JMO 2005 B2] The diagram shows a square which has been divided into five congruent rectangles. The perimeter of each rectangle is 51cm. What is the perimeter of the square?



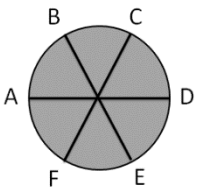
Level: Junior Ref No: J64 **Puzz Points: 13**

[JMO 2005 B4] In this figure ADC is a straight line and $AB = BC = CD$. Also, $DA = DB$.

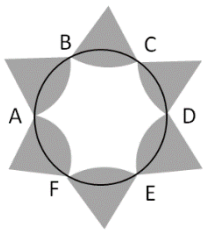
Find the size of $\angle BAC$.



Level: Junior Ref No: J66 **Puzz Points: 15**



[JMO 2005 B6] Points A, B, C, D, E and F are equally spaced around a circle of radius 1. The circle is divided into six sectors as shown on the left.



The six sectors are then rearranged so that A, B, C, D, E and F lie on a new circle, also of radius 1, as shown on the right with the sectors pointing outwards.

Find the area of the curvy *unshaded* region.

Solutions

These are numerical solutions only where applicable. For full solutions, please buy past papers from http://shop.ukmt.org.uk/downloads

J03. 13

J05. –

J09. $x = 80$

J14. –

J17. $\frac{21\sqrt{3}}{2}$

J21. $36°$

J22. $12 + 4\sqrt{3}$

J27. -

J28. 28cm by 122cm and 18cm by 132cm

J34. -

J39. $\frac{1}{2}x$

J41. $\frac{1}{30}$

J43. $135 - x$

J44. $1:5$

J46. $16:5\pi$. Square has larger area.

J53. -

J56. $45°$

J58. 36

J62. 85cm

J64. $36°$

J66. $3\sqrt{3} - \pi$