**1** If the values of two angles in a triangle are 60 and 75 degrees respectively, what is the measure of the third angle?

Proposed by Evan Zhang.

Answer: 45

Solution: The sum of three angles in a triangle is 180 so the third angle's measure is 180 - 60 - 75 = 45.

**2** Square ABCD has side length 1. What is the area of triangle ABC?

Proposed by Bradley Guo.

Answer:  $\left|\frac{1}{2}\right|$ 

**Solution:** Triangle *ABC* has the same area as triangle *ACD* and their sum is 1. So triangle *ABC* has area  $\frac{1}{2}$ .

**3** An equilateral triangle and a square have the same perimeter. If the side length of the equilateral triangle is 8, what is the square's side length?

Proposed by Evan Zhang.

Answer: 6

**Solution:** The perimeter of the triangle is  $3 \cdot 8 = 24$ . The perimeter of the square is also 24 so its side length must be  $\frac{24}{4} = 6$ .

**4** What is the maximum possible number of sides and diagonals of equal length in a quadrilateral?

Proposed by Bradley Guo.

Answer: 5

**Solution:** A rhombus with angles 60 and 120 degrees has 4 sides and 1 diagonal of equal length. A quadrilateral with all 4 sides and 2 diagonals of equal length is impossible because a rhombus with equal-length diagonals is a square, which has a diagonal that is longer than its side length.

5 A square of side length 4 is put within a circle such that all 4 corners lie on the circle. What is the diameter of the circle?

Proposed by Kevin Yao.

Answer:  $4\sqrt{2}$ 

**Solution:** The diameter of the circle will be a diagonal of the square by symmetry. The side length of the square is by Pythagorean theorem  $\sqrt{4^2 + 4^2} = 4\sqrt{2}$ .

6 Patrick is rafting directly across a river 20 meters across at a speed of 5 m/s. The river flows in a direction perpendicular to Patrick's direction at a rate of 12 m/s. When Patrick reaches the shore on the other end of the river, what is the total distance he has traveled?

Proposed by Kevin Yao.

Answer: 52

**Solution:** Every second, Patrick moves 5 meters towards the other side of the river, and 12 meters along the river. Thus, he travels 13 meters every second for 4 seconds, which gives a total distance of 52.

7 Quadrilateral ABCD has side lengths AB = 7, BC = 15, CD = 20, and DA = 24. It has a diagonal length of BD = 25. Find the measure, in degrees, of the sum of angles ABC and ADC.

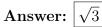
Proposed by Kevin Yao.

**Answer:** 180

**Solution:** 7-24-25 and 15-20-25 are both Pythagorean triples, and so two of the angles are right angles. Since the sum of the internal angles of a quadrilateral is 360,  $m\angle ABC + m\angle ADC = 360 - 180 = 180$ .

8 What is the largest P such that any rectangle inscribed in an equilateral triangle of side length 1 has a perimeter of at least P?

Proposed by Bradley Guo.



**Solution:** Two corners of the rectangle must be on the same side of the triangle. Let the side length of the edge between the two corners be x. Then the other side length of the rectangle is  $\frac{(1-x)\sqrt{3}}{2}$ , and so the perimeter of the rectangle is  $\sqrt{3} + (2 - \sqrt{3})x$ . This is minimized at x = 0 which gives an answer of  $\sqrt{3}$ .