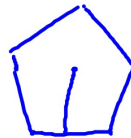
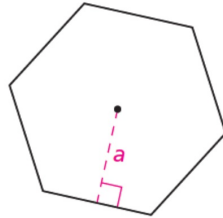


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Please record the definition of apothem in your notes

Definition

The **apothem** a of a regular polygon is a perpendicular segment from the center point of the polygon to one of its sides.



5.3 Connecting Area, Circumference

Objective: To establish that the area of some regular polygons is the perimeter times the apothem.

For Discussion

1. Find the area of a regular hexagon of side 12 in.

$A = 62.34 \times 6$
 $A = 374.04 \text{ in}^2$

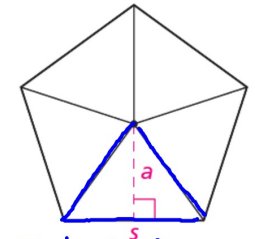
$A = \frac{1}{2}bh$
 $A = \frac{1}{2}(12)(10.39)$
 $A = 62.34 \text{ in}^2$

$a^2 + b^2 = c^2$
 $6^2 + h^2 = 12^2$
 $36 + h^2 = 144$
 $-36 \quad -36$
 $h^2 = 108$
 $h \approx 10.39$

In-Class Experiment

In this experiment, you will find a formula for the areas of regular polygons.

2. Look at the regular pentagon and divide it into five congruent triangles meeting at the center. What role does the apothem a of the pentagon play for each of these triangles? *a is the height*
3. If s is the length of each side of the pentagon, what is the area of each congruent triangle? What is the area of the whole pentagon? $A = \frac{1}{2}(s)(a)$
4. What would change if the regular polygon had four sides, six sides, or n sides? Can you find the polygon's perimeter somewhere in the formula for its area?

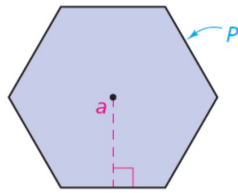


$$A = 5 \cdot \frac{1}{2}(s)(a)$$

$$A = \frac{1}{2}Pa$$

Theorem 5.1

The area A of a regular polygon is equal to half of the product of its perimeter P and its apothem a .



$$A = \frac{1}{2} Pa$$

For You to Do

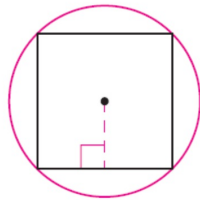
- What is the area of a regular hexagon with side length 8?
- Use the area formula $A = \frac{1}{2} Pa$ to calculate the area of a square with side length 12. Check your result by calculating the area of the square another way.

$4^2 + a^2 = 8^2$
 $16 + a^2 = 64$
 $-16 \quad -16$
 $a^2 = 48$
 $a = 6.92$

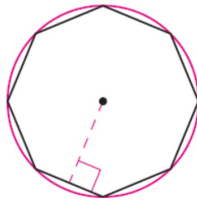
$A = \frac{1}{2} Pa$
 $P = 48$
 $a = 6.92$
 $A = \frac{1}{2} (48)(6.92) = 166.08 u^2$

For Discussion

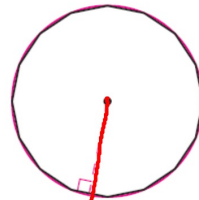
- Below are three regular polygons, each inscribed in a circle with radius r . The number of sides in each polygon increases from 4 to 8 to 16. Imagine that these pictures continue for a sequence of regular polygons with more and more sides inscribed in this same circle.



4 sides



8 sides



16 sides

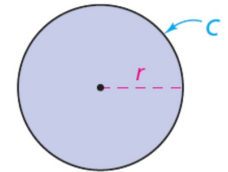
Think about how the length of each polygon's apothem changes as you draw polygons with more and more sides. Compare each polygon's perimeter and area with the circumference and area of the circle each is inscribed in.

Theorem 5.2 Area & Circumference of a circle

$$A = \frac{1}{2} Pa$$

$$A = \frac{1}{2} Cr$$

$A = \pi r^2$
 $C = 2\pi r = \pi d$



For You to Do

- A flying disc has area 154 in.^2 and diameter 14 in. Find its circumference.

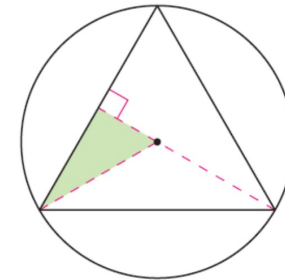
$$14\pi \text{ in}$$

On Your Own

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5. Find the area of each figure.

- A stop sign has sides that are 6 inches long and an apothem that is 7.2 inches.
- In the figure, an equilateral triangle is inscribed in a circle of radius 2 cm. The center of the circle that circumscribes a triangle is the triangle's circumcenter. The circumcenter of a triangle divides each of the triangle's medians into two segments. One is twice as long as the other. This should give you enough information to find the side length of the equilateral triangle using the shaded triangle in the figure.



- A wheel of a toy car has an area of 5 cm^2 and a radius of 1.26 cm. There is a mark on the point of the wheel that touches the floor. You start pushing the car forward and the marked point does not touch the floor any more. What is the shortest distance you have to push the car for the mark to touch the floor again?
- Standardized Test Prep** Beth wants to find the area she can enclose with 264 mm of string. She makes a circle so that the ends of the string touch. The circle has a radius of 42 mm. What is its area?
A. 1764 mm^2 B. 3353 mm^2 C. 5544 mm^2 D. $11,088 \text{ mm}^2$