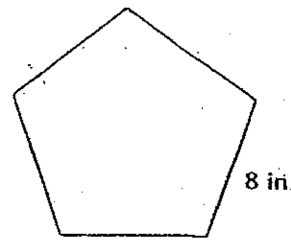
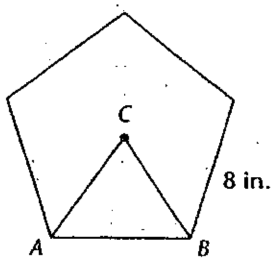
NAME ______________________________ CLASS ______________ DATE ______________

Enrichment
10.1 Revisiting Areas of Regular Polygons



The figure at right is a regular pentagon. Recall that the formula for the area, A, of a regular polygon is $A = \frac{1}{2}ap$, where a is the length of its apothem and p is its perimeter. Since the apothem is not labeled in this figure, it may seem that you cannot find the area. In Exercises 1–4, however, you will see how you can apply your knowledge of the tangent ratio to find the "unknown" length of the apothem and, consequently, find the area.

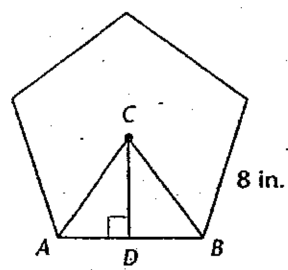
1. Draw the center, C, and radii $\overline{AC}$ and $\overline{BC}$.



a. $m\angle ACB =$ __________

b. $m\angle ABC =$ __________

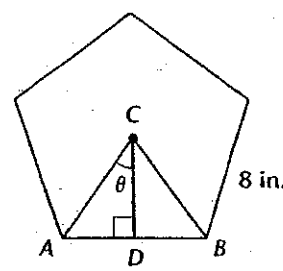
2. Draw an apothem, $\overline{CD}$, perpendicular to $\overline{AB}$.



a. $m\angle ACD =$ __________

b. $AD =$ __________

3. Identify $m\angle ACD$ as θ. Write a tangent ratio.



$\tan \square^\circ = \dfrac{\square}{CD}$

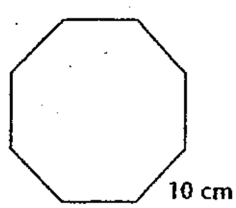
4. a. Now solve the equation from Exercise 3 to find the length, a, of the apothem. Round to the nearest hundredth. $a \approx$ __________

b. What is the perimeter, p, of the regular pentagon? $p =$ __________

c. What is the area, A, of the regular pentagon? $A \approx$ __________

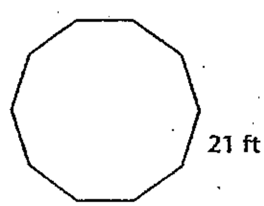
Find the area, A, of each regular polygon. Round your answers to the nearest tenth.

5.



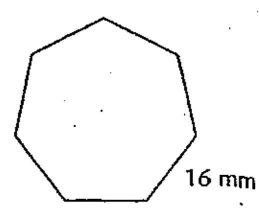
$A \approx$ __________

6.



$A \approx$ __________

7.



$A \approx$ __________

Devise a formula that can be used to find the following:

8. the area, A, of a regular n-gon given the length of one side, s __________

9. the area, A, of a regular n-gon given the length of its apothem, a __________

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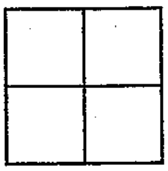
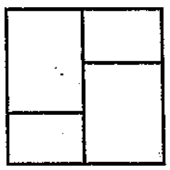
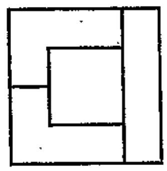
11.4 Coloring a Map

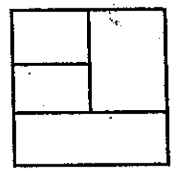
When a map is made, no two regions sharing a common border should have the same color. For centuries, map makers have tried to use the fewest colors possible while following this practice. It was not until the twentieth century, however, that topologists were finally able to find the smallest number of colors required for any map. On this page you will investigate the problem by using some simple maps.

Each "map" below has four regions. Color each map with as few colors as possible so that no two regions touching along an edge have the same color. If two regions touch only at a corner, they are not considered to touch along an edge.

1. 

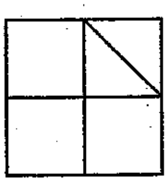
2. 

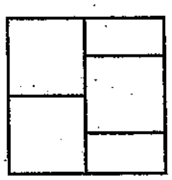
3. 

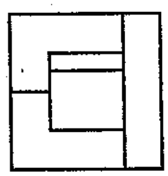
4. 

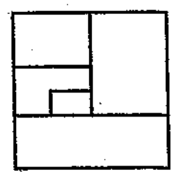
You probably discovered that the map in Exercise 3 required four colors. Do you think this means that a map with five regions may require five colors?

Each map below has five regions. Color each map with as few colors as possible so that no two regions touching along an edge have the same color.

5. 

6. 

7. 

8. 

You probably found that, even with five regions, the greatest number of colors you required was four. With the aid of computers, topologists have been able to prove that, for any map on a plane surface, with any number of regions, the greatest number of colors required is four. This is called the **Four-Color Map Theorem.**

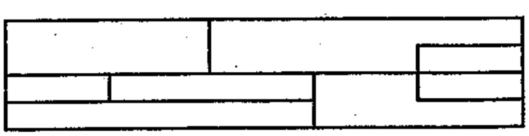
On a separate sheet of paper, draw a map with six regions that requires:

9. exactly two colors

10. exactly three colors

11. exactly four colors

12. Do you think that the Four-Color Map Theorem applies to a map on a Möbius strip? Copy each pattern below onto a long strip of paper. Make the lines heavy enough so that they are visible on both sides of the paper. Then cut out the strip, give it a half-twist, and tape both sides securely to form a Möbius strip. How many colors are required for each map?

a. 

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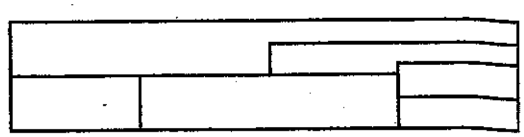
b. 

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