

Student Guide

Angles in Polygons

Questions 1–16 (SG pp. 396–401)

1.\* Answers will vary. Students may reply that polygons are made of line segments connected at endpoints, and that each endpoint meets the endpoint of only one other side with no overlap.

2–6. Steps should produce an angle sum that is as close to a straight angle as shown:



7–8. Sum of angles should be close to  $180^\circ$ .

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**Angles in Polygons**

**What is a Polygon?**  
These shapes are polygons.

These shapes are *not* polygons.

1. What makes a shape a polygon?

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**Adding the Angles of a Triangle**  
To investigate the angles in a triangle, complete the following questions.

2. Use a pencil and ruler to draw a triangle on a sheet of blank paper. Make sure the triangle covers at least one fourth of the paper. Mark the vertices with dots as shown in the example.

3. Measure the three angles of the triangle with your protractor. Write the angle measures inside the triangle. Cut out the triangle.

4. Tear off the three angles as shown in the example.

5. Place the three angles next to each other with the vertices and edges touching each other as shown.

6. Describe the angle that is formed when all three angles are placed together this way.

7. Add the angle measures of each angle in your triangle. What is the sum of the three angles?

8. Compare your results for Questions 6 and 7 with at least two other students' results. How do your results compare?

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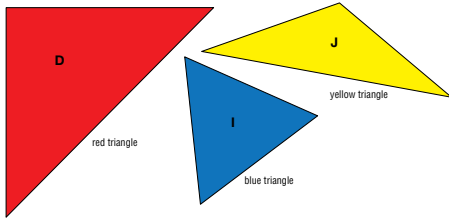
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\*Answers and/or discussion are included in the lesson.

# Answer Key • Lesson 5: Angles in Polygons

9. Measure (or use shortcuts) to find the measures of the angles in the three Power Polygons™ below. Fill in a table like the one below to find the sums of the angles of those triangles.



Triangle	Angle Measures			Sum of Angles
Red Triangle (D)				
Blue Triangle (I)				
Yellow Triangle (J)				

10. A. Write a rule about the sum of the angles in a triangle.  
 B. Do you think the rule is true for every triangle? Explain your thinking.

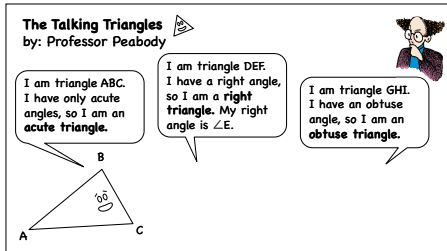
The students in Mrs. Dewey's class answered Question 7 using their own triangles. Nila found the sum of the angles in her triangle to be  $180^\circ$ . When Romesh added the angles in his triangle, the sum was  $179^\circ$ . Ana's sum was  $182^\circ$ .

11. Why do you think the three students' measurements were different from each other?  
 12. Think about the kinds of angles that make up the 180 degrees in a triangle.  
 A. Can a triangle have all acute angles? If so, show an example.  
 B. Can a triangle have all right angles? More than one right angle? Show or tell how you know.  
 C. Can a triangle have more than one obtuse angle? Show or tell how you know.

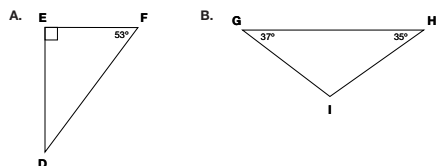
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Professor Peabody forgot to finish drawing the triangles in his cartoon below.



13. A. Do you agree that triangle ABC is an acute triangle? How do you know?  
 B. Use a ruler to make a sketch of the two missing triangles on a separate sheet of paper. Label the vertices with the correct letters.  
 14. Can an obtuse triangle have a right angle? Explain.  
 15. Find the missing degree measures for the triangles below. Do not measure the angles.



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\*Answers and/or discussion are included in the lesson.

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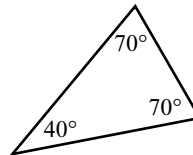
9. Angle measures and sums should be close to the following:

Triangle	Angle Measures			Sum of Angles
Red Triangle (D)	$45^\circ$	$45^\circ$	$90^\circ$	$180^\circ$
Blue Triangle (I)	$60^\circ$	$60^\circ$	$60^\circ$	$180^\circ$
Yellow Triangle (J)	$30^\circ$	$30^\circ$	$120^\circ$	$180^\circ$

10. A–B. Answers will vary, but should include the result that the sum of the angles in any triangle is  $180^\circ$ .

11.\* Errors are likely in measurement.

12. A. Yes.

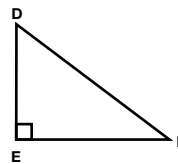


B. No, two right angles have a sum of  $180^\circ$  already. The triangle cannot be completed with a third angle.

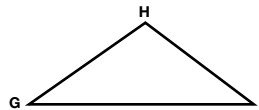
C.\* No. Similar reasoning to Part B.

13. A. Yes. Explanations will vary.  
 Possible explanation: All the angles are less than  $90^\circ$ .

B. Possible right triangle:



Possible obtuse triangle:



14. No. The sum of the obtuse angle and a right angle is already greater than the sum of all three angles in a triangle,  $180^\circ$ .

15. A.\*  $\angle D = 37^\circ$   
 B.  $\angle I = 108^\circ$

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16. A.  $\angle A = 60^\circ$ ; Possible explanation:

$$\angle D + \angle E + \angle A = 180^\circ$$

$$\text{so } 90^\circ + 30^\circ + 60^\circ = 180^\circ$$

B.  $\angle AGB = 30^\circ$ ; Possible explanation:

$$\angle A + \angle G + \angle B = 180^\circ;$$

$$60^\circ + \angle G + 90^\circ = 180^\circ;$$

$$\text{so } \angle AGB = 30^\circ.$$

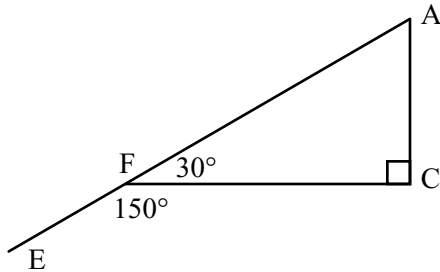
C.  $\angle AFC = 30^\circ$ ; Possible explanation:

$$\angle A = 60^\circ, \angle C = 90^\circ, \text{ so } \angle F = 30^\circ,$$

D.  $\angle EFC = 150^\circ$ ; Possible explanation:

$$\overline{AE} \text{ makes a straight angle. I know}$$

$$\angle AFC = 30^\circ, \text{ so } 180^\circ - 30^\circ = 150^\circ.$$



E. Polygon EFCD =  $180^\circ$ . Possible explanation:  $90^\circ + 90^\circ + 30^\circ + 150^\circ = 360^\circ$ .

### Student Guide

#### Homework

#### Questions 1–8 (SG pp. 401–404)

- B, D, F, and H are polygons.
- A has a curved side.  
C has two segments with unconnected ends.  
E has two segments that touch other segments at three points.  
G has curved sides.
- A.  $13^\circ$   
B.  $54^\circ$   
C.  $69^\circ$   
D.  $131^\circ$
- Hexagon LMNOPQ is not regular. The angles are not all equal.  $\angle P$  and  $\angle M$  are acute.  $\angle L$ ,  $\angle N$ ,  $\angle O$ , and  $\angle Q$  are obtuse.

16. Find the missing degree measures in the triangles below. Do not measure the angles. Show or tell how you calculated the measure of each angle.

- What is the measure of  $\angle A$ ?
- What is the measure of  $\angle AGB$ ?
- What is the measure of  $\angle AFC$ ?
- What is the measure of  $\angle EFC$ ?
- Look at polygon EFCD. What is the sum of all the angles?

Use the *Add and Subtract Angles* pages in the *Student Activity Book* to practice finding unknown angle measurements.

**Homework**

- Which of these shapes are polygons?
- Which are not polygons? Explain why each is not a polygon.

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3. Without a protractor, find the measure of each missing angle. Name the missing angle with your measurement.

- 
- 
- 
- 

4. Is hexagon LMNOPQ regular? Why or why not?

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# Answer Key • Lesson 5: Angles in Polygons

5. A. Find a right triangle in the picture above. Name your triangle using the letters of the triangle's three vertex points.  
 B. Find an acute triangle in the picture above.  
 C. Find an obtuse triangle in the picture above.  
 D. Can you find more examples of right, acute, and obtuse angles in the picture? Name as many of each as you can.

6. Find the missing angle measures in the triangles below. Do not measure the angles.

A. B. C.

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5. A. Right triangles: triangles BCA and BCE  
 B. Acute triangles: triangle AED, BAD, and ACD  
 C. Obtuse triangles: triangles AEB, DEC, and BCD  
 D. Additional examples will vary.
6. A.  $23^\circ$   
 B.  $55^\circ$   
 C.  $85^\circ$
7.  $70^\circ$
8. A.  $90^\circ$   
 B.  $90^\circ$   
 C.  $90^\circ$   
 D.  $90^\circ$   
 E.  $30^\circ$   
 F.  $30^\circ$   
 G.  $60^\circ$

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7. Without using a protractor, find the measure of  $\angle DBA$ .

8. Find the measurements for all the angles in the figure. Do not use your protractor.

A.  $\angle T$   
 B.  $\angle V$   
 C.  $\angle TSV$   
 D.  $\angle TUV$   
 E.  $\angle VSU$   
 F.  $\angle SUT$   
 G.  $\angle SUV$

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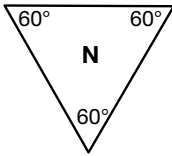
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Student Activity Book

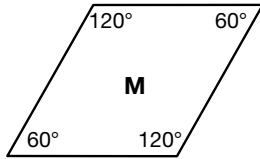
Measuring Polygon Angles

Questions 1–10 (SAB pp. 329–331)

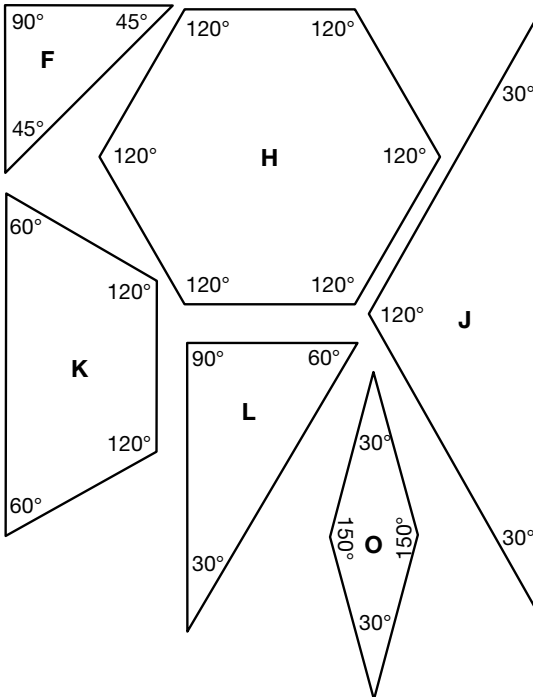
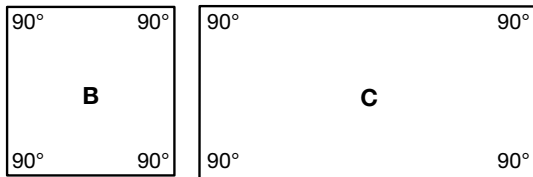
1.\*



2.\*



3.



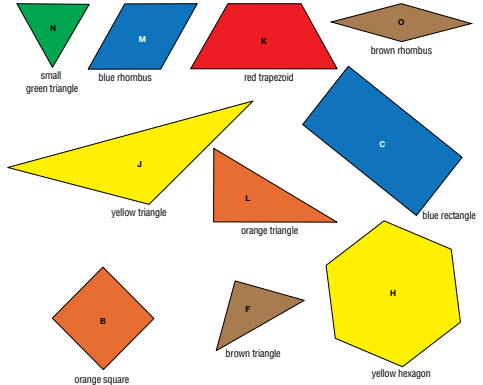
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\*Answers and/or discussion are included in the lesson.

Name \_\_\_\_\_ Date \_\_\_\_\_

Measuring Polygon Angles

Here are the names for ten Power Polygons™. Take out these polygons to help you answer Questions 1–3 below.



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1. Find the measures of the angles of the small green triangle. Write the angle measures inside the green triangle above.
2. Place two green triangles on top of the blue rhombus. What is the degree measure of each of the angles of the rhombus? (Hint: you do not have to measure.) Write the angle measures inside the blue rhombus above.
3. Find the angle measures of all the polygons. You can use shortcuts to find angle measures. Write the angle measures inside the pictured shapes.

Angles in Polygons

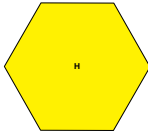
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# Answer Key • Lesson 5: Angles in Polygons


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4. Explain the shortcuts you can use to find the angle measures of the yellow hexagon.



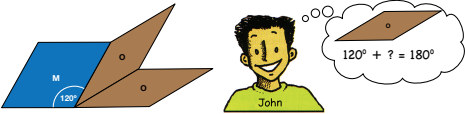
yellow hexagon

5. Explain the shortcuts you can use to find the angle measures of the red trapezoid.



red trapezoid

6. John decided that the small angle of a brown rhombus is  $60^\circ$ . He noticed that when he put together the large angle of a blue rhombus with the small angles on two brown rhombuses, they made a  $180^\circ$  angle.



Do you agree that the small angle on a brown rhombus is  $60^\circ$ ? Why or why not?

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7. Linda wrote the following number sentence to show her shortcuts. Find the missing angle and show which Power Polygons™ she might have put together.

$$60^\circ + n = 90^\circ$$

A polygon is a **regular polygon** if all sides are the same length and all angles have the same degree measure.

8. Use the Power Polygons™ to trace three polygons that are regular and three that are not regular in the table below. Name each polygon.

Regular Polygons	Not Regular Polygons

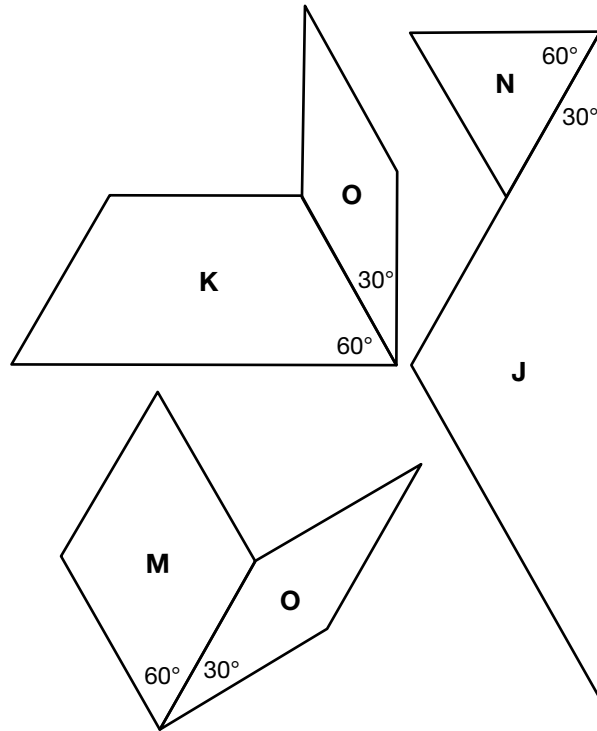
9. Show or tell how to decide if the blue rhombus is a regular polygon.

10. Show or tell how to decide if the yellow hexagon is a regular polygon.

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4. Answers may vary. Possible response: Two red trapezoids (K) cover the yellow hexagon (H), which is a regular shape. I know one angle is  $120^\circ$ , so they all are  $120^\circ$ .
5. Answers may vary. Possible response: I used a small green triangle (N). The acute angle is  $60^\circ$  and the obtuse angle is two  $60^\circ$  angles which is  $120^\circ$ .
6. No, John did not consider that there are two brown rhombuses. He should have divided  $60^\circ$  by 2.
7.  $N = 30^\circ$ ;  $60^\circ + 30^\circ = 90^\circ$
- Responses may vary. Possible response:



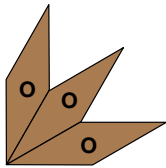
8. Regular polygons include the small green triangle (N), orange square (B), and yellow hexagon (H). All others are not regular.
9. Sides are equal but all angles are not equal.
10. All sides and all angles are equal.

Student Activity Book

Add and Subtract Angles

Questions 1–5 (SAB pp. 332–333)

1.  $\angle A$  is about  $35^\circ$   
 $\angle B$  is about  $155^\circ$   
 $\angle C$  is about  $135^\circ$   
 $\angle D$  is about  $90^\circ$   
 $\angle E$  is about  $29^\circ$   
 $\angle F$  is about  $276^\circ$
2.  $\angle R = 65^\circ$   
 $\angle U = 45^\circ$   
 $\angle X = 10^\circ$
3. A.  $90^\circ$   
 B.  $90^\circ$   
 C.  $90^\circ$   
 D. The sum of the acute angles in a right triangle is  $90^\circ$ .
4.  $\angle G = 20^\circ$   
 $\angle H = 70^\circ$
5. A.  $n = 30^\circ$



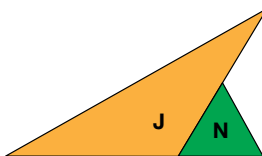
B.  $n = 60^\circ$



C.  $n = 45^\circ$



D.  $n = 60^\circ$

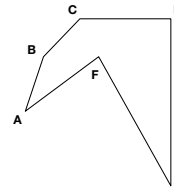


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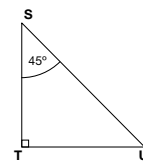
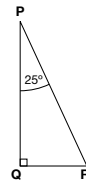
Name \_\_\_\_\_ Date \_\_\_\_\_

Add and Subtract Angles

1. Measure the angles of hexagon ABCDEF. Write your measurement next to each angle.



2. Find the missing angle measurements in the triangles below. Write the measurement next to each angle.



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3. Look at the triangles in Question 2.
  - A. Find the sum of  $\angle P$  and  $\angle R$ .
  - B. Find the sum of  $\angle S$  and  $\angle U$ .
  - C. Find the sum of  $\angle X$  and  $\angle V$ .
  - D. What pattern do you see in the sum of each pair of angles?

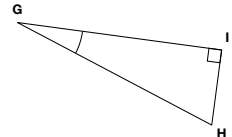
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Angles in Polygons

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4. The sum of  $\angle G$  and  $\angle I$  is  $110^\circ$ . Find the measure of  $\angle G$  and  $\angle H$ . Write the angle measure next to the angle.



5. Each number sentence shows how the angles in some Power Polygons™ are put together. Find the missing angle in each number sentence. Then match the number sentence to the picture it describes on the right.

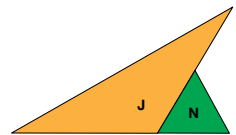
A.  $30^\circ + n + 30^\circ = 90^\circ$

$n =$  \_\_\_\_\_



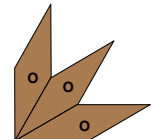
B.  $60^\circ + 60^\circ + n = 180^\circ$

$n =$  \_\_\_\_\_



C.  $45^\circ + 90^\circ + n = 180^\circ$

$n =$  \_\_\_\_\_



D.  $120^\circ + n = 180^\circ$

$n =$  \_\_\_\_\_



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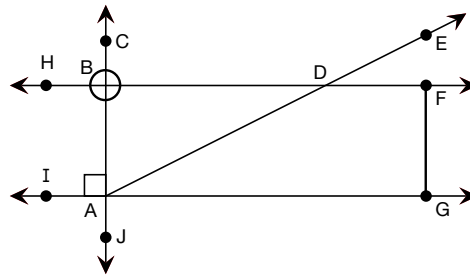
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**Teacher Guide**

**Lines, Angles, and Polygons Quiz**

**Questions 1–12 (TG pp. 1–2)**

- Acute. The angle is smaller than a right angle.
- Possible answers are:  $\angle ADF$  (or  $\angle FDA$ )  
 $\angle BDE$  (or  $\angle EDB, \angle EDH, \angle HDE$ )  
 $\angle IAD$  (or  $\angle IAE, \angle DAI, \angle EAI$ )  
 $\angle JAD$  (or  $\angle JAE, \angle DAJ, \angle EAJ$ )
- A–B.**



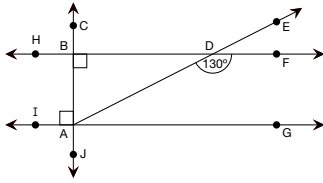
- A.** parallel rays, and **C.** not intersecting rays
- B.** intersecting lines, and **D.** perpendicular lines
- Point D
- Answers will vary. Line should be drawn vertically with arrows on both ends.
- $\angle BDA = 50^\circ$   
 $\angle BAD = 40^\circ$
- $50^\circ$
- $195^\circ$
- A.**  $\angle B = 132^\circ$      $\angle E = 82^\circ$   
**B.** Answers will vary. A possible response is that  $\angle B$  is about mid-way between a right angle ( $90^\circ$ ) and a straight angle ( $180^\circ$ ).  $\angle E$  is very close to a right angle ( $90^\circ$ ) but slightly smaller.
- A.**  $\angle WUV = 60^\circ$   
**B.**  $\angle WVS = 30^\circ$   
**C.**  $\angle TSU = 60^\circ$

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**Lines, Angles, and Polygons Quiz**

Use the picture below to answer Questions 1–8.



- Is  $\angle DAG$  acute, right, or obtuse? Explain why you think so.
- Name an obtuse angle in the picture. \_\_\_\_\_
- A.** Circle point B in the picture.  
**B.** Use a ruler to draw the line segment  $\overline{FG}$ .
- Circle *all* the possible answers.  $\overline{BF}$  and  $\overline{AG}$  are \_\_\_\_\_  
**A.** parallel rays  
**B.** intersecting rays  
**C.** not intersecting rays  
**D.** perpendicular rays
- Circle *all* the possible answers.  $\overline{CA}$  and  $\overline{AG}$  are \_\_\_\_\_  
**A.** parallel lines  
**B.** intersecting lines  
**C.** not intersecting lines  
**D.** perpendicular lines
- Where do  $\overline{AE}$  and  $\overline{BF}$  intersect? \_\_\_\_\_
- Use a ruler to draw a new line in the picture that is parallel to  $\overline{CA}$ .
- Find the measure of  $\angle BDA$  and  $\angle BAD$ . Write the angle measures on the picture above.

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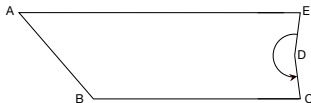
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Assessment Master

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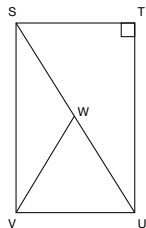
Name \_\_\_\_\_ Date \_\_\_\_\_

Use the picture of polygon ABCDE below to answer Questions 9–11.



- Circle the best estimate for the measure of  $\angle A$ . Do not use a protractor.  
 $110^\circ$     $10^\circ$     $85^\circ$     $170^\circ$     $50^\circ$
- Circle the best estimate for the measure of reflex  $\angle D$ . Do not use a protractor.  
 $80^\circ$     $170^\circ$     $195^\circ$     $45^\circ$     $350^\circ$
- A.** Use a protractor to find the measure of  $\angle B$  and  $\angle E$  to the nearest degree.  
 $\angle B =$  \_\_\_\_\_     $\angle E =$  \_\_\_\_\_  
**B.** Explain how you know your answers are reasonable by describing the size of  $\angle B$  and  $\angle E$ .
- Rectangle STUV is built from three triangles. Triangle UYW has three equal angles. Without using a protractor, find the measure of the angles below. Write the angle measures on the picture.

- $\angle WUV =$  \_\_\_\_\_
- $\angle WVS =$  \_\_\_\_\_
- $\angle TSU =$  \_\_\_\_\_



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