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Chapter 1- Lesson 2
Segments and their Measures

Goals

I can…

Find the lengths of segments using coordinates.

Explain the meaning of the most important theorem in High School math.

I can use the most important theorem in High School math.

Introduction

1. When might it be important to be able to measure the length of a segment?

2. Would there be times when it would not be possible to measure the length of a segment directly? Explain.

3. Would it ever be useful to be able to figure out the length of a segment from the co-ordinates of the endpoints of a segment?

4. In the diagram of collinear points below, $PT = 24$, $QR = 4$, $PS = 14$, and $PQ = RS$.

Find the following. Justify.

a. ST b. PQ c. PR

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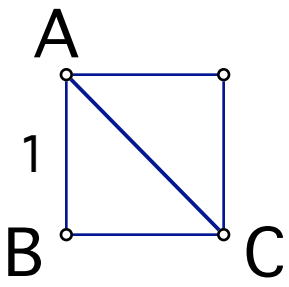
5. What is the segment addition postulate? In your own words, what does it mean?

6. Consider the square below. Which side is longer, $\overline{AB}$ or $\overline{AC}$? Explain.



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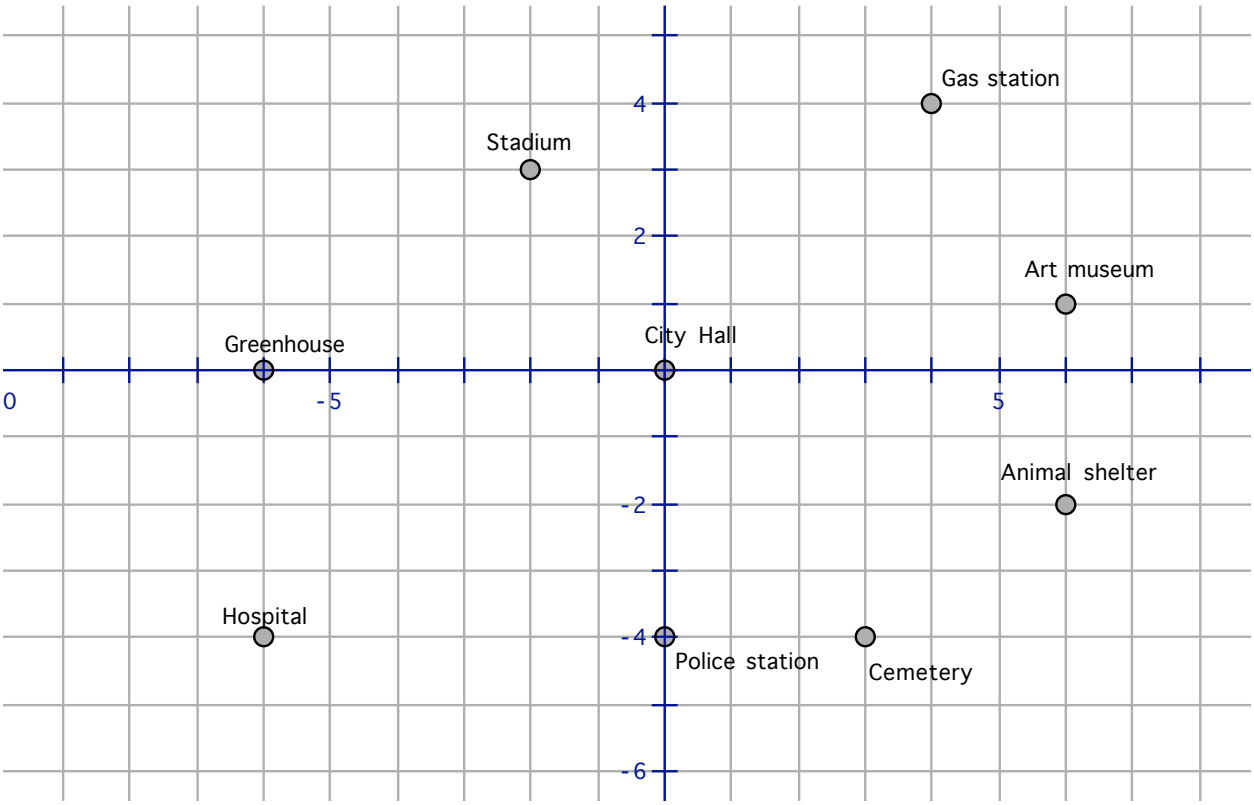
Designing Parks

The Euclid City Council is developing parks with geometric shapes. All of the parks must have corners at the intersection of two streets, and for some parks the council gives the designers additional constraints. For example, Descartes Park must have a border with vertices (1, 1) and (4, 2).

Use the map below to answer the following questions. Be prepared to explain your answers.



7. Suppose Descartes Park is going to be a square. What could the coordinates of the other two vertices be? Give two answers.

8. Suppose Descartes Park is going to be a non-square rectangle. What could the coordinates of the other two vertices be?

9. Suppose Descartes Park is going to be a right triangle. What could the coordinates of the other vertex be?

10. Suppose Descartes Park is going to be a parallelogram that is not a rectangle. What could the coordinates of the other two vertices be?

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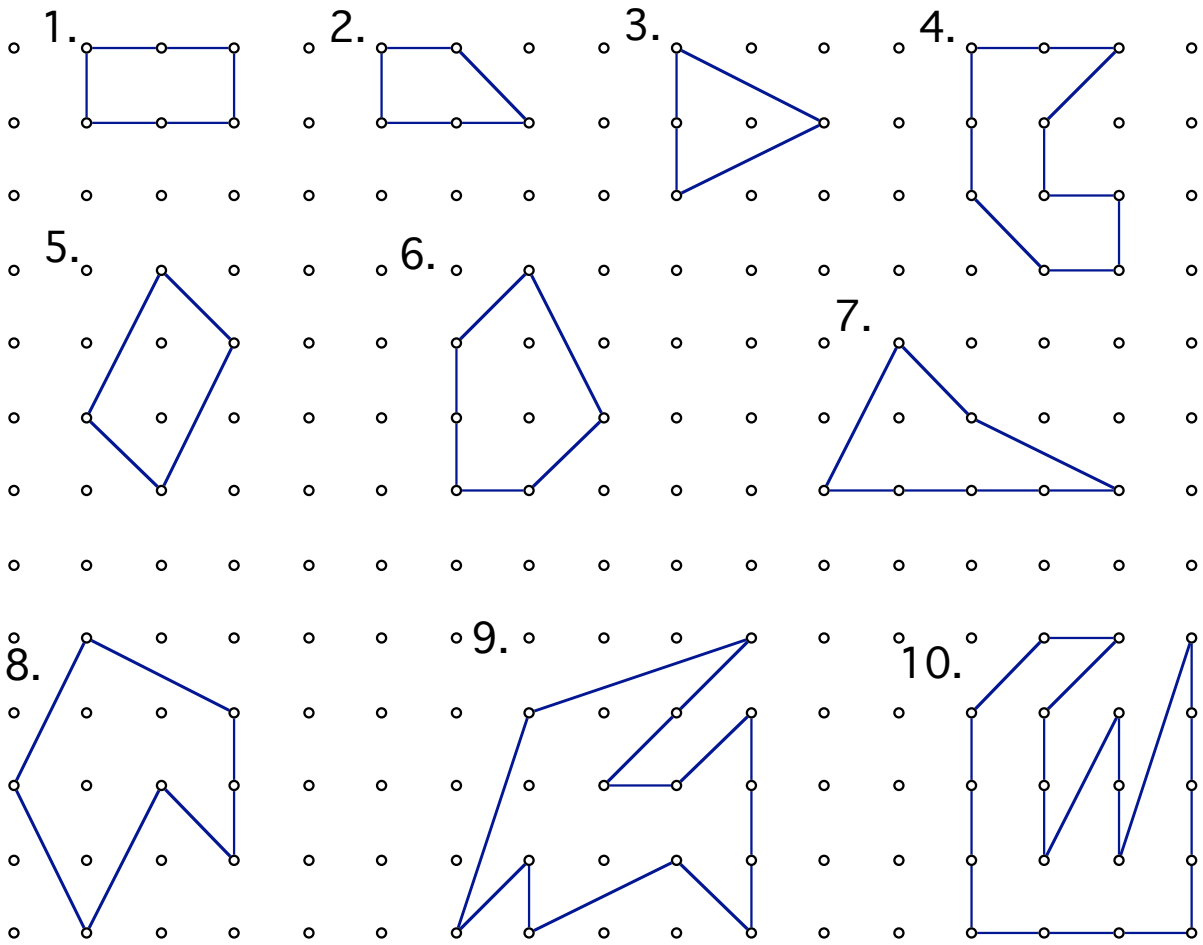
Finding Areas

11. Below are some park designs submitted to the Euclid City Council. To determine costs, the council needs to know the area of each park.



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Finding Squares

12. What are all of the possible areas for squares, with vertices on dots, that can be made on a 5 x 5 grid like the ones below? Use dot or graph paper to investigate then summarize your results below. Staple the dot paper you used to investigate to the back of this packet.

Area	Possible?
1	
2	
3	
4	
5	
6	

Area	Possible?
7	
8	
9	
10	
11	
12	

Area	Possible?
13	
14	
15	
16	
17	
18	

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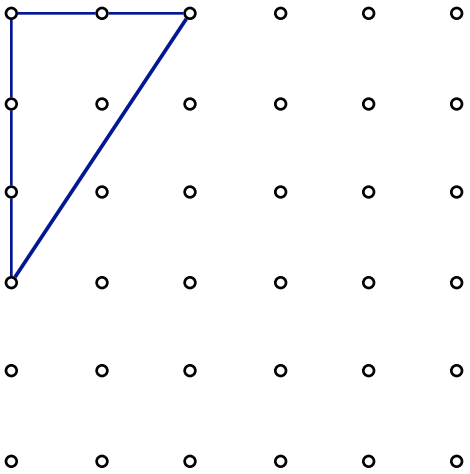
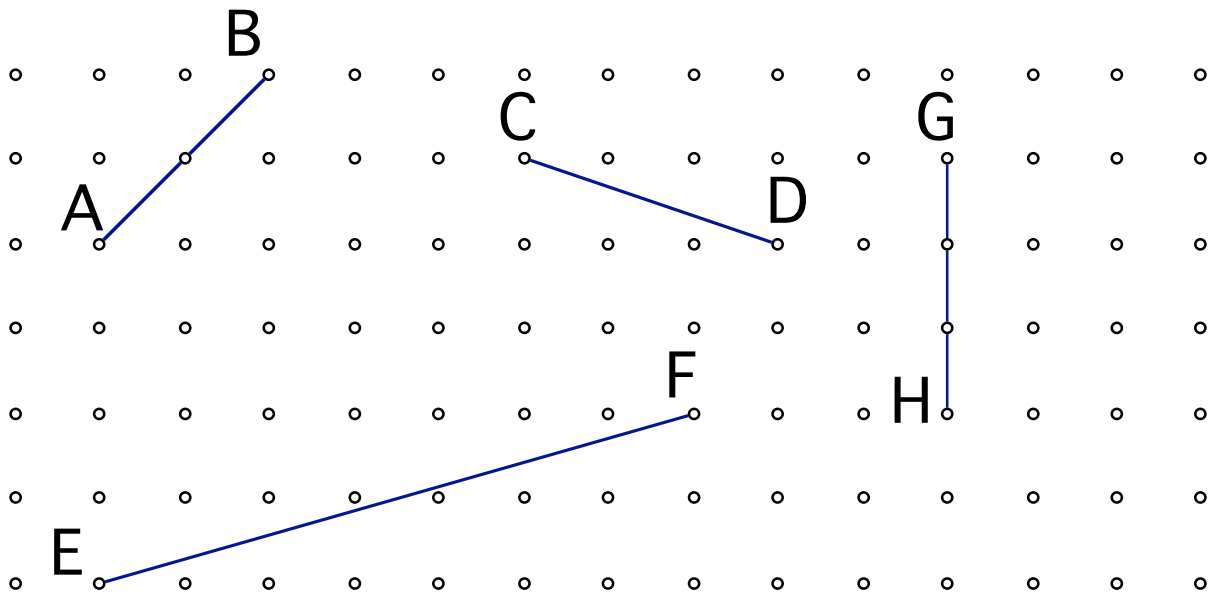
13. Sam drew only what is shown below and then figured out the area the square on the hypotenuse would be-- without actually drawing the square! Show how Sam could have done this.



Drawing Segments

14. What are the lengths of the segments drawn below? Justify.



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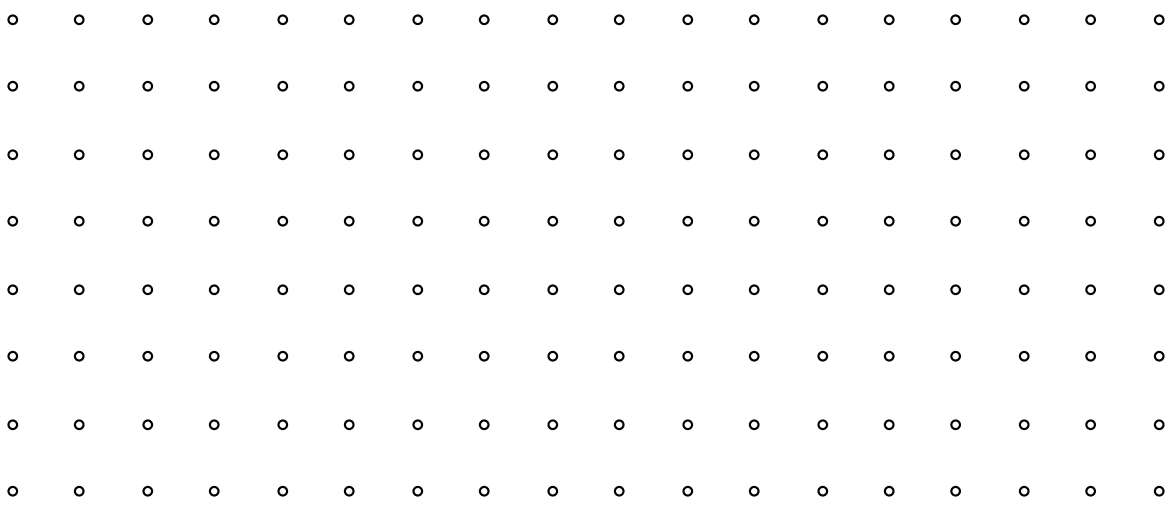
15. Using what you have learned, draw line segments of the following lengths on the dot grid below. Label the endpoints of the segments with appropriate letters. (The endpoints of the segments must be on dots.) Use right triangles to justify.

1. $EF = \sqrt{13}$ 2. $GH = \sqrt{20}$ 3. $IJ = \sqrt{65}$ 4. $LM = 2\sqrt{8}$ 5. $NO = \sqrt{32}$



16. There are two segments above that are congruent. Which ones? Explain why that happened.

17. A student says, “You can make a square with an area of 97 with the vertices on dots if you had a big enough sheet of dot paper.” What do you think? Justify.

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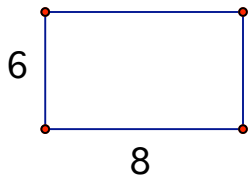
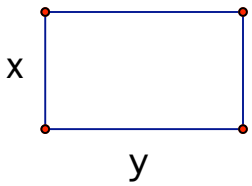
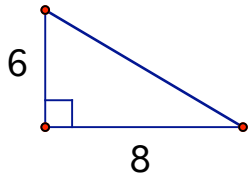
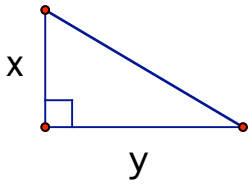
The Pythagorean Theorem

18. What are the areas of the following shapes?

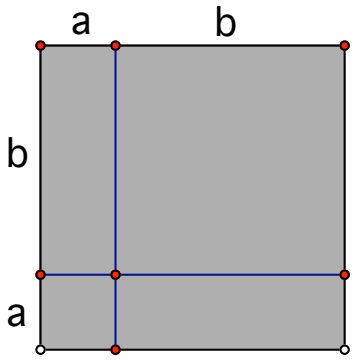


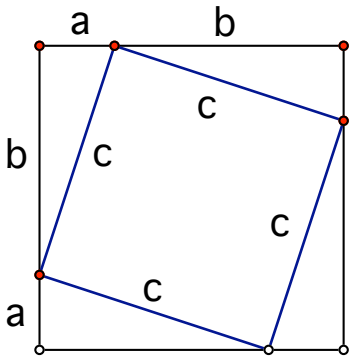






Use the drawings below to answer questions 21 to 25.





19. What's true about the two big squares?

20. Write the areas inside the polygonal pieces in the two square figures above.

21. Write an equation that equates the sum of the areas on the shaded polygons with the sum of the areas of the unshaded polygons. Then simplify your equation.

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22. Use words to state the meaning of your simplified equation (from above) as it refers to the legs and the hypotenuse of the triangle shown below.

23. The relationship between the areas of the _____ on the _____ and _____ of right triangles is called the _____. It says that the sum of the _____ of the squares on the _____ of a _____ triangle is equal to the area of the square on the _____.

Practice

1. A classmate suggests that a triangle with side lengths of 4, 5, and 9 units is a right triangle. Use the Pythagorean theorem to show that this must be incorrect.

2. A right triangle has legs of lengths 5 and 12 units. What is the length of its hypotenuse? Justify.

3. Notice that the answer to question (2) above is a whole number. When all three sides of a right triangle have whole number side lengths, the three numbers are called a *Pythagorean triple*. Find an example of another Pythagorean triple. Justify.

4. One triangle has sides of length 4, 6, and 8 cm. Another triangle has sides of 6, 8, and 10 cm. Is either of these a right triangle? Justify.

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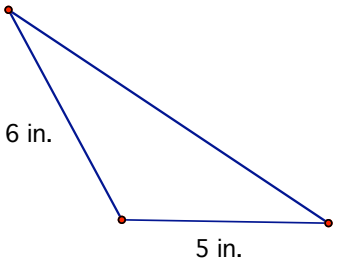
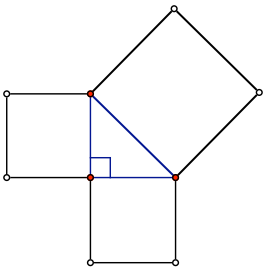
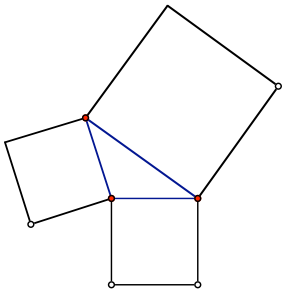
5. Tommy said, “The third side of the triangle below is $\sqrt{36+25} = \sqrt{61}$ inches.” Is it possible that Tommy is correct? Explain.

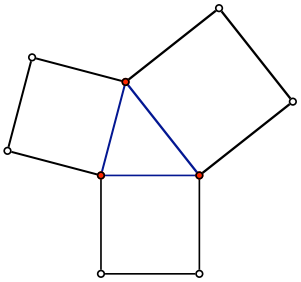


6. According to the Pythagorean theorem, what has to be true about the three areas of the squares in the diagrams?



7. Based on what you know about the Pythagorean theorem, what has to be true about the areas of the squares in the diagrams below.





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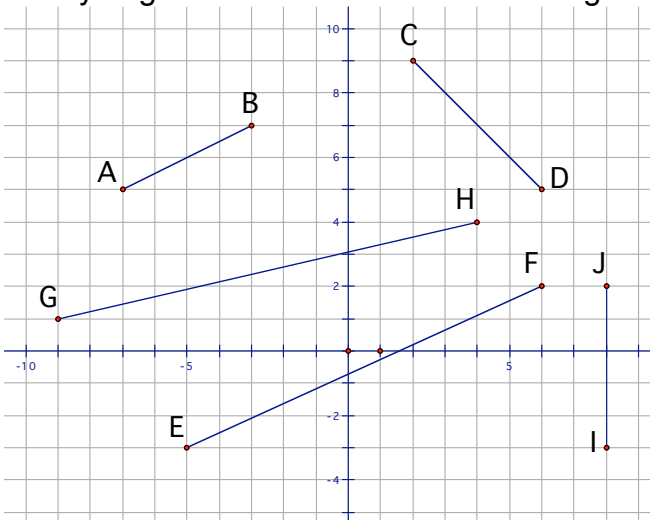
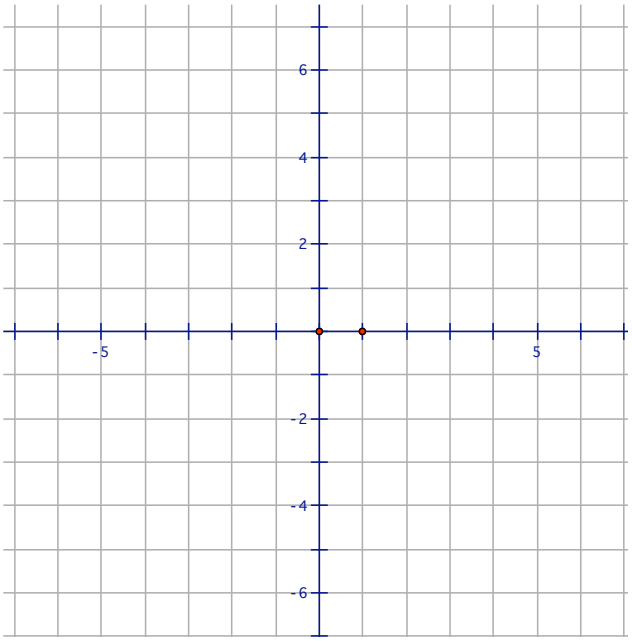
8. Label the endpoints of each of the segments below with their coordinates. Then use the Pythagorean theorem to find their lengths. Justify with clear work.



9. Sketch and label the following segments. Then find the lengths of the segments with the following endpoints. Justify by showing clear work.

   A(2, 6), B(3, 1) C(-6, 1), D(1, -1)

   E(6, -2), F(-6, -6)



10. Imagine that you are standing at the point (3, 6) on the coordinate plane. You are going to walk "over and up" to get to (5, 13).

    a. How far over and how far up do you have to travel?

    b. Find a way to use the coordinates to find the over and up without counting or drawing. Describe your method.

c. How could you use your method to find the distance between the two points?

11. Find the distance between the points A(-2, 3) and B(4, 8) WITHOUT drawing or counting. Justify with clear work.

12. What is the "Distance Formula" (you can look it up in your textbook) and how is it like the Pythagorean theorem?

13. Show how to use the distance formula to find the distance between the points H(-2,3) and K(4,9).

14. On separate paper, do the following problems: Txt. p.21 #13-18, 23-30, 34, 35, 40, 41, 53, 54, 56, 60-71.