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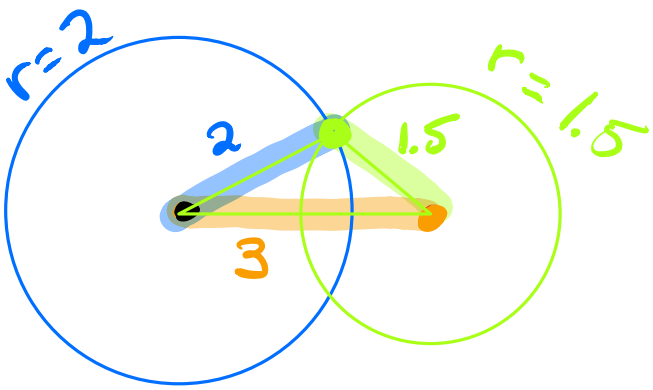
6. Use a ruler and a compass to construct a triangle that has one side of length 3 inches, one side of length 2 inches, and one side of length 1.5 inches. Describe your method, and explain why it must produce the desired triangle.

not necessary ~~Circle of radius 3~~



SECTION SUMMARY AND STUDY ITEMS

Section 10.4 Triangles, Quadrilaterals, and Other Polygons

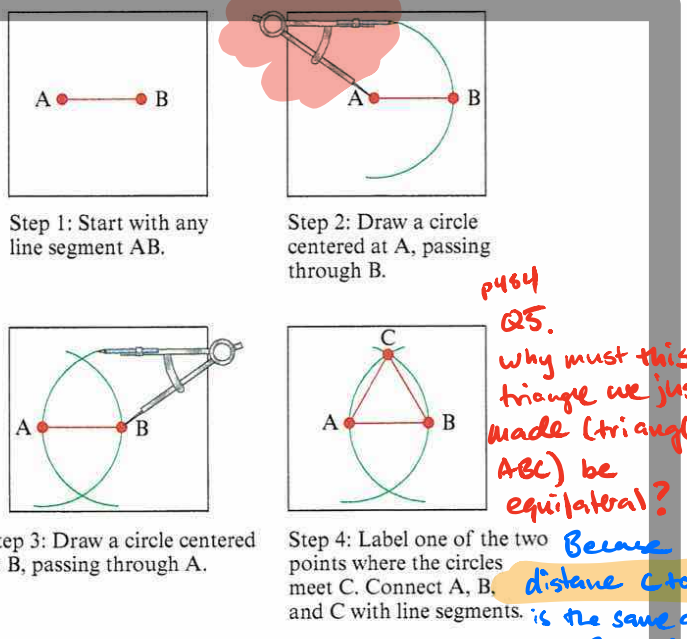
Squares, rectangles, parallelograms, rhombuses, and trapezoids are special kinds of quadrilaterals. Isosceles and equilateral triangles are special kinds of triangles. Quadrilaterals and triangles are kinds of polygons. The properties that a shape has determine which categories it belongs to. Categories of shapes often have subcategories. The shapes in a subcategory have properties in addition to all the properties that the shapes in the larger category have. Venn diagrams and other diagrams can show how categories of shapes are related.

Key Skills and Understandings

1. Give our (short) definitions of special quadrilaterals and triangles.
2. Describe how categories of quadrilaterals are related to each other, and show the relationships with the aid of a Venn diagram or other clear diagram. When possible, explain why the relationships hold.
3. Use a compass to construct triangles of specified side lengths (including equilateral and isosceles triangles), and use the definition of circle to explain why the construction must produce the required triangle.
4. Use a compass to construct rhombuses, and use the definition of circle to explain why the construction must produce a rhombus.
5. Fold and cut paper to produce various triangles and quadrilaterals.
6. Describe how to make shapes by walking and turning along routes.

Practice Exercises for Section 10.4

1. Draw a Venn diagram (or other clear diagram) showing the relationship between the categories of rectangles and rhombuses. Which shapes are in both categories? Explain.
2. Draw a Venn diagram (or other clear diagram) showing the relationship between the categories of parallelograms and trapezoids. Explain.
3. Some books define trapezoids as quadrilaterals that have *exactly one* pair of parallel sides. Draw a Venn diagram (or other clear diagram) showing how the categories of parallelograms and trapezoids are related when this alternate definition of trapezoid is used. Explain.
4. Draw a Venn diagram (or other clear diagram) showing the relationship between the categories of rhombuses and parallelograms.
5. Figure 10.76 shows a method for constructing an equilateral triangle. Explain why this method must always produce an equilateral triangle.



Step 1: Start with any line segment AB.

Step 2: Draw a circle centered at A, passing through B.

Step 3: Draw a circle centered at B, passing through A.

Step 4: Label one of the two points where the circles meet C. Connect A, B, and C with line segments.

Figure 10.76 Constructing an equilateral triangle.

a compass

p484 Q5. Why must this triangle we just made (triangle ABC) be equilateral? Because distance C to B is the same as A to B (it's on the circle & we didn't change the compass) & similarly distance C to A is the same as A to B.

(We can write BC = AB and AC = AB)

6. Use a ruler and a compass to construct a triangle that has one side of length 3 inches, one side of length 2 inches, and one side of length 1.5 inches. Describe your method, and explain why it must produce the desired triangle.

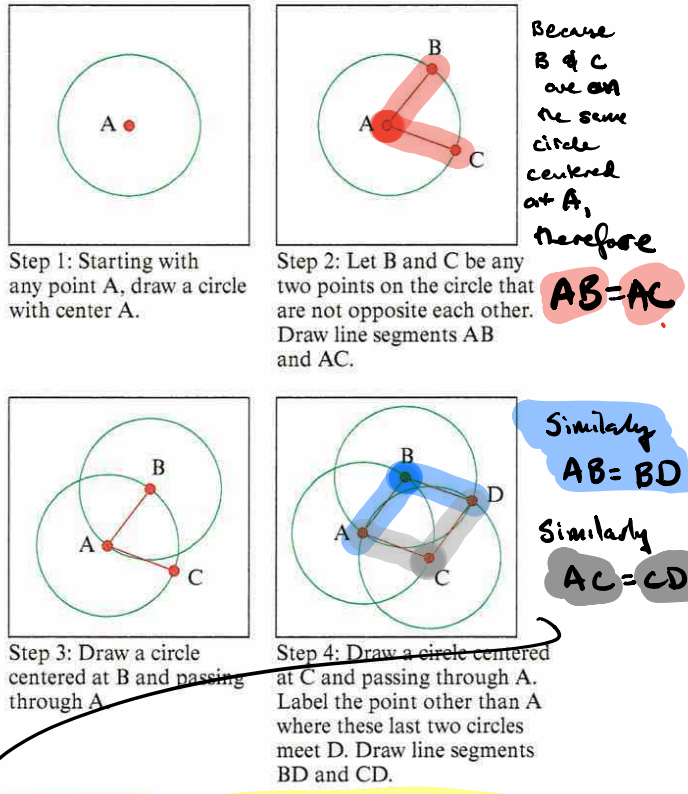
7. Use the definition of circles and rhombuses to explain why the quadrilateral ABDC produced by the method of Figure 10.77 must necessarily be a rhombus.

8. Give instructions telling Robot Rob how to move and turn so that his path is a regular pentagon that has sides of length 2 meters. Explain how to determine the instructions.

9. Give instructions telling Automaton Audrey how to move and turn so that her path is a parallelogram that has a 10-foot side, a 20-foot side, and a 70° angle. Explain how to determine the instructions.

TEACHING TIP
Video in MyMathLab: Constructing an Equilateral Triangle

TEACHING TIP
Video in MyMathLab: Constructing a Rhombus



Step 1: Starting with any point A, draw a circle with center A.

Step 2: Let B and C be any two points on the circle that are not opposite each other. Draw line segments AB and AC.

Step 3: Draw a circle centered at B and passing through A.

Step 4: Draw a circle centered at C and passing through A. Label the point other than A where these last two circles meet D. Draw line segments BD and CD.

Figure 10.77 Method for constructing rhombuses.

Answers to Practice Exercises for Section 10.4

1. See Figure 10.78, which shows that rectangles and rhombuses have squares as a common subcategory. The shapes in both categories are those shapes that have 4 right angles (as rectangles do) and have 4 sides of the same length (as rhombuses do). According to the definition, those are exactly the shapes that are squares.

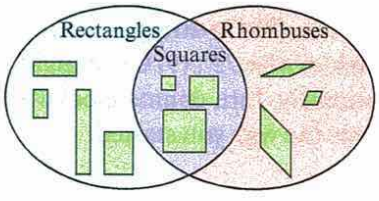


Figure 10.78 Venn diagram of rectangles and rhombuses.

2. See Figure 10.79, which shows that parallelograms are a subcategory of trapezoids. According to the definition, every parallelogram is also a trapezoid because parallelograms have two pairs of parallel sides, so they can be said to have at least one pair of parallel sides. Therefore parallelograms are a subcategory of trapezoids.

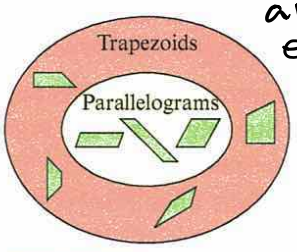


Figure 10.79 Venn diagram of parallelograms and trapezoids.

3. See Figure 10.80. According to the alternative definition, no parallelogram is a trapezoid because parallelograms have two pairs of parallel sides, so they don't have exactly one pair of parallel sides. Therefore, with this alternative definition, the set of parallelograms and the set of trapezoids do not have any overlap.

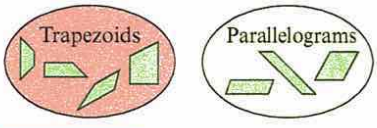


Figure 10.80 Venn diagram of parallelograms and trapezoids, according to the alternative definition.

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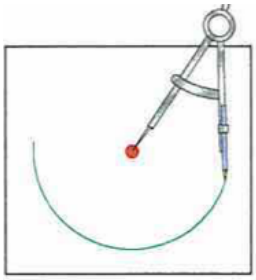
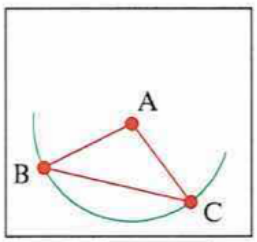
5. Figure 10.85 shows a method for constructing isosceles triangles.

   a. Use the method of Figure 10.85 to draw two different isosceles triangles.

   b. Use the definition of circles to explain why this method will always produce an isosceles triangle. Making the center one vertex of the triangle

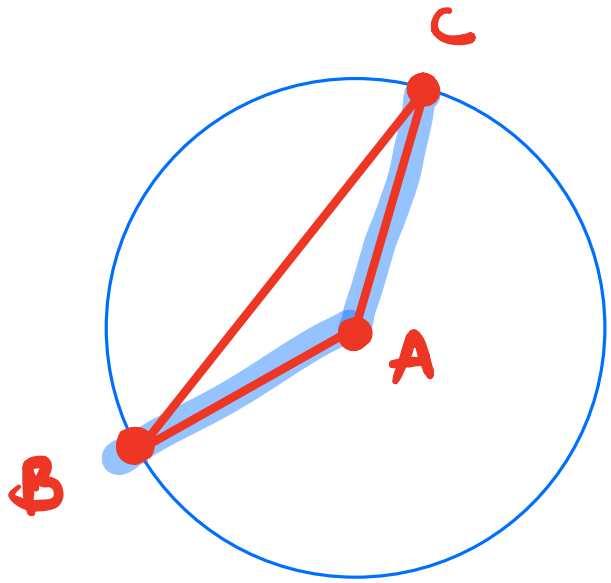


Step 1: Draw part of a circle.



Step 2: Connect the center of the circle with two points on the circle.

Figure 10.85 A method for constructing isosceles triangles.



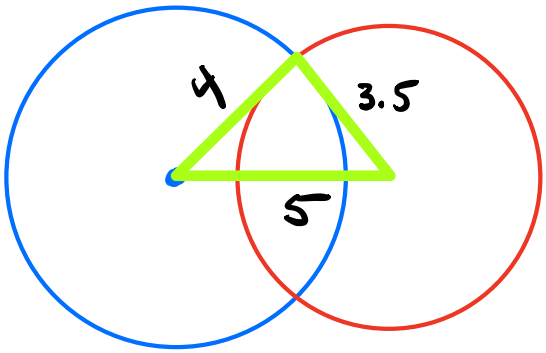
Because B and C lie on the same circle centered at A, therefore

$AB = AC$,

so 2 sides of the triangle ABC are the same length, which is the definition of isosceles.

8. **a.** Use a ruler and compass to help you draw a triangle that has one side of length 5 inches, one side of length 3.5 inches, and one side of length 4 inches.

b. Explain why your method of construction must produce a triangle with the required side lengths.



9. Is there a triangle that has one side of length 4 inches, one side of length 2 inches, and one side of length 1 inch? Explain.

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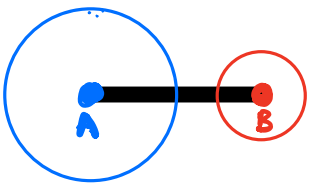
No.



There's no intersection, so there exists no point that's 2 inches from A and 1 inch from B. So there is no such triangle