

Important Concepts . . .

# Preview Review



**Mathematics    Grade 9**  
**W3 - Lesson 12: Polygons and Scale  
Diagrams**

## Important Concepts of Grade 9 Mathematics

W1 - Lesson 1 .....	Powers
W1 - Lesson 2 .....	Exponents
W1 - Lesson 3 .....	Rational Numbers
W1 - Lesson 4 .....	Order of Operations
W1 - Lesson 5 .....	Square Roots of Rational Numbers
W1 - Review	
W1 - Quiz	
W2 - Lesson 6 .....	Graphing Linear Relations
W2 - Lesson 7 .....	Solving Linear Relations
W2 - Lesson 8 .....	Linear Inequalities
W2 - Lesson 9 .....	Polynomials
W2 - Lesson 10 .....	Surface Area of 3D Objects
W2 - Review	
W2 - Quiz	
W3 - Lesson 11 .....	Properties of Circles
W3 - Lesson 12 .....	Polygons and Scale Diagrams
W3 - Lesson 13 .....	Rotational Symmetry
W3 - Lesson 14 .....	Representing Data
W3 - Lesson 15 .....	Probability
W3 - Review	
W3 - Quiz	

## Materials Required

Paper  
Pencil  
Ruler  
Protractor  
Tracing Paper

**No Textbook Required**

**This is a stand-alone course.**

### Mathematics Grade 9

Version 6

Preview/Review W3 - Lesson 12

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# Preview/Review Concepts for Grade Nine Mathematics



***W3 – Lesson 12:***

***Polygons and Scale Diagrams***

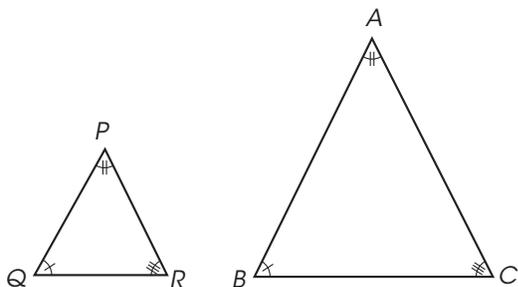
# OBJECTIVES

By the end of this lesson, you will be able to:

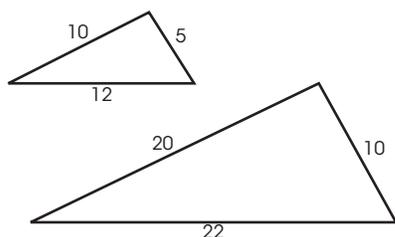
- Determine if the polygons in a given pre-sorted set are similar, and explain the reasoning.
- Solve a given problem, using the properties of similar polygons.
- Draw a diagram to scale that represents an enlargement or a reduction of a given 2-D shape.
- Determine the scale factor for a given diagram drawn to scale.
- Determine if a given diagram is proportional to the original 2-D shape, and, if it is, state the scale factor.

## GLOSSARY

**Corresponding Angles:** Corresponding angles have the same location in geometric shapes.



**Corresponding Sides:** Corresponding sides have the same location in geometric shapes.



**Similar Figures:** These polygons have the same shape but can be different sizes. They will have the same corresponding angles and sides.

**Polygon:** A two-dimensional closed figure made up of three or more straight line segments.

**Enlargement:** To increase the dimensions of an image by a constant factor.

**Reduction:** To decrease the dimensions of an image by a constant factor.

**Scale Factor:** The constant factor that all dimensions of an image have been enlarged or reduced.

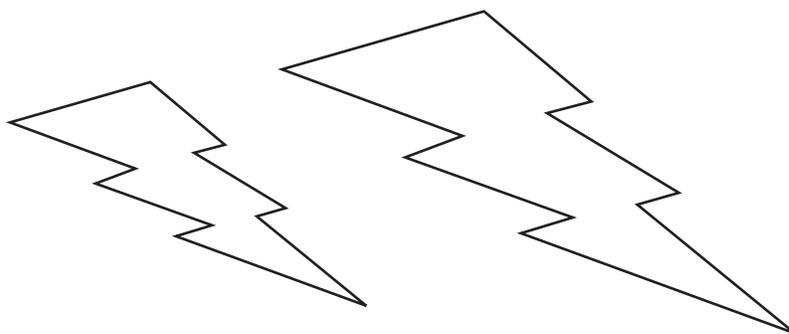
## W3 – Lesson 12: Polygons and Transformations

### Materials required:

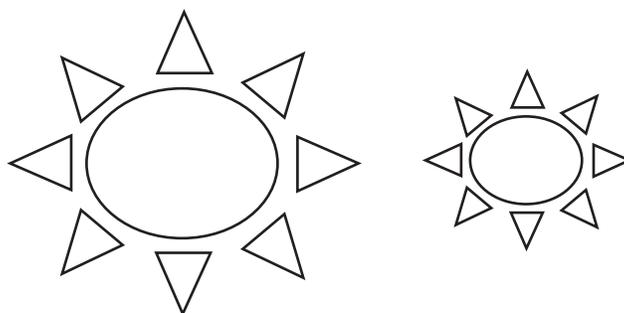
- Paper, pencil, Ruler, Protractor, and Tracing paper

### Part 1: Enlargement, Reductions and Scale Factor

An **enlargement** is to increase an image by a constant factor. The enlargement results in a similar image. The image is the same shape but will be proportionally larger than the original image.



A **reduction** is to decrease an image by a constant factor. The reduction results in a similar image. The image is the same shape but will be proportionally smaller than the original image.

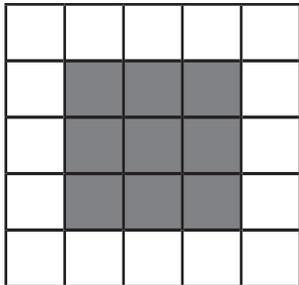


The **scale factor** is the constant that the dimensions of an image are multiplied by to either increase or decrease the image. If the scale factor is greater than 1, the image has been enlarged. If the scale factor is less than 1, the image has been reduced.

The **scale diagram** is a larger or smaller representation of the image that has been proportionally enlarged or reduced.

### Example 1

Draw the image with a scale factor of 2.



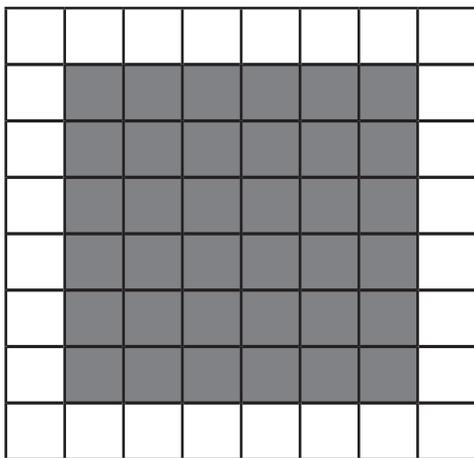
Multiply each side of the original shape by 2. Remember, scale factors that are greater than 1 indicate the image has been enlarged.

$$3 \text{ units} \times 2 = 6$$

$$3 \text{ units} \times 2 = 6$$

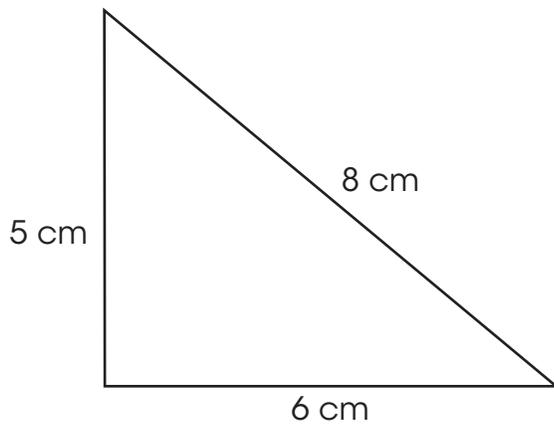
The new dimensions are:  
6 units and 6 units.

The enlarged image should have new dimensions of  $6 \times 6$ . The scale factor is 2.



**Example 2**

Draw the image with a scale factor of 0.5.

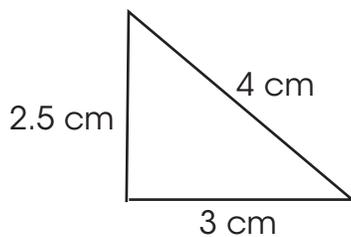


Multiply each side of the original shape by 0.5. Remember, scale factors that are less than 1 indicate the image has been reduced.

$$\begin{aligned}8 \text{ cm} \times 0.5 &= 4 \text{ cm} \\5 \text{ cm} \times 0.5 &= 2.5 \text{ cm} \\6 \text{ cm} \times 0.5 &= 3 \text{ cm}\end{aligned}$$

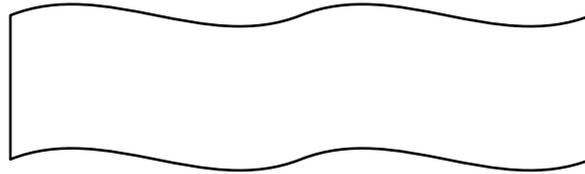
The new dimensions are: 2.5, 4 and 3.
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Draw the image with a scale factor of 0.5.



**Example 3**

Below is a drawing of a banner used to advertise a garage sale. The scale of the banner is 1:3. If the drawing of the banner below measures 144 cm, what is the actual length of the banner?



To solve for the actual length of the banner, set up a proportion, using the scale factor.

$$\frac{1}{3} = \frac{144}{x}$$

Solve for the unknown value  $x$ .

$$\frac{1}{3} = \frac{144}{x}$$

$$\frac{1}{3}x = 144$$

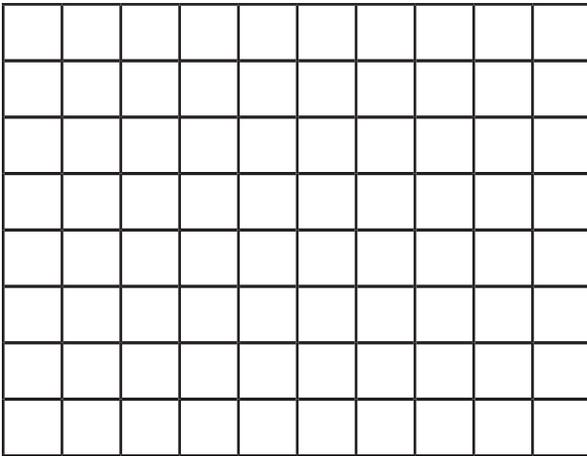
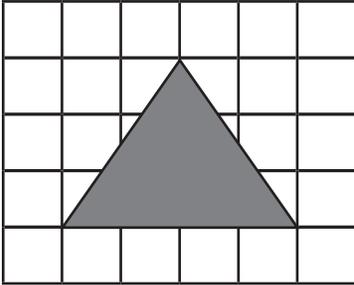
$$x = (144)(3)$$

$$x = 432 \text{ cm}$$

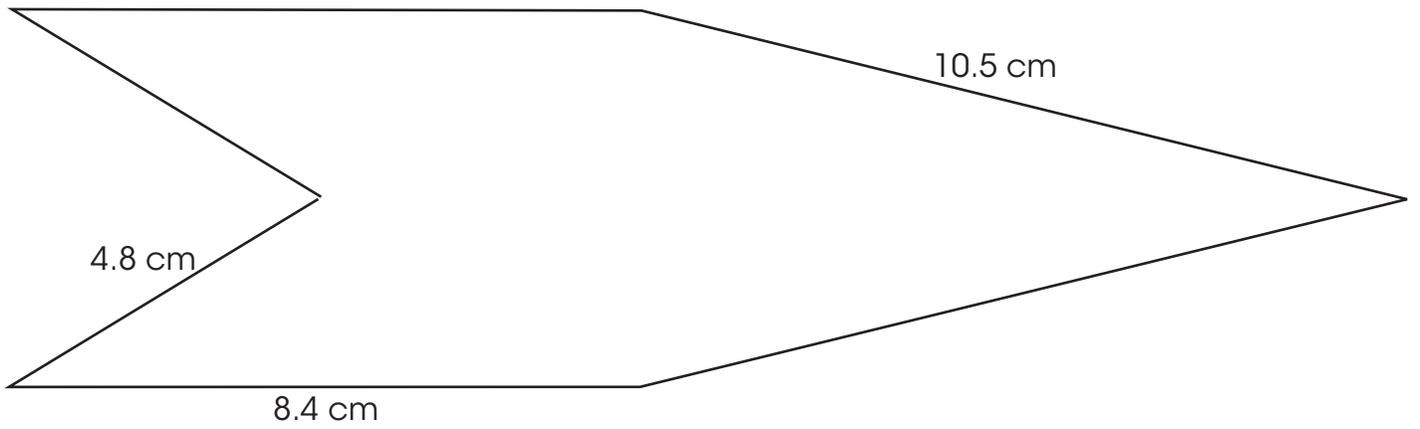
The actual length of the banner is 432 cm.

### Practice Questions

1. Draw the image with a scale factor of 2.



2. Draw the image with a scale factor of 0.5.



3. Determine the correct length for the given scale factor.
- A poster measures  $40 \text{ cm} \times 60 \text{ cm}$ . What are the dimensions of the scale diagram with a scale factor of  $0.5$ ?
  - A skateboard has wheels with a diameter of  $54 \text{ mm}$ . What are the dimensions of the scale diagram with a scale factor of  $3$ ?
  - A table has a length of  $90 \text{ cm}$ . What are the dimensions of the scale diagram with a scale factor of  $\frac{1}{9}$ ?

4. Solve the following proportions.

a.  $90 = \frac{x}{117}$

b.  $\frac{1}{12} = \frac{10.5}{x}$

c.  $\frac{1}{x} = \frac{3}{156}$

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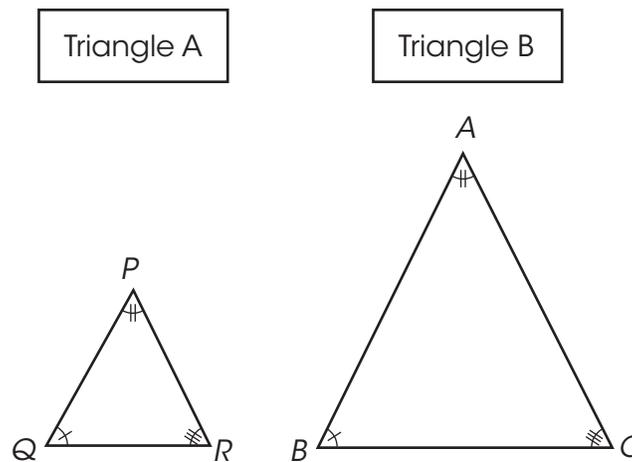
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## Part 2: Exploring Triangles

Similar polygons may be of different sizes or orientation, but they must be the same shape. To see if polygons are similar, check to see if they have corresponding sides and corresponding angles.

Corresponding sides are sides in polygons that have the same relative position in figures.

Corresponding angles are angles in polygons that have the same relative position in figures.



### Corresponding Sides

	Triangle A	Triangle B
<b>Line</b>	$PQ$	$AB$
<b>Line</b>	$PR$	$AC$
<b>Line</b>	$QR$	$BC$

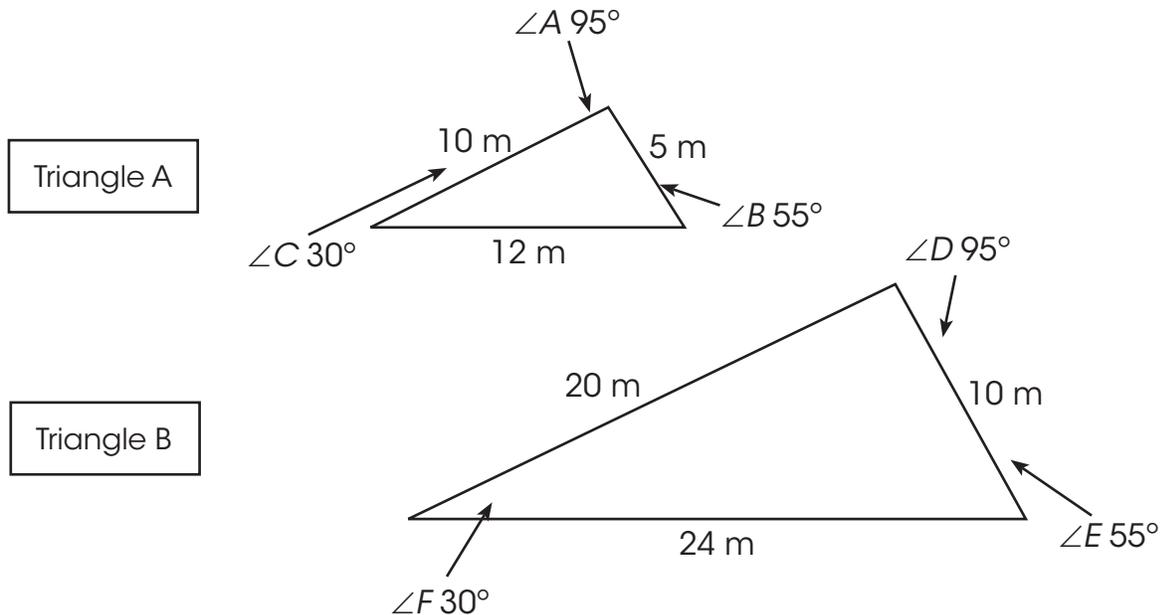
### Corresponding Angles

	Triangle A	Triangle B
<b>Angle</b>	$\angle P$	$\angle A$
<b>Angle</b>	$\angle Q$	$\angle B$
<b>Angle</b>	$\angle R$	$\angle C$

Once triangles have been determined to be similar, problems related to similar triangles can be solved using either scale factor or proportion.

### Example 1

Decide if these triangles are similar.



To see if the triangles are similar, check to see if they have either corresponding angles or corresponding sides.

$$\begin{aligned} \angle A &= 95^\circ \text{ and } \angle D = 95^\circ \\ \angle B &= 55^\circ \text{ and } \angle E = 55^\circ \\ \angle C &= 30^\circ \text{ and } \angle F = 30^\circ \end{aligned}$$

The corresponding angles are all equal.

Now check to see if there are corresponding sides. In order for the sides to correspond, the ratio of each side must be equal.

Triangle A sides lengths = 10 m, 12 m, 5 m  
 Triangle B side lengths = 20 m, 24 m, 10 m

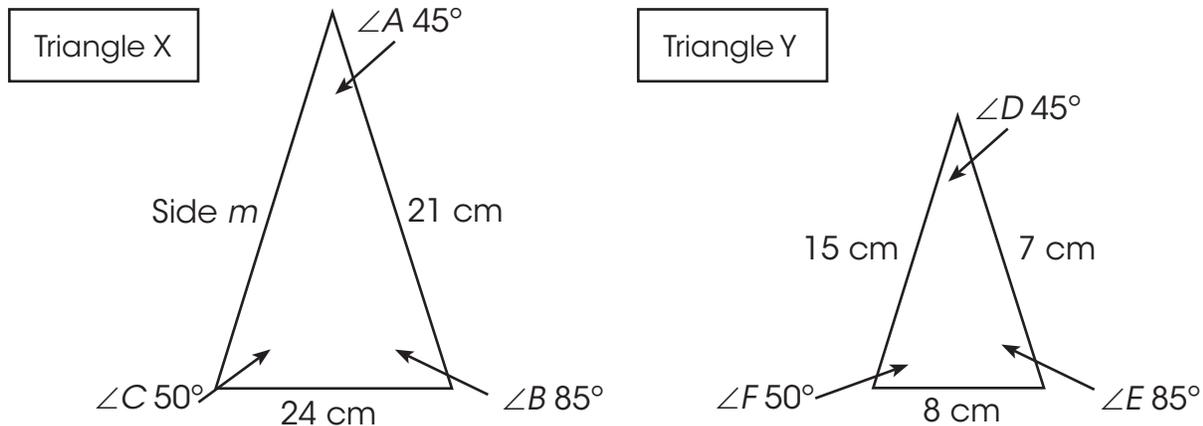
The ratio of Triangle B to Triangle A.

$$\frac{20}{10} = 2 \quad \frac{24}{12} = 2 \quad \frac{10}{5} = 2$$

All sides are proportional with a scale factor of 2. So Triangle A and Triangle B are proportional.

### Example 2

The following triangles below are similar. Determine the length of the missing side  $m$ .



To find the missing side, compare the corresponding sides to determine the scale factor. Once the scale factor is known, solve for the missing side.

$$\frac{AC}{DF} = \frac{m}{15} \quad \frac{CB}{FE} = \frac{24}{8} \quad \frac{BA}{ED} = \frac{21}{7}$$

$$\qquad \qquad \qquad = 3 \qquad \qquad \qquad = 3$$

The scale factor is 3.

Using algebra,  $\frac{m}{15} = 3$

$$\frac{m}{15} \square 15 = 3 \square 15$$

$$m = 45$$

Or solve by using proportion,  $\frac{AC}{DF} = \frac{CB}{FE}$

$$\frac{m}{15} = \frac{24}{8} \quad \text{Cross Multiply}$$

$$8m = 360$$

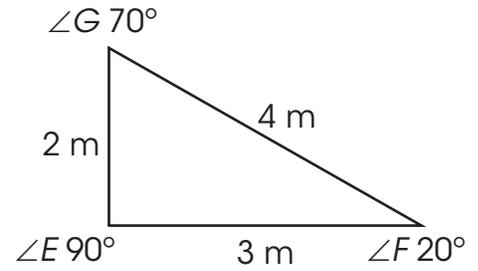
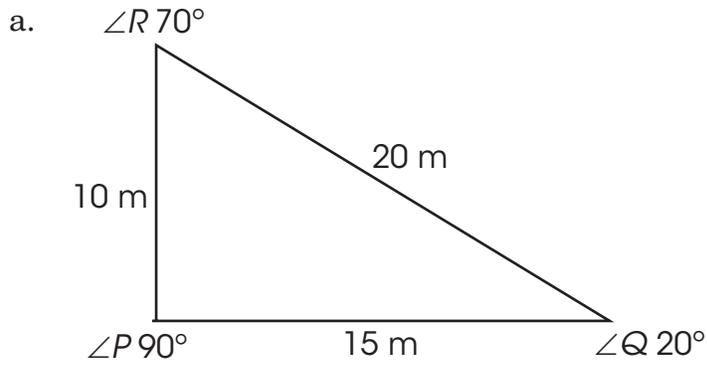
$$\frac{8m}{8} = \frac{360}{8}$$

$$m = 45$$

Using either method,  $m = 45$ . The missing side is 45 cm.

### Practice Questions

- Determine if the following triangles are similar by comparing both the sides and the angles.



- b. Use the chart below to determine if Triangle A and B are similar.

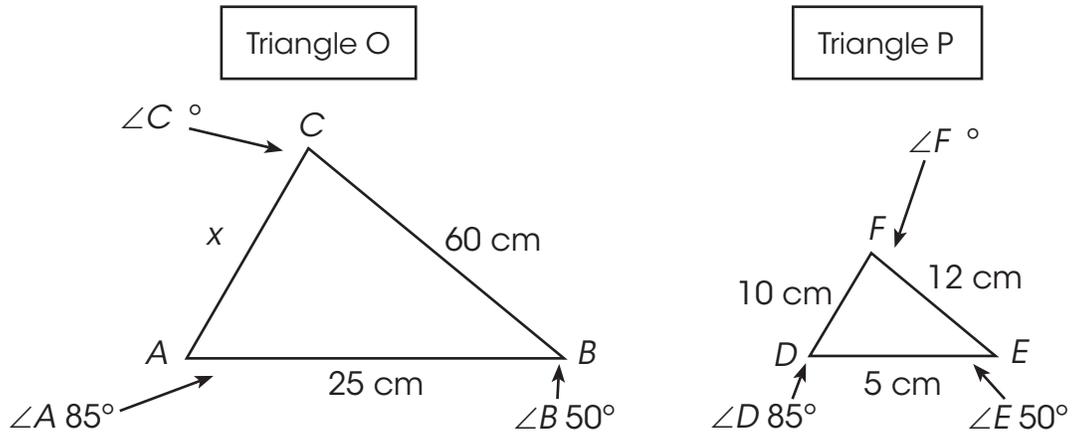
### Corresponding Angles

	Triangle A	Triangle B
<b>Angle X</b>	$\angle 85^\circ$	$\angle 85^\circ$
<b>Angle Y</b>	$\angle 65^\circ$	$\angle 65^\circ$
<b>Angle Z</b>	$\angle 30^\circ$	$\angle 30^\circ$

### Corresponding Sides

	Triangle A	Triangle B
<b>Line</b>	45 m	15 m
<b>Line</b>	27 m	9 m
<b>Line</b>	24 m	6 m

2. The following triangles are similar. Find the missing side and angles.



$\angle C$  \_\_\_\_\_

$\angle F$  \_\_\_\_\_

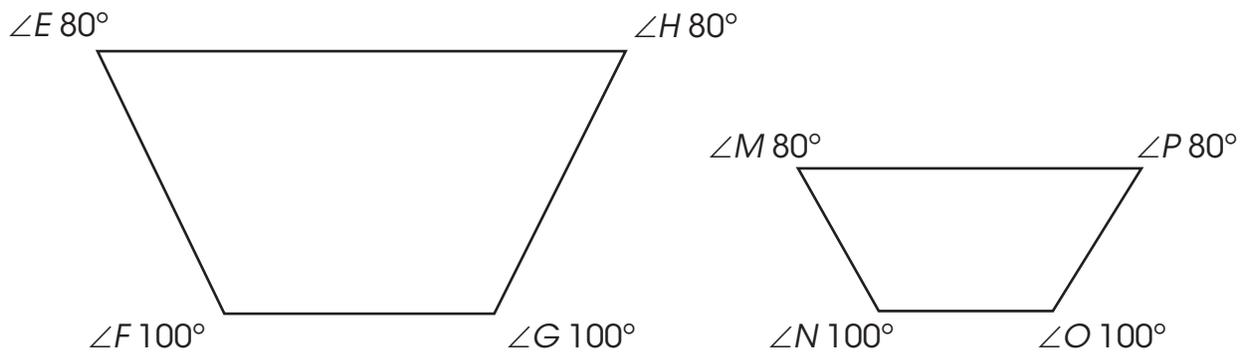
$x$  \_\_\_\_\_

### Part 3: Exploring Polygons

A polygon is a two dimensional figure that is made up of three or more line segments. These line segments are straight. Polygons do not have any curved edges.

To determine if polygons are similar, like triangles, they must have corresponding angles that are equal in measure. They also must have side lengths that are proportional.

Like triangles, similar polygons can be used to determine unknown side lengths or angle measures.



#### Corresponding Sides

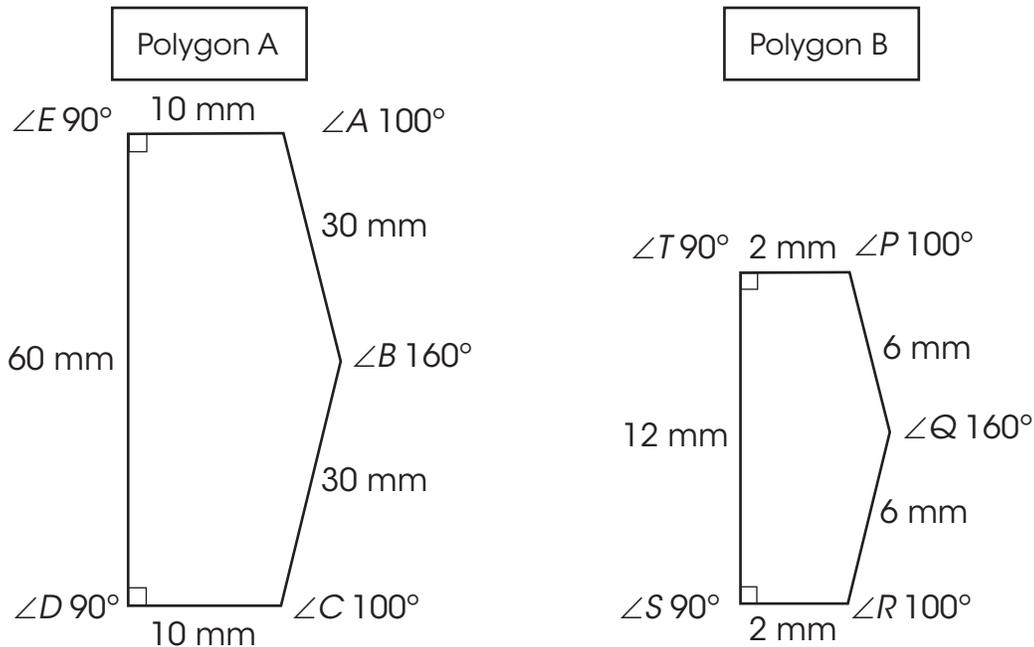
	Polygon A	Polygon B
<b>Line</b>	<i>EF</i>	<i>MN</i>
<b>Line</b>	<i>FG</i>	<i>NO</i>
<b>Line</b>	<i>GH</i>	<i>OP</i>
<b>Line</b>	<i>HE</i>	<i>PM</i>

#### Corresponding Angles

	Triangle A	Triangle B
<b>Angle</b>	$\angle E$	$\angle M$
<b>Angle</b>	$\angle F$	$\angle N$
<b>Angle</b>	$\angle G$	$\angle O$
<b>Angle</b>	$\angle H$	$\angle P$

### Example 1

Decide if these polygons are similar.



To see if the polygons are similar, check to see if they have either corresponding angles or corresponding sides.

$$\begin{aligned} \angle A = 100^\circ \text{ and } \angle P = 100^\circ \quad \angle B = 160^\circ \text{ and } \angle Q = 160^\circ \\ \angle C = 100^\circ \text{ and } \angle R = 100^\circ \quad \angle D = 90^\circ \text{ and } \angle S = 90^\circ \\ \angle E = 90^\circ \text{ and } \angle T = 90^\circ \end{aligned}$$

The corresponding angles are all equal. Now check to see if there are corresponding sides.

Polygon A sides lengths = 60 mm, 10 mm, 30 mm, 30 mm, 10 mm

Polygon B side lengths = 12 mm, 2 mm, 6 mm, 6 mm, 2 mm

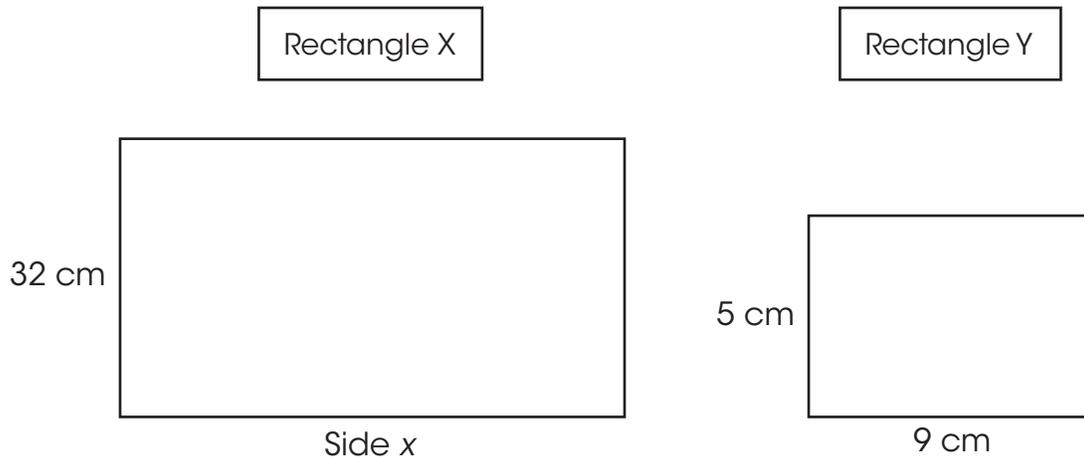
The ratio of Polygon A to Polygon B.

$$\frac{60}{12} = 5 \quad \frac{10}{2} = 5 \quad \frac{30}{6} = 5 \quad \frac{30}{6} = 5 \quad \frac{10}{2} = 5$$

All sides are proportional with a scale factor of 5. So Polygon A and Polygon B are proportional.

**Example 2**

The following rectangles below are similar. Determine the length of the missing side  $x$ .



Since the rectangles are similar, the side lengths will be proportional. Set up a proportion to solve for the unknown side.

$$\frac{32}{5} = \frac{x}{9} \quad \text{Cross Multiply}$$

$$5x = 288$$

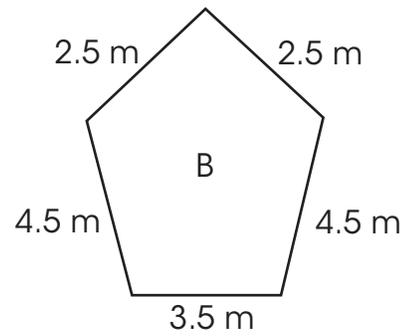
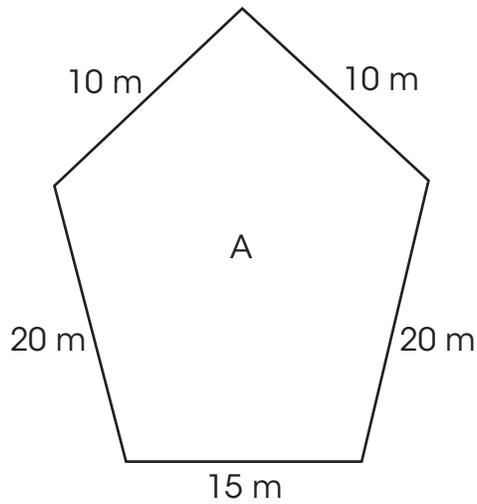
$$\frac{5x}{5} = \frac{288}{5}$$

$$x = 57.6$$

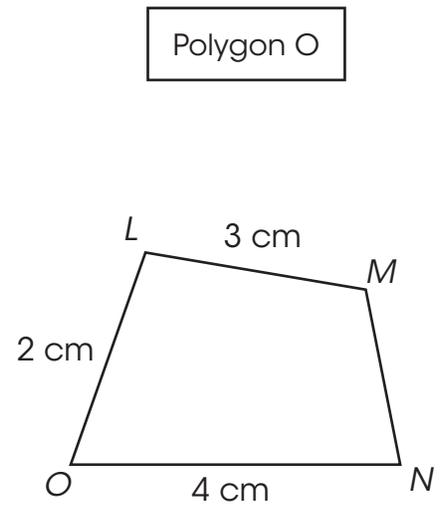
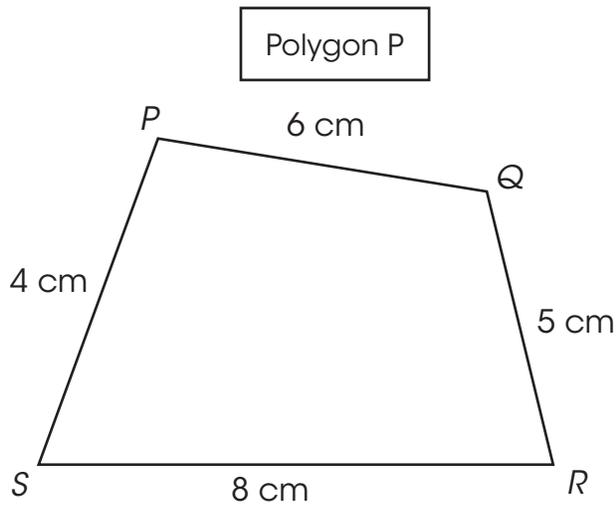
The missing side length on Rectangle X is 57.6 cm.

### Practice Questions

- Determine if the following polygons are similar by comparing both the sides and the angles.

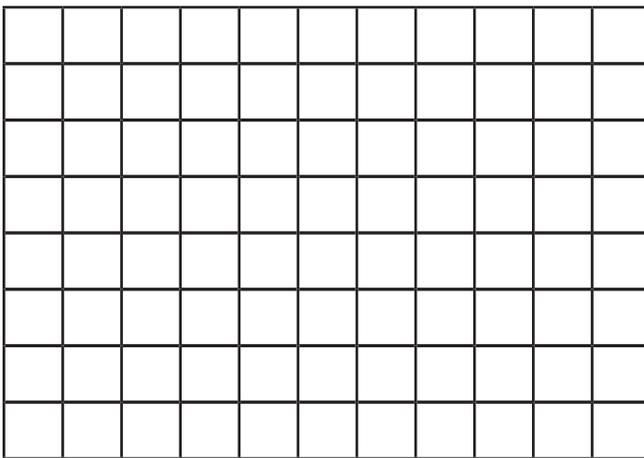
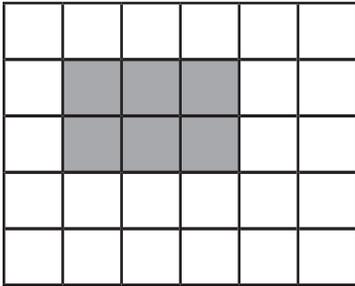


2. The following polygons are similar. Find the length of the missing side.



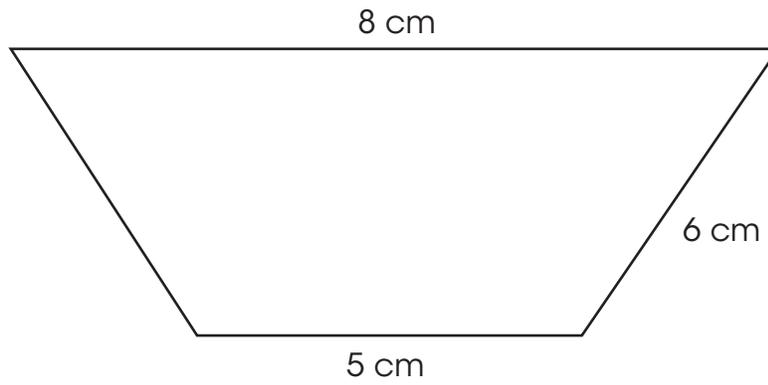
## Lesson 12 Assignment

1. a. Draw the image with a scale factor of 3.



- b. Is this a reduction or an enlargement? \_\_\_\_\_

2. a. Draw the image with a scale factor of 0.5.



- b. Is this a reduction or an enlargement? \_\_\_\_\_

3. Determine the correct length for the given scale factor.
- A board game measures  $50 \text{ cm} \times 80 \text{ cm}$ . What are the dimensions of the scale diagram with a scale factor of 4?
  - A fan has a diameter of  $54 \text{ mm}$ . What are the dimensions of the scale diagram with a scale factor of  $\frac{1}{3}$ ?
  - A desk has a length of  $1.5 \text{ m}$ . What are the dimensions of the scale diagram with a scale factor of 3?

4. Solve the following proportions. Round to the nearest tenth when needed.

a.  $\frac{1}{7} = \frac{x}{249.2}$

b.  $\frac{1}{15} = \frac{12.8}{x}$

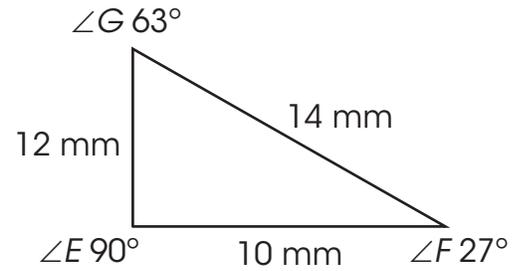
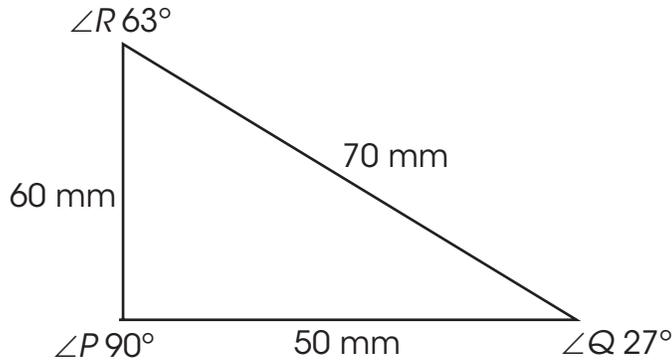
c.  $\frac{1}{x} = \frac{18}{278}$

\_\_\_\_\_

\_\_\_\_\_

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5. a. Determine if the following triangles are similar by comparing both the sides and the angles.



- b. Use the chart below to determine if Triangle A and B are similar.

### Corresponding Angles

	Triangle A	Triangle B
<b>Angle X</b>	$\angle 60^\circ$	$\angle 60^\circ$
<b>Angle Y</b>	$\angle 25^\circ$	$\angle 25^\circ$
<b>Angle Z</b>	$\angle 105^\circ$	$\angle 105^\circ$

### Corresponding Sides

	Triangle A	Triangle B
<b>Line</b>	105 mm	35 mm
<b>Line</b>	90 mm	30 mm
<b>Line</b>	81 mm	9 mm

6. The following polygons are similar. Find the length of the missing side  $AD$ .

