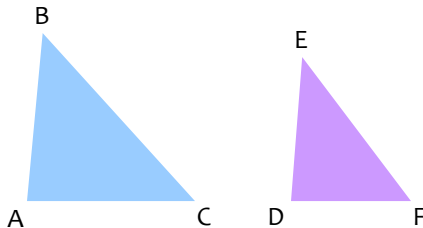# Similar Polygons

Intro

Two polygons are similar if they are the same shape but not necessarily the same size. Same shape means corresponding angles are congruent and corresponding sides are proportional. In order to determine whether the side lengths are proportional, you must set up ratios.

Before we begin discussing how to find the ratio of corresponding side lengths, let's talk about naming conventions.

When polygons are similar, we use the following notation:

$$\Delta ABC \sim \Delta DEF$$

Refers to "similar"

The notation gives us a lot of information about the corresponding angles and sides. In this case, the notation tells us:

$$\angle A \cong \angle D, \angle B \cong \angle E, \angle C \cong \angle F \quad \text{and} \quad \frac{AB}{DE} = \frac{BC}{EF} = \frac{AC}{DF} .$$

Finding Similarity

How can you determine if polygons are similar? Well, I'm glad you asked! Remember, in order for polygons to be similar, they must satisfy two important characteristics:
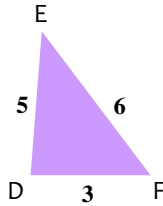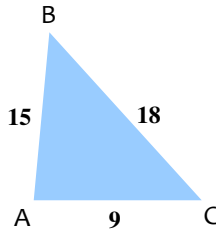
1. Corresponding angles must be congruent.
2. Corresponding sides must be proportional.

Now, the first characteristic is pretty simple to understand. If you find the measure of the interior angles of your polygons and compare them, corresponding angles need to be the same.

The second characteristic is a little bit more involved. For corresponding sides to be proportional, they must have the same similarity ratio or scale factor.

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Let's take a look at an example:

$\triangle ABC \sim \triangle DEF$. Find the scale factor of $\triangle ABC \sim \triangle DEF$.

$$\frac{AB}{DE}=\frac{BC}{EF}=\frac{AC}{DF}$$

$$\frac{15}{5}=\frac{18}{6}=\frac{9}{3}=\frac{3}{1}$$

The scale factor, or similarity ratio, of $\triangle ABC$ to $\triangle DEF$ is $\frac{3}{1}$.

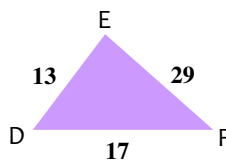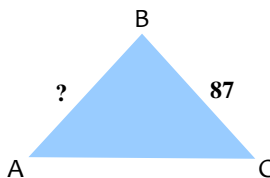Note: Here are a couple of tips when working with similar polygons.

1. If the question asked for the scale factor of $\triangle DEF$ to $\triangle ABC$, your answer would be $\frac{1}{3}$. It is very important you write your scale factor in the order it was asked, otherwise you will get the wrong answer!

2. The scale factor must be the same for **all** corresponding sides of your polygons, otherwise, they can not be considered similar. Suppose you have two quadrilaterals, if three corresponding sides have the same scale factor and the fourth corresponding sides are different, then the quadrilaterals are **not** similar.

Using Similarity to Solve Problems

Now that you have an understanding of ratios and similarity, let's try to use our knowledge to solve some problems.

Example 1:

The two triangles below are similar. Given the measures of the triangles, find the length of AB.

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Since the triangles are similar, corresponding sides are proportional.

Therefore, $\dfrac{AB}{BC} = \dfrac{DE}{EF}$.

Let's substitute the values into our proportion and solve: $\dfrac{x}{87} = \dfrac{13}{29}$
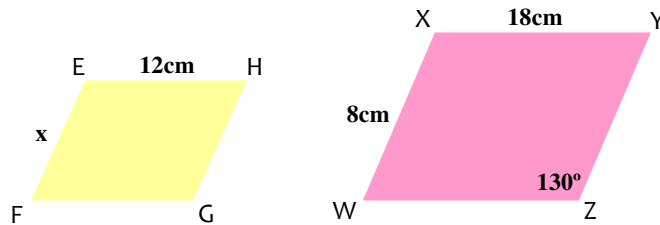
$$29x = 87(13)$$

$$29x = 1131$$

$$\boxed{x = 39}$$ ── Length of AB.

Example 2:

EFGH ~ WXYZ. Find *EF* and m∠G.

Since the two quadrilaterals are similar, corresponding angles are congruent and corresponding sides are proportional.

1. Corresponding angles must be congruent, so ∠G ≅ ∠Z, therefore ∠G = 130°.

2. $\dfrac{EF}{XW} = \dfrac{EH}{XY}$, substituting our values we get $\dfrac{x}{8} = \dfrac{12}{18}$

$$18x = 8(12)$$

$$18x = 96$$

$$x = 5.3$$

The measure of EF is 5.3cm.

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