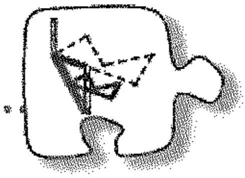
Notes

3.1.4 How can I use equivalent ratios?



Applications and Notation

Now that you have a good understanding of how to use ratios in similar figures to solve problems, how can you extend these ideas to situations outside the classroom? You will start by considering a situation for which you want to find the length of something that would be difficult to physically measure.

3-35. GEORGE WASHINGTON'S NOSE

On her way to visit Horace Mann University, Casey stopped by Mount Rushmore in South Dakota. The park ranger gave a talk that described the history of the monument and provided some interesting facts. Casey could not believe that the carving of George Washington's face is 60 feet tall from his chin to the top of his head!

However, when a tourist asked about the length of Washington's nose, the ranger was stumped! Casey came to her rescue by measuring, calculating and getting an answer. How did Casey get an answer?

Your Task: Figure out the length of George Washington's nose on the monument. Work with your team to come up with a strategy. Show all measurements and calculations on the next page with clear labels so anyone could understand your work. There are questions below to guide your thinking.

What is this question asking you to find?

How can you use similarity to solve this problem?

Is there something in this room that you can use to compare to the monument?

What parts do you need to compare?

Do you have any math tools that can help you gather information?

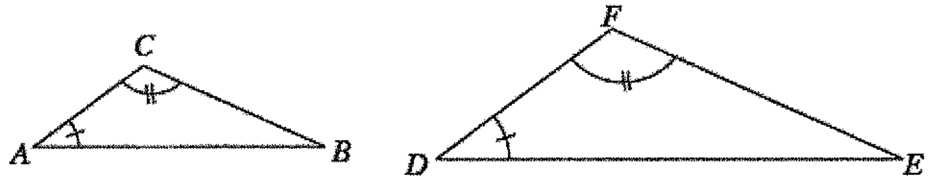
3-36. When solving problem 3-35, you may have written a proportional equation like the one below. When solving proportional situations, it is very important that parts be labeled to help you follow your work.

$$\frac{\textit{Length of George's Nose}}{\textit{Length of George's Head}} = \frac{\textit{Length of Student's Nose}}{\textit{Length of Student's Head}} \qquad \frac{2}{9} = \frac{x}{60}$$

$120 = 9x$

$\boxed{133_4 = X}$

Likewise, when working with geometric shapes such as the similar triangles below, it is easier to explain which sides you are comparing by using notation that everyone understands



a. One possible proportional equation for these triangles is $\frac{AC}{AB} = \frac{DF}{DE}$. Write at least three more proportional equations based on the similar triangles above.

$\frac{CB}{BA} = \frac{FE}{DE}$, $\frac{CA}{DF} = \frac{CB}{FE}$, $\frac{DF}{AC} = \frac{DE}{AB}$

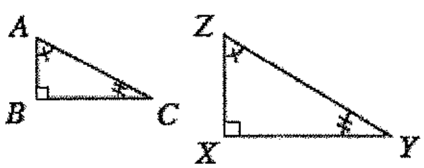
b. Jeb noticed that $m\angle A = m\angle D$ and $m\angle C = m\angle F$. But what about $m\angle B$ and $m\angle E$? Do these angles have the same measure? Or is there not enough information? Justify your conclusions.

c.

Yes, $180 - m\angle A - m\angle C = m\angle B$ and since
$180 - m\angle D - m\angle F = m\angle E$
$m\angle A = m\angle D$
$m\angle C = m\angle F$

$\therefore \boxed{m\angle B = m\angle E}$

3-37. The two triangles below are similar. Read the Math Notes below to learn about how to write a statement to show that two shapes are similar.



$\triangle ABC \sim \triangle ZXY$

↓

similar symbol

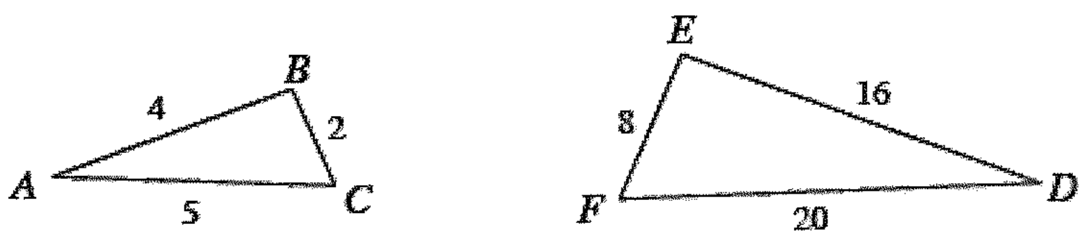
Methods and Meanings

Math Notes

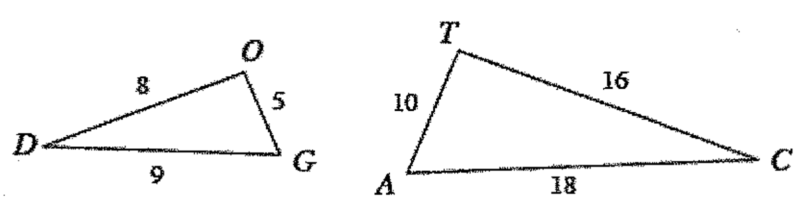
Writing a Similarity Statement

A **similarity transformation** is a sequence of transformations that can include rigid transformations, dilations, or both. Two figures are **similar** if there is a similarity transformation that takes one shape onto the other. Similarity transformations preserve angles, parallelism of two lines, and ratios of side lengths.

To represent the fact that two shapes are similar, use the symbol "$\sim$". For example, if there is a similarity transformation that takes ΔABC onto ΔDEF, then you know they are similar and this can be stated as $\Delta ABC \sim \Delta DEF$. The order of the letters in the name of each triangle determines which sides and angles correspond. For example, in the statement $\Delta ABC \sim \Delta DEF$, you can determine that $\angle A$ corresponds to $\angle D$ and that $\overline{BC}$ corresponds to $\overline{EF}$.



Now examine the two triangles below.



Which of the following statements are correctly written and which are not? Note that more than one statement may be correct. Discuss your answers with your team.

i. $\Delta DOG \sim \Delta CAT$ ✗

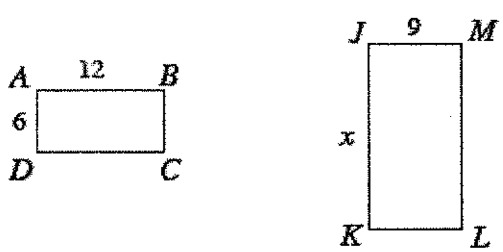
ii. $\Delta DOG \sim \Delta CTA$ ✓

iii. $\Delta OGD \sim \Delta ATC$ ✗

iv. $\Delta DGO \sim \Delta CAT$ ✓

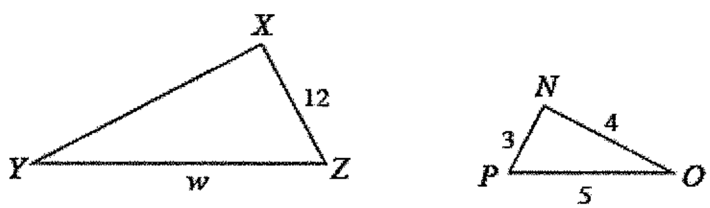
3-38. Find the value of the variable in each pair of similar figures below by setting up a proportion. You may want to color code corresponding sides.

a. $ABCD \sim JKLM$



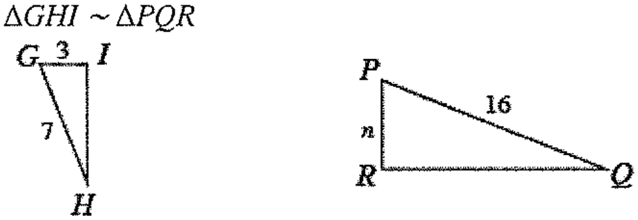
$$\frac{x}{12} = \frac{9}{6}$$

b. $\Delta NOP \sim \Delta XYZ$



$$\frac{12}{3} = \frac{w}{5}$$

c. $\Delta GHI \sim \Delta PQR$

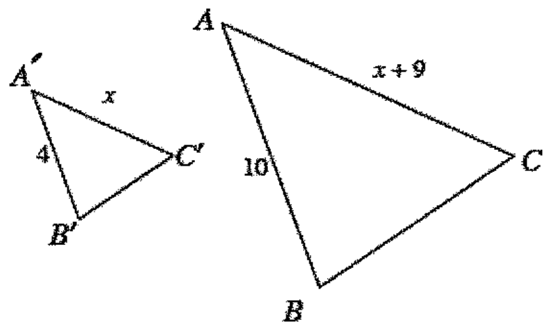


$$\frac{3}{n} = \frac{7}{16}$$

d. $\Delta \underline{AB}C \sim \Delta X\underline{Y}Z$

$$\frac{10}{11} = \frac{7}{m}$$

3-39 Rochida decides to redraw an overlapping triangle as two separate triangles, as shown below. Write and solve a proportional equation to find x using the corresponding sides.



$$\frac{10}{4} = \frac{x+9}{x}$$

$$4x + 36 = 10x$$

$$36 = 6x$$

$$\boxed{6 = x}$$

a. How long is AC ? How long is AC' ?

b. What must the ratio of the original segment $\overline{BC}$ to its image $\overline{B'C'}$ be? Explain.

c. What is the relationship between $\overline{B'C'}$ and $\overline{BC}$?