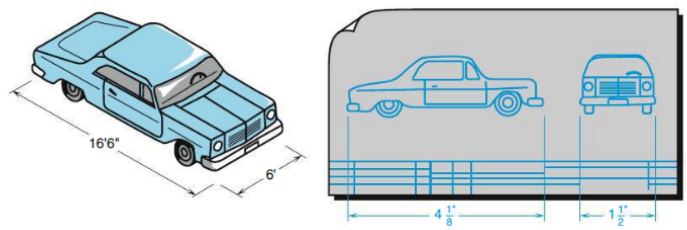
There are some very cool problems we can do once we know about proportions.

Technology Integrated Mathematics
Class Notes
Ratios: Special Applications (Section 4.2)

Ooh, ooh, ooh! What a lovely set of applications we have to play with today. Let's jump right in.

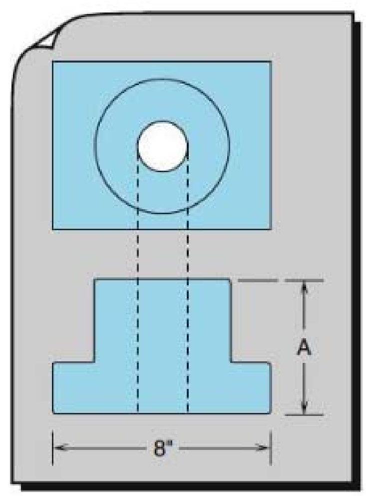
Scale Drawings:
Think of a scale model of a car or blueprints for a building. We have the following proportion to help us along. Also, the book gives us a great example of a car and its scale drawing.

$$\frac{\text{actual length}}{\text{drawing length}} = \frac{\text{actual width}}{\text{drawing width}}$$



expl 1: The base of the flange shown in the drawing is actually 8 in. Its drawing width is 3 in.
a.) What will the actual dimension of measurement *A* be if it is 2.25 in. in the drawing?

b.) What is the scale factor of the drawing?

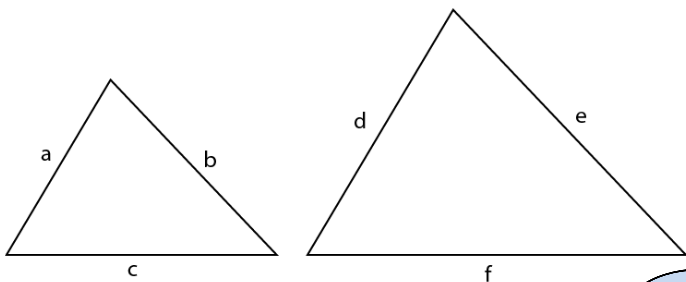


We could think of the drawing and actual flange as two objects with the same shape but different sizes.

Similar Figures:

You may remember that **similar** means that two pictures have the same shape but different sizes. It is as if we put a picture into a photocopier and made it bigger all the way around. Or, we zoomed into a picture on our phone.

Look at these triangles even though many shapes besides triangles could be explored. It is a fact that the ratios of corresponding sides are equal.

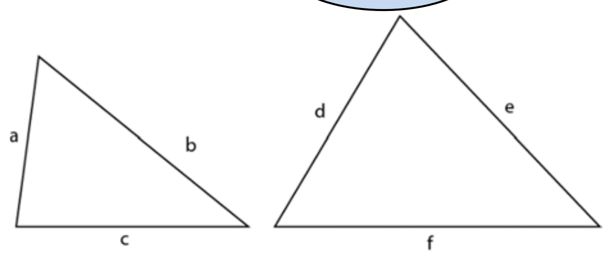


We know that $\frac{a}{d} = \frac{b}{e} = \frac{c}{f}$.

There are other ratios that are equal but we will start there.

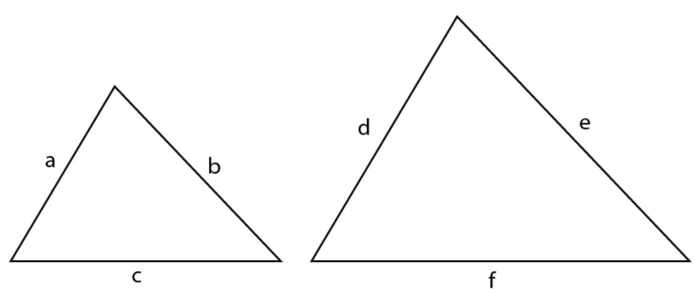
Notice these ratios are all in the form of smaller triangle on top and larger triangle on bottom. Consistency is important.

To be clear, many triangles are *not* similar. I simply moved one vertex on the first triangle and made these *non-similar* triangles. I could *not* use the proportions above for these triangles.



expl 2: We will use the drawing of similar triangles from above. Given the dimensions below, find the length of side f.

side a: 4.5 cm
side c: 7 cm
side d: 6.75 cm



Direct and Inverse Proportion:
Sometimes we will notice how one quantity increases as another decreases, like your car speed and the time it takes to drive somewhere. As your speed increases, the time it takes decreases. Here, time and speed are said to be **inversely proportional**.

Other quantities will increase or decrease simultaneously with each other. The electrical resistance of a wire increases as the length of the wire increases. The sides of those similar triangles are another example. They are said to be **directly proportional**.

We can set up proportions to solve problems involving these types of quantities. Be careful and make sure you know if the relationship is directly or inversely proportional! Here are some quantities that are inversely or directly proportional.

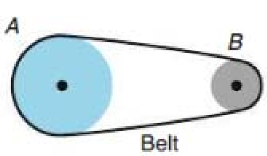
Consumption:
How much paint you use increases with the square footage painted. The amount of gasoline used increases if you drive a longer distance. These quantities are **directly** proportional.

Picture a small wall and a larger wall.

$$\frac{\text{Gallons of paint needed for small wall}}{\text{Gallons of paint needed for large wall}} = \frac{\text{Area of small wall}}{\text{Area of large wall}}$$

The direct relationship is consistent, top to bottom.

Pulleys:
The speed of a pulley is **inversely** proportional to its diameter.

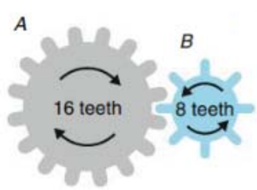


$$\frac{\text{speed of pulley } A}{\text{speed of pulley } B} = \frac{\text{diameter of pulley } B}{\text{diameter of pulley } A}$$

This ratio has the A term on top

This ratio has the A term on the bottom

Gears:
The speed of a gear is **inversely** proportional to its size too (measured in number of teeth).



$$\frac{\text{speed of gear } A}{\text{speed of gear } B} = \frac{\text{teeth in gear } B}{\text{teeth in gear } A}$$

This ratio has the A term on top

This ratio has the B term on top

Look at how the inverse relationship "switches" the top and bottom.

expl 3: If the alternator-to-engine drive ratio is 2.45 to 1, what rpm will the alternator have when the engine is idling at 400 rpm? (Hint: Use a direct proportion.)

Mind the order of the words and ratio. Set up a proportion *with words* first.

expl 4: A 15-tooth gear on a motor shaft drives a larger gear having 36 teeth. If the motor shaft rotates at 1200 rpm, what is the speed of the larger gear?

expl 5: A cylindrical vent 6 in. in diameter must be cut at an angle to fit a gable roof with a 2/3 pitch. This means that the vent must also have a ratio of rise to run of 2:3. Find the height x of the cut that must be made on the cylinder to make it fit the slope of the roof.

This is a similar triangle problem.