Technology Integrated Mathematics
Class Notes
Ratios: Ratio and Proportion (Section 4.1)

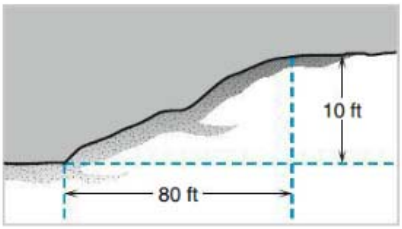
We often compare two numbers to understand a problem.

We will use ratios and proportions in a large variety of problems. We will need to use our basic understanding of fractions along with some trades-specific knowledge.

Definition: Ratio: A **ratio** is a comparison, using division, of two quantities of the same kind. Both are usually expressed in the same units.

This comes from the book and is a narrow definition of ratio.

Slope of a Hill:
A hill is a good example. Imagine the hill pictured here.

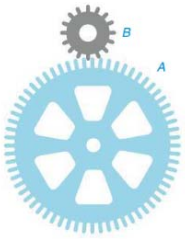


The vertical distance is ten feet. The horizontal distance is 80 feet. We compare the two measurements to get its steepness.

You will see ratios reduced to lowest terms more often than not.

We say that the steepness of the hill is $\frac{10\,ft}{80\,ft} = \frac{1}{8}$.

Gear Ratio:
We see ratios in working with gears too. Consider the following picture of two interlocking gears.



We will imagine that gear B is attached to some spindle that drives it. Gear A is connected to gear B and so is driven by the first gear's motion. We will find the gear ratio of a gear system by the following formula.

$$\text{Gear ratio} = \frac{\text{number of teeth on the driven gear}}{\text{number of teeth on the driving gear}}$$

expl 1: Gear A is the driven gear and has 64 teeth. Gear B is the driving gear and has 16 teeth. What is the gear ratio? Write answer in lowest terms.

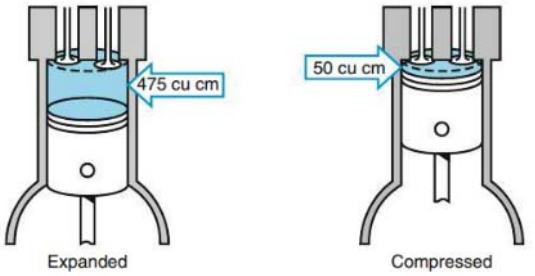
A ratio of 4/1 can be written as 4:1 and is read "4 to 1".

This means A rotates once for every four rotations of B.

Compression Ratio:
In an automobile engine, there is a large difference between the volume of a cylinder space when a piston is at the bottom of its stroke and when it is at the top of its stroke. The difference in volumes is called **engine displacement**.

It is useful to talk of the **compression ratio** of an engine. This compares the volume of a cylinder at maximum expansion to the volume of the cylinder at maximum compression. Here is a picture and the formula we will use.

$$\text{Compression ratio} = \frac{\text{expanded volume}}{\text{compressed volume}}$$



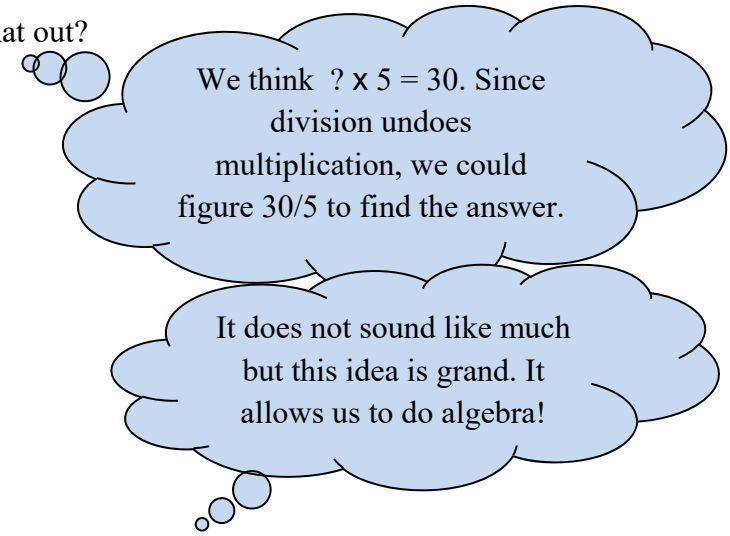
Before we look at an example, let's cover another definition.

Definition: Proportion: A **proportion** is an equation that sets two ratios equal.

We will be given three of four pieces of information and use a proportion to solve for the missing piece. First, let's review some basic algebra.

Algebra Review:
What times 5 makes 30? How do you figure that out?

Algebraically, we need to solve the equation
$x \cdot 5 = 30$

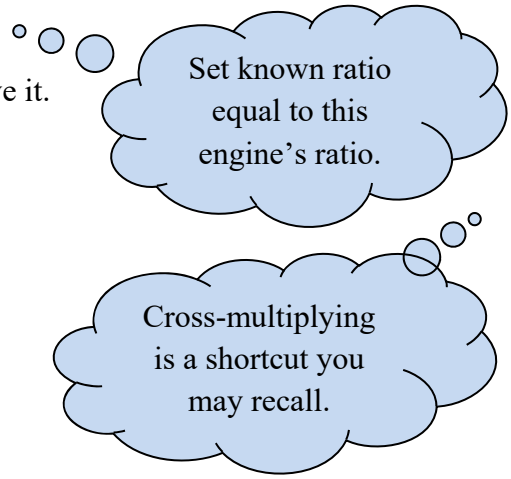


It turns out that we can always divide both sides of a true equation by a non-zero number and the resultant equation is still true. This works for multiplication by any number also.

Those operations are important to us now. Later we will see how this is also true for addition and subtraction but let's not get ahead of ourselves.

expl 2: The compression ratio in a certain engine is 9.6 to 1. If the expanded volume of a cylinder is 48 cu in., what is the compressed volume?

Let x be the compressed volume. Form a proportion and solve it. Do not forget units.



Check your answer.

expl 3: Solve the proportions. Check your answers.

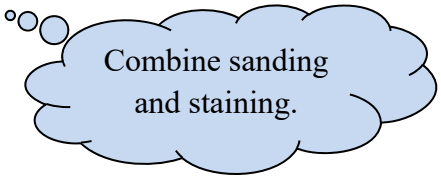
a.) $\frac{23}{138} = \frac{x}{18}$

b.) $\frac{6.2\ cm}{x} = \frac{1.2\ in.}{11.4\ in.}$

expl 4: Solve the proportion. You'll have to convert the left side to inches first (or feet, but you cannot have both).

$$\frac{2\ ft\ 6\ in.}{4\ ft\ 3\ in.} = \frac{3.2\ cm}{L}$$

expl 5: A painting contractor knows from experience that sanding trim requires 0.80 to 1.00 hours of labor per 100 linear feet, and that staining that same trim requires 0.50 to 0.75 hours of labor per 100 linear feet. What would the minimum and maximum number of total hours of labor required for sanding and staining 360 linear feet of trim?



expl 6: The headlights of a car are set so the light beam drops 2 in. for each 25 ft measured horizontally. If the headlights are mounted 30 in. above the ground, how far ahead of the car will they hit the ground?