Geometry, *You Can Do It !*
Ratio & Proportion

by Bill Hanlon

A **ratio** is a comparison betwen two numbers. An example might be comparing a baby's birth weight to it's length. We might see a comparison like 7 lbs. to 21 inches.

A **proportion** is a statement of equality between two ratios. We use those all the time. When you know one drink will cost \$.50, then 2 drinks will cost \$1.00.

We could express that proportion in fractional form.

$$\frac{\text{1 drink}}{.50} = \frac{\text{2 drinks}}{1.00}$$

When setting up a proportion, it's very important to have the ratio described the same way on both sides of the equal signs.

In other words, if I'm going to have a proportion describing inches to feet on one side, then I must use inches to feet on the other side of the equal sign.

So someone might set up the proportion like this;

$$\frac{\text{inches}}{\text{feet}} = \frac{\text{inches}}{\text{feet}}$$

Someone else might have set up the equality this way;

$$\frac{\text{feet}}{\text{inches}} = \frac{\text{feet}}{\text{inches}}$$

What you can't do is describe one side of the equality one way and the other side another way.

Sometimes we have to manipulate proportions to describe data given in problems. Specifically, we will need to be able to work with proportions when we deal with similar polygons in the next section.

Looking at a proportion such as

$$\frac{1}{2} = \frac{3}{6}$$

If we played with that long enough, we might notice something.

We could turn both of those ratios upside down and the equality would still hold. In other words, 2/1 = 6/3

We could write the original proportion sideways and again the equality would remain. 1/3 = 2/6

I know, you are finding this facinating. If we kept playing math, we would also see we could cross multiply and the equality would again hold.

Let's see, 1x6 = 2x3. This is good stuff !

As we continue with geometry, these equalities we are finding will come in handy. In fact, what we need to do is formalize them.

Properties of Proportion

If $\frac{a}{b} = \frac{c}{d}$, **then**

1. $ad = bc$
2. $\frac{b}{a} = \frac{d}{c}$
3. $\frac{a}{b} = \frac{c}{d}$
4. $\frac{a+b}{b} = \frac{c+d}{d}$
5. $\frac{a}{b} = \frac{a+c}{b+d}$

What we have done is transform the original proportion into five equivalent equations.

These five properties will be used in future work. When any of these properties is needed as a reason for a proof, the phrase ***a property of proportions*** can be used.

The a,b,c, and d are referred to as the first, second, third, & fourth terms of the proportion. repectively. You try some using equal fractions.