Astronomy 1102/1104 19 January, 2009
Problem Solving with Algebra

Many students are a little uncomfortable with mathematics. Despite this fact, we will have to use mathematics in this class from time to time. Some students might find this little handout helpful.

Algebra is a method of solving equations for some quantity. For example, how would you solve the following equation for y?

$$x = 3y^2 + 2b$$

Solving the equation for y means writing it as "y = something". How do we do that? The trick is to just remember that if you do the same things to both sides of an equality, it is still an equality. You can:

- add or subtract
- multiply or divide
- take the square or square root (or cube, or fourth power ...)
- exponentiate or take the logarithm

To solve the equation above, I must first subtract 2b from both sides of the equation:

$$x - 2b = 3y^2$$

I can then divide by 3:

$$y^2 = (x-2b)/3$$

Finally, if I take the square root of both sides, I am left with

$$|y| = [(x-2b)/3]^{1/2}$$

To solve a physics or astronomy problem, it is usually necessary to set it up first.

For example: A barrel contains 40 gallons of water, but it has a leak; it loses 5 gallons every hour. How long will it be before the barrel is empty?

You can just look and see the answer is 40/5 = 8 hours. But let's take a closer look and see how we got this.

First, let's define some variables.

G = the total number of gallons of water G = 40
L = the leakage rate (in gallons per hour) L = 5
T = the time it takes to lose all the water (in hours)

Clearly,

$$G = LT.$$

If this seems a little hasty, look at the units. On the left, we have gallons. On the right, we have (gallons/hour) × hours = gallons.

To solve an equation, we first have to set it up, then solve for the quantity we are after. Sometimes the details can look a little daunting, but if you keep in mind the goal, it's not so bad.