Tips for Word Problems

It isn't always obvious what math to use when reading a word problem. The way we use words in English is much more complicated than simple math formulas! Here are some pointers.

Translating English to Math

- **"Of" means multiply.** Usually when people use "of" in math, they mean multiply. Here are some examples: 15% of $20. 5 boxes of a dozen donuts each. We never say 5 of 12, since that would sound funny, but as soon as you add units to the first number, it makes sense: 5 boxes of 12 or 15% of 20.
- **"Out of" means divide.** 4 out of 5 dentists. This one is easy and doesn't need units because the phrase "out of" implies that the units on the top and bottom of the fraction are the same.
- **"Per" also means divide.** 55 miles per hour. The word "per" is used for division when the units for the two numbers are not the same. It also makes sense if the units are the same, but it sounds weird: 4 dentists per 5 dentists.
- **"And" usually means add.** You already know this. One big exception is when you are counting branching possibilities. For example, if Alice had 4 children, and each child had 3 children of their own, then Alice would have 12 grand children.
- **"Is" means equals.** This one sounds obvious, but people often forget to that to solve for an unknown, you usually need to solve an equation.
- **"What"/"How" questions indicate unknowns.** If a problem asks 'how much' or 'what is', that means there is an unknown quantity. Pick a letter to represent the unknown.

Common Types of Word Problems

- **Proportion Problems** These are problems where you have a part divided by a whole that is equal to some proportion, fraction, or percentage.

  $$\frac{\text{Part}}{\text{Whole}} = \text{Proportion}$$

  Typically, you'll have enough information to figure out two of the three (Part, Whole, Proportion) and then you solve for the one that's left.

- **Linear Functions** These are problems where there is a linear relationship between an input variable and an output variable. Usually you'll be able to use the formula

  $$y = mx + b.$$

  The slope m will be a rate (a number that has different units in the numerator and denominator like 10 miles per hour or $2 per gallon). Multiplying the input variable x by the slope m should change the units of x to match the units of the output variable y and the y-intercept b. Typically, you'll have enough information to figure out three of the variables (x, y, m, b), and then you can solve for the one that's left.

- **Rate Problems** These are proportion problems where the proportion is a rate. There are lots of types of rate problems. One common example is distance, time, and velocity problems.

  $$\frac{\text{Distance}}{\text{Time}} = \text{Velocity}.$$

  You solve rate problems the same as any other proportion problems.