Conversions

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Agronomists often need to convert a value from one set of units to another, or solve a problem that requires using known relationships. Here is an example of how I approach these situations.

Question: How many acres are there in 10 square kilometers? (My business partner in Brazil farms 10 km^2 and I want to know how many acres this is).

1. Find and write out all of the relationships that will be needed to go from the units of my starting value (square kilometers) to the units of my ending value (acres). Each relationship must link to another relationship or my starting or ending units.

   1 km = 1000 m, so that means $(1 \text{ km})^2 = 1 \text{ km}^2 = (1000 \text{ m})^2 = 10^6 \text{ m}^2$

   1 m = 3.2808 ft, so that means $(1 \text{ m})^2 = 1 \text{ m}^2 = (3.2808 \text{ ft})^2 = (3.2808)^2 \text{ ft}^2$

   640 acres = 1 square mile

   5280 ft = 1 mile, so that means $(5280 \text{ ft})^2 = (5280)^2 \text{ ft}^2 = 1$ square mile

2. Think again about what I am starting with and what I want to end up with.
$$10 \text{ km}^2 = ... = ? \text{ acres}$$

3. Arrange the relationships found in Step 1 into factors so that all of the units cancel, except the unit of my answer (acres). The order doesn't matter!
$$10 \text{ km}^2 \times \frac{10^6 \text{ m}^2}{1 \text{ km}^2} \times \frac{1 \text{ square mile}}{(5280)^2 \text{ ft}^2} \times \frac{(3.2808)^2 \text{ ft}^2}{1 \text{ m}^2} \times \frac{640 \text{ acres}}{1 \text{ square mile}} = ? \text{ acres}$$

4. Do the math.
$$10 \times 10^6 \div 1 \times 1 \div (5280)^2 \times (3.2808)^2 \div 1 \times 640 \div 1 =$$

5. I find 2470.9937... (I did the math all in one step to avoid rounding errors.) In significant figures, 2471.0 if 10 km^2 is exact (has an infinite number of significant figures), but 2500 if 10 km^2 has only two significant figures.

6. And the answer is 2500 acres! (Because I doubt the 10 km^2 has more than 2 significant figures, and using just 2 significant figures gives me all the information I need to compare with my farm.)

7. Wait. Does this make sense? Well, 10 km = 6.2 miles and 1 km is more than half a mile, so 10 km^2 is more than $6 \times 0.5 = 3$ square miles and $3 \times 640 = 1920$, so my answer sounds mathematically plausible. Plus 2500 acres is not too much different from a large Iowa farm.