Multiplying and dividing scientific notation

Sometimes we'll have problems where we're asked to multiply and divide scientific notation at the same time. It doesn't matter if we do the multiplication first and then the division, or the division first and then the multiplication.

Either way, our process for multiplying scientific notation doesn't change, and our process for dividing scientific notation doesn't change.

Remember, when we multiply scientific notation we multiply the decimal numbers, then multiply the powers of 10, adding the exponents. And when we divide scientific notation we divide the decimal numbers, then divide the powers of 10, subtracting the exponents. And in both cases, we need to make sure to express the answer in proper scientific notation.

Let's do an example.

Example

Simplify the expression.

$$\frac{(2.3 \times 10^{-4})(6.4 \times 10^{12})}{4.2 \times 10^{10}}$$

There are a few ways that we could simplify this expression, but we'll choose to do the multiplication in the numerator first, and then once we have the numerator simplified we'll divide by the denominator.

Starting in the numerator, we'll multiply the decimal numbers.

$$2.3 \times 6.4 = 14.72$$

Then we'll multiply the powers of 10 from the numerator.

$$10^{-4} \times 10^{12} = 10^{-4+12} = 10^{8}$$

Which means that the numerator simplifies to

$$14.72 \times 10^{8}$$

and the full expression is now

$$\frac{14.72 \times 10^{8}}{4.2 \times 10^{10}}$$

Technically, the number in the numerator isn't in proper scientific notation, since in 14.72 there are two digits to the left of the decimal point, but we don't have to deal with that yet. We can divide by the denominator first, and then deal with it at the end if we need to.

Let's divide the decimal numbers.

$$14.72 \div 4.2 \approx 3.5$$

Remember that the squiggly lines $\approx$ mean that 3.5 is an approximate result. If we were to give that result to 5 decimal places, it would be 3.50476, so by rounding it to the nearest tenth, we get 3.5.

Now we'll divide the powers of 10.

$$10^{8} \div 10^{10} = 10^{8-10} = 10^{-2}$$

Multiplying our results, we get

$$3.5 \times 10^{-2}$$

Since this is already in proper scientific notation, there's nothing else we need to do.
