

Lesson 4: Scientific Notation

In the last section you learned how to use sig digs in your calculations.

- What do you do if you multiply numbers like $537 \times 269 = 144\,453\dots$ you are supposed to only have three sig digs, but your answer sure has more than three sig digs! *We need a way to show the correct number of sig digs.*
- What if you have a large number like **4 500 000 000** km (the distance from Neptune to the sun), or a small number like **0.000 000 010** cm (the diameter of an atom) and you don't want to be bothered with writing out all those zeros? *We need a way to show really big and really small numbers.*

To get around these problems, we use **Scientific Notation** (sometimes called Exponential Notation).

- This system makes use of "powers of 10", raising 10 to whatever value you need.
- You can get either really big numbers by using positive powers like $10^5 = 100\,000$
- You can also show really small numbers by using negative powers like $10^{-5} = 0.00001$

Example 1:

$$10^5 = 10 \times 10 \times 10 \times 10 \times 10 = 100\,000$$

$$10^{-5} = 1/10 \times 1/10 \times 1/10 \times 1/10 \times 1/10 = 0.00001$$

Don't worry about spending half a minute using your calculator to figure out what 10^5 equals. Instead, notice that 10^5 written out has five zeros.

Converting Numbers into Scientific Notation

When you use scientific notation, follow these rules. We'll try them out on the numbers from the start of the lesson ...

1. Move the decimal over so that only one non-zero number is to the left of the decimal.
4 500 000 000 \Rightarrow **4.500 000 000**
0.000 000 010 \Rightarrow **000 000 01.0**
2. Count how many spaces over you moved the decimal. If you moved it to the left it's positive, if you moved it to the right it's negative.
4.500 000 000 \Rightarrow moved **9** spaces left (+9)
000 000 01.0 \Rightarrow moved **8** spaces right (-8)
3. Get rid of any numbers that are not sig digs. This might depend on the numbers you used in your calculation.

$$\mathbf{4.500\,000\,000} \Rightarrow \mathbf{4.5}$$

I'm assuming that all those other zeros were probably just place holders, although I'd need a reason to do this in a real question.

Warning!

When you use sci not, you might be writing a number down with more or less sig digs than it actually has. Be very careful to pay attention to the number of sig digs you are really dealing with.

$$000\ 000\ 01.0 \Rightarrow 1.0$$

I'll keep this last zero. Since it was written in the original number for such a small number, it's probably significant.

4. Write down the number, multiplied by 10 to the power of however many spaces you found in step 2.

$$4\ 500\ 000\ 000 = 4.5 \times 10^9$$

$$0.000\ 000\ 010 = 1.0 \times 10^{-8}$$

If you ever need to change a number in scientific notation back to regular form, do the reverse of the above.

Scientific Notation on Your Calculator

Most calculators now have a key on them for doing scientific notation. Look for one of the following...

EXP (most Casio calculators)
EE (most TI calculators, and you might have to use the 2nd function key to use it)
10^x
S.N.

Warning!

Do **NOT** use the "hat" symbol on your calculator to enter scientific notation (eg. 4.5×10^5). Your calculator will treat this as two separate numbers, and you will get some calculations wrong because of it (it screws up the proper order of operations). Do not make excuses like "I'll use brackets," since you'll only screw up later.

On your calculator, type in the question as it's written.

- Remember, the calculator doesn't care about sig digs... it's up to you to round off the answer.
- Most of the time you'll be dealing with multiplying and dividing Scientific Notation, which makes it easier to figure out the sig digs.
- Use the rules we covered for sig digs, but don't look at the 10 to whatever power part... it does not count for sig digs.
- If you have to type in a negative number, use the (-) button on the calculator, not the subtraction button.

Example 2: Determine the answer to the following question. Try doing it on your calculator to see if you get the same answer.

$$4.587 \times 10^4 \div 1.2 \times 10^{-3} = 3.8 \times 10^7$$

If you're using a TI graphing calculator, you'll notice that it shows scientific notation with an "E" (for exponent). The above example would look like this on your display...

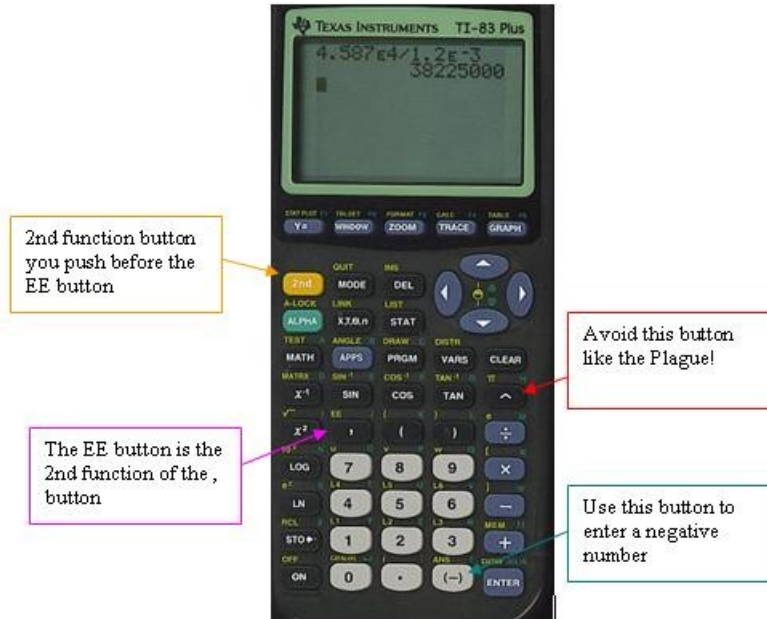


Illustration 1: TI:83 Calculator

To make typing scientific notation easier for me on this site, I will be using a style similar to the way a TI-83 would show the numbers. For example, I'll be typing $4.587e4$ instead of 4.587×10^4 . Hope ya' don't mind.

Video Killed the Radio Star!

It's really easy to mix up typing a set of numbers on your calculator using scientific notation.

[Click here](#) to watch a video on the proper method. I'm using a Casio calculator, but it's the same sort of ideas on most calculators.