

## Scientific notation and your calculator

NAME:

**Really big numbers (like 6,538,000,000,000,000) or really small numbers (like .0000000000000023) are written more easily using scientific notation. Calculators also use scientific notation quite a bit. This worksheet is designed to teach you about scientific notation in general and how to interpret the calculator's use of it.**

1. Fill in the table for the powers of ten by writing the decimal equivalents. Use commas where necessary. The few in the middle are done for you to get you started. Use your calculator if you'd like.

Number in exponent form	Number in decimal form
$10^{-6} = \frac{1}{10^6}$	
$10^{-5} = \frac{1}{10^5}$	
$10^{-4} = \frac{1}{10^4}$	
$10^{-3} = \frac{1}{10^3}$	
$10^{-2} = \frac{1}{10^2}$	
$10^{-1} = \frac{1}{10^1}$	.1
$10^0$	1
$10^1$	10
$10^2$	
$10^3$	
$10^4$	
$10^5$	
$10^6$	

2. What is the pattern that emerges in the table? Using this pattern, what do you think  $10^{12}$  would be?

3. Scientific notation is an easy way to write really big numbers like 9,000,000,000,000. This can be thought of as  $9 * 1,000,000,000,000$ . Using the alternative way to write 1,000,000,000,000, how else could I write  $9 * 1,000,000,000,000$  ?

4. So we see that 9,000,000,000,000 could be concisely written as  $9 * 10^{12}$ . This is the idea behind scientific notation. This shorthand notation is quite convenient.

So really, any number can be written as “something times ten to some power”.

To see the connection between the exponent of the ten and the number in decimal form, complete the table. Notice  $5 * 10^0$  is done for you; it will serve as a reference point. Use your calculator if you'd like. (Remember your order of operations: evaluate the exponent before multiplying by the 5.)

Number in scientific notation form	Number in decimal form
$5 * 10^{-4} = \frac{5}{10^4}$	
$5 * 10^{-3} = \frac{5}{10^3}$	
$5 * 10^{-2} = \frac{5}{10^2}$	
$5 * 10^{-1} = \frac{5}{10^1}$	
$5 * 10^0$	<b>5.0</b>
$5 * 10^1$	
$5 * 10^2$	
$5 * 10^3$	
$5 * 10^4$	

5. Each number can be thought of as taking **5.0** and moving the decimal place so many places to either the left or the right. What is the connection between the exponent on the ten and how the decimal point moves? Try to be precise in explaining when it moves left or right and how many places.

6. Scientific notation lets us write any number as “some number (between 1 and 10) times ten raised to some power”. We could even have numbers like  $6.345 * 10^3$ . To translate this, we would move the decimal point over three places to the right to get 6345 or 6,345 (Since  $10^3$  is really 1000, this is just 6.345 times 1000).

Practice translating between scientific notation and decimal forms in the table below. **The numbers in the left column should always be in the form  $a * 10^n$  where  $a$  is a number between 1 and 10, not including 10.** The (universally used) restriction that  $a$  is between 1 and 10 ensures everyone’s answers will match. Notice the exponent  $n$  will always be an integer.

Number in scientific notation form	Number in decimal form
	.000 000 65
	8,500,000,000,000,000
	.000 000 000 000 034
$5.4 * 10^{-8}$	
$8 * 10^7$	
$2.4 * 10^6$	
	.000 689
$-9.478 * 10^{-5}$	
	-.000 000 004 92
$-1.72 * 10^{12}$	

7. Our last task is to interpret how the calculator denotes scientific notation. Instead of writing  $2.4 * 10^6$ , the calculator writes 2.4E6. If you want to enter a number in scientific notation, you use the **EE** button. On the **TI86** or **TI85**, the **EE** button is directly above the **7** button. On the **TI84**, **TI83**, or **TI82**, **EE** is the second function of the **comma** button, directly above the **7** button.

Let's say we want to find the value of  $\frac{3.4 * 10^9}{6.5 * 10^4}$ . Let's use the **EE** function on our calculators. We do not need to use parentheses because the calculator knows to evaluate the scientific notation first, before dividing. Simply put "3.4E9/6.5E4" into the calculator.

Did you get 52307.69?

Note: We could have put in " $(3.4 * 10^9)/(6.5 * 10^4)$ " and gotten the same result. Notice how you need parentheses here. Try this.

8. Often the calculator will use scientific notation. For instance, when we find roots via the Root / Zero function (later, in more advanced algebra classes), it gives us the  $x$  value (which is what we want) but sometimes it also gives us something like  $y = 9.86E-32$ . Explain why this can be interpreted as 0.