Name:

Skill Sheet 2.3   Scientific Notation

Visualizing and working with very large and very small numbers is easier when you use scientific notation. In this skill sheet, you will practice using scientific notation.

1. When is scientific notation useful?

Scientific notation is useful for large and small numbers, but not when the numbers need to be highly precise. This is because at high precision, each number must be displayed. The two examples below illustrate when scientific notation is useful and when it is not.

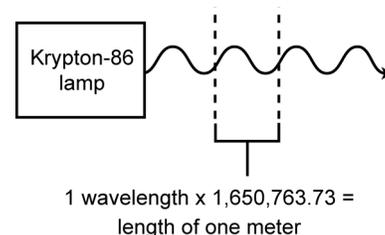*Scientific notation is useful when the number is not very precise:*
Speed of light = 300,000,000 cm/sec = 3.00×10^8 cm/sec
Here, the speed of light is not a precise number. We do not know if the speed of light is 299, 999, 999 cm/sec or 300,000,000.321 cm/sec.

Scientific notation is not useful when the number is precise:
A precise length of 1 meter = 1,650,763.73 wavelengths of orange-red light from a krypton-86 lamp.
We cannot easily write this number using scientific notation.

1 wavelength x 1,650,763.73 = length of one meter

	A	B
1. Which of the following numbers in these sentences would be useful to write in scientific notation?	The amount of money he had in his bank account was $30,892.23.	The net worth of that businessman is $53,000,000.000.
2. Which of the following numbers should not be written in scientific notation?	503, 099, 111, 834.45	0.00000000672

2. Why is scientific notation useful?

Multiplying and dividing in scientific notation is so easy that you can often make estimates in your head. To multiply in scientific notation, multiply the two bases and add the two exponents. For example, you can easily calculate the square of the speed of light (3.00×10^8 cm/sec) using scientific notation:

Multiply bases:	*Add exponents:*	*Assemble the number:*
$3.00 \times 3.00 = 9.00$	$10^8 \times 10^8 = 10^{16}$	9.00×10^{16} cm/sec

Dividing two numbers in scientific notation is similar to multiplying them. To divide, the first base is divided by the second base. Then the second exponent is subtracted from the first.

	Divide bases:	*Subtract exponents:*	*Assemble the number:*
$4.00 \times 10^8 \div 2.00 \times 10^2$ =	$4.00 \div 2.00 = 2.00$	$10^8 \div 10^2 = 10^{(8-2)} = 10^6$	2.00×10^6

3. Converting from standard notation to scientific notation

- Note the position of the decimal in the standard notation number. If there is no decimal, add one at the end of the number.
- Count the number of places as you move the decimal until the base number is equal or greater than 1, but less than 10.
- Usually the base is shown to two decimal places. Round the base number to two decimal places if necessary.
- Write the exponent, equal to the number of places moved, as a power of ten. If you moved the decimal to the left, the exponent is positive. If you moved it to the right, the exponent is negative.

Convert these standard notation numbers to scientific notation:

	Standard notation	Scientific notation
1.	6,700,000	
2.	300,000,000	
3.	3,600,000	
4.	0.000645	
5.	150,000,000	
6.	0.001	
7.	186,000	
8.	0.001341	

4. Converting from scientific notation to standard notation

- If the exponent is negative, count places left from the decimal in the base number equal to the exponent.
- If the exponent is positive, count places right from the decimal in the base number equal to the exponent.

$4.00 \times 10^8 =\ 400 \times 10^6$ *Now add six more zeros to 400 to make* 400,000,000

Convert these scientific notation numbers to standard notation:

	Scientific notation	Standard notation
1.	3.47×10^8	
2.	7.94×10^3	
3.	1.96×10^{-3}	
4.	4.50×10^9	
5.	9.61×10^{-6}	
6.	2.02×10^5	
7.	7.01×10^{-10}	
8.	4.44×10^1	

5. Scientific notation using a calculator

You can convert between standard and scientific notation with a scientific calculator. Calculators vary in keystrokes used, but most are similar to the keystroke steps listed here. Compare these steps to the instructions for your scientific calculator.

To enter a number in scientific notation:

- Type the base number using the number keys and the decimal key.

- Press the exponent key. On some calculators this key is labeled <EE>. Other common exponent keys are <Ex >, <Exp>, and <x10>. This automatically sets up the power of ten exponent entry.

- If the exponent is negative, press the <(-)> and then type exponent. Doing this will make the exponent a negative number. On some calculators, you type the negative sign after typing the exponent.

 Check your work in Part 3 by using these steps with a calculator.

To convert a number in scientific notation to standard notation:

- If the calculator has different display modes, set it for standard notation display.

- Enter a number in scientific notation using the steps above.

- Press the <=> key.

 Check your work in Part 4 by using these steps with a calculator.

6. Scientific notation operations using a calculator

Calculators can do math operations (+, -, ·, ÷) in scientific notation and mixed standard and scientific notation. The procedure is no different from what you have used with standard notation. Simply enter the first number, the operator, the second number, and then type <=>. Some calculators allow the display mode to be changed between standard and scientific notation. A calculator set to standard notation display mode allows you to divide two numbers in scientific notation, but the result appears in standard notation. To display the result in scientific notation, change the display mode. Solve these operations with your calculator in scientific notation mode.

1.	$2.34 \times 10^3 \times 6 =$
2.	$2.34 \times 10^3 \times 1.10 \times 10^4 =$
3.	$7.02 \times 10^3 \div 2.34 \times 10^2 =$
4.	$4.32 \times 10^9 + 7.87 \times 10^9 =$
5.	$5.21 \times 10^{-4} - 3.01 \times 10^{-4} =$
6.	$5.06 \times 10^2 + 410 =$
7.	$7.22 \times 10^5 \times 3.33 \times 10^3 =$
8.	$8.64 \times 10^4 - 5.02 \times 10^3 =$
9.	$9.87 \times 10^{-7} \div 2.10 \times 10^{-3} =$
10.	$6.88 \times 10^{-3} + 2.45 \times 10^{-3} =$