



**Scientific Notation
and
Significant Figures**

Expressing Large and Small Numbers

- Math in a science class can result in some very large numbers (123,000,000,000) and some very small numbers (.000000000123)
- Instead of writing big or small numbers, a shorthand method was created to deal with these numbers.
- The shorthand method is called *Scientific Notation*.
- It looks like this: 1.23×10^{11}
- The first number (1.23) is called the coefficient.
- The second number (10^x) is called the base and is always written in exponential form.

Writing a number in scientific notation

There are three steps to complete to change a number into scientific notation:

Step 1: Move the decimal point in the original number to the left or right so that the new number has a value between 1 and 10.

Step 2: Count the number of decimal places the decimal point is moved in Step 1. If the original number is 10 or greater, the count is positive. If the original number is less than 1, the count is negative.

Step 3: Multiply the new number in Step 1 by 10 raised to an exponent equal to the count found in Step 2.

Example

- The distance between the sun and the dwarf planet Pluto is approximately 5,906,000,000 kilometers. Change to scientific notation.
 1. The first step gives me 5.906000000
 2. I moved the decimal point 9 places. The original number is greater than 10 so my exponent will be positive.
 3. Putting the information together we get 5.906×10^9

Example

- The mass of a proton is approximately .0000000000000000000000000000165. Change to scientific notation.
 1. The first step gives me 1.65
 2. I moved the decimal point 24 places. The original number is less than one so my exponent will be negative.
 3. Putting the information together we get 1.65×10^{-24}

Significant Figures

Rules for Significant Figures

- All digits are significant except zeros (zeros may or may not be significant).
- Placeholder zeroes are not significant. Placeholder zeros would disappear if the number is placed in scientific notation (example: 0.00025 has two significant figures, 2 and 5).
- Terminating zeros ending to the left of the decimal point may not be significant. When the decimal point is not shown (example: 2000), you must assume that the zeros are NOT significant.

Rules (cont'd)

- Zeros are significant when they trail a number to indicate precision in the number. For example, 0.05678000, the zeros to the left of 5 are not significant but the three zeros following the 8 are. Thus the digit contains seven significant figures.
- Zeros trapped between any two significant digits are significant; for example, 5008 and 500.1.

Adding and Subtracting Significant Figures

- When adding and subtracting numbers, count the number of decimal places to determine the number of significant figures.
- The answer cannot contain more places after the decimal than the smallest number of decimal places in the numbers being adding or subtracted.

164.123456 (6 places after the decimal point)

2.5678 (4 places after the decimal point)

0.21 (2 place after the decimal point)

166.90125 (result)

166.90 (rounded to 2 places in the answer)

Multiplying and Dividing Significant Figures

- When multiplying or dividing numbers, count the total number of significant figures in each number. The answer cannot contain more significant figures than the number being multiplied or divided with the least number of significant figures.

23.123123 (8 significant figures)

× 1.3344 (5 significant figures)

30.855495 (answer on calculator)

30.855 (rounded to 5 significant figures)