

Rules for Significant Figures

Counting significant figures:

1. Nonzero integers. Nonzero integers are **always** counted as significant. For example, in the number 1.36, there are three significant figures.
2. Zeros. There are three different classes of zeros:
 - a) Leading zeros are zeros that precede all the nonzero digits. Leading zeros are **never** counted as significant. For example, in the number 0.0017, there are two significant figures, the 1 and the 7. The zeros are not significant because they simply indicate the position of the decimal.
 - b) Captive zeros are zeros that fall **between** nonzero digits. Captive zeros are **always** counted as significant. For example, in the number 1006, there are four significant figures.
 - c) Trailing zeros are zeros at the right end of the number. Trailing zeros are only significant if the number contains a decimal point. For example, the number 200 has only one significant figure, while the number 200. has three, and the number 200.00 has five significant figures.
3. Exact numbers. If a number was obtained by counting: 5 pennies, 10 apples, 2 beakers, then the number is considered to be exact. Exact numbers have an infinite number of significant figures. If a number is part of a definition then the number is also exact. For example, 1 inch is defined as exactly 2.54 centimeters. Thus in the statement .1 in. = 2.54 cm, neither the 1 nor the 2.54 limits the number of significant figures when its used in a calculation.

Rules for counting significant figures also apply to numbers written in scientific notation. The number of significant figures are found in the coefficient. For example, the number 2.00×10 has three significant figures. Scientific notation offers two advantages: the number of significant figures can be indicated easily, and fewer zeros are needed to write very large or very small numbers. For example, the number 6,000,000 is more conveniently written as 6×10^6 and the number has one significant figure no matter in which form it is written.

Rules for Rounding

1. If the digit to the right of the position which you are rounding to
 - a) is less than 5, the preceding digit remains the same. For example, 4.32 rounded to two significant figures becomes 4.3.
 - b) is equal to or greater than 5, the preceding digit is increased by 1. For example, 2.7636 rounded to two significant figures becomes 2.8.
2. In a series of calculations, carry extra digits through to the final result and then round off. This means that you should carry all of the digits that show on your calculator (or most of them) until you arrive at your final answer and then round off.

Rules for Using Significant Figures in Calculations

1. For multiplication or division, the number of significant figures in the result is the same as that in the measurement with the smallest number of significant figures. For example:

$$\begin{array}{ccccccc} 34.91 & \times & 0.0053 & = & 0.185023 & \text{Rounds to} & 0.19 \\ \uparrow & & \uparrow & & & & \uparrow \\ \text{four} & & \text{two} & & & & \text{two} \\ \text{sig figs} & & \text{sig figs} & & & & \text{sig figs} \end{array}$$

Because 0.0053 has only two significant figures, it limits the answer to two significant figures.

2. For addition or subtraction, your final answer is rounded to the place, when starting from the right, where every number in that column is a significant figure. For example:

$$\begin{array}{rcl} \text{a)} & 12.72 & \\ & 34.1 & \\ + & \underline{0.463} & \\ & 47.283 & \text{Rounds to } 47.3 \\ & \uparrow & \\ & \text{all numbers} & \\ & \text{are significant to} & \\ & \text{the tenths place} & \end{array}$$

$$\begin{array}{rcl} \text{b)} & 900 & \\ & 370 & \\ + & \underline{101.037} & \\ & 1371.037 & \text{Rounds to } 1400 \\ & \uparrow & \\ & \text{all numbers} & \\ & \text{are significant to} & \\ & \text{the hundreds place} & \end{array}$$