Managing Numbers

Significant Digits (Figures)

Significant digits, some times also known as significant figures, are the *number of digits that are important or meaningful in a measured or calculated quantity.* There are, however, few rules that apply in counting the significant digits.

Rules

- We usually use numbers 1, 2, 3 . . . 9, and 0 (zero) represent any number; measured or calculated. Any digit other than zero is always significant and counts as one digit. For example, 5674 has four significant digits, 7.83848 has six significant digits.

- The zero (0) is not always significant. If zero comes in between the numbers and at the end of the number is significant. For example, 45.0405 has 6 significant digits, and 3.404200 has 7 significant digits.

- Zeros at the beginning of any number or used to locate the decimal point are not significant. For example, 000045.60, is the same as 45.60 and has four significant digits. Adding zeros at the beginning of the number does alter its magnitude. Consider another example, 0.000785, which has three significant digits because zeros between the decimal point and the first non-zero number are used to locate the decimal place.

- If the number does not contain decimal point, the trailing zero(s) may or may not be significant. For example, the number 1400 may contain 2 or 3 or 4 significant digits that introduce certain ambiguity. To avoid this, one should express numbers like this in scientific notations. In this particular case, the 1400 may be written as 1.4×10^3 with two significant digits or 1.40×10^3 with three significant digits or 1.400×10^3 with four significant digits.

Example

Determine the number of significant digits in the following numbers.

(a) 3.456 cm
(b) 0.0078 g
(c) 200 m
(d) 1234.56×10^6 atoms
(e) $74.060\ ^0C$

Answer

(a) This number has four significant digits because it contains all non-zero numbers.
(b) This number has two significant digits because zeros before the first non-zero number are used in order to locate the decimal point and they are not significant. The best practice in dealing with such numbers is to convert them into scientific notations and then count the significant digits only in prefixes disregarding the exponential parts. This number in scientific notation becomes 7.8×10^{-2} that obviously has two significant digits.

(c) This number has an ambiguity because there is no decimal point. The number of significant digits could be one 1 (2×10^2) or two (2.0×10^2) or three (2.00×10^2).

(d) Six significant digits; digits only in the prefix are counted.

(e) Five significant digits.

Significant Figures in Calculations

There are two rules that apply, one for addition/subtraction, and another for multiplication/division.

Addition/Subtraction

In addition/subtraction, the answer must be reported to the *same number of decimal places* as there are in a least precise number (more decimal places, more precise and less decimal places, less precise). Consider the following example.

$$34.457 + 2.69 + 567.7857 = 604.93270$$

Here the least precise number is 2.69 because it carries the least number of decimal places. Hence, the answer must also contain two decimal places. The proper answer should be 604.93 after rounding off.

Multiplication/Division

In multiplication/division, the answer must be reported to the *total number of digits* that are present in a number with a smallest number of significant digits. Consider the following example.

$$1.345 \times 8.23 = 11.06935$$

The number 8.23 contains the smallest number of significant digits (three significant digits), and hence the answer must be 11.1 after rounding off.

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Hands on Practice to Count Number of Significant Figures