

Significant Figures (Significant Digits)

If we give 40 people ten Vernier calipers and one line to measure, there is very little chance that all 40 people will come up with the exact same number for their measurement. They'll get things like 4.45, 4.46, 4.43, 4.44, 4.45, etc. So what is the true measurement? Significant figures help us handle such cases.

Significant figures rules exist for measurements and for computations with measurements. This section introduces these rules.

The Point: Report only ONE questionable digit for measurements.

In the example with the Vernier caliper above, everyone agrees on the "4.4" part of the measurement. The hundredths-place is the questionable digit.

The Exceptions:
Counting Numbers and Defined Quantities

The Exceptions: Counting numbers are said to have infinite significant digits. That is to say, if there are three people in the room, no one will say there are 2.999 people in the room. (That would be awkward!) We will all agree there are 3.0000000000... people **exactly**. Definitions also follow this exception. When something is defined, there is no question. For example, 1 inch is defined as 2.54 cm. Because it's defined, the 2.54 has infinite significant figures (and yes, so too the 1 inch).

The Sig Fig Rules for a Measurement:

A measurement consists of multiple digits. Each digit is tested to determine whether it is significant.

- Nonzero numbers are significant. (that is, 1,2,3,4,5,6,7,8, and 9)
- Zeros between significant figures are significant.
- Zeros to the right of the decimal AND to the right of a significant figure are significant.
- Small counting numbers (under, say, 10,000) are usually considered exact and have infinite significant figures. (ex. 2 chickens)

Examples:

How many significant figures are there in each of the following numbers?

2.0

2.0e-3

2.00

0.0002

0.0200

0.2000

Answers to exercise on previous page:

- 2.0 (2 sf)
- 2.00 (3sf)
- 0.0002 (1sf)
- 0.0200 (3sf)
- 0.2000 (4sf)
- 2.0e-3 (2 sf)

The Sig Fig Rules for Computation—Addition and/or Subtraction

The answer cannot be more precise than the least precise measurement.

TIP: Solve by using decimal place.

Example:

Sum the following three measurements and report to the correct sig figs.

2.58
2.6
2.575

The simple sum is 7.755.

One number goes to the tenths place. That's the least precise number. (final digit is farthest to left) So the answer can only be reported to the tenths place.

The answer is 7.8.

The Sig Fig Rules for Computation—Multiplication and/or Division

Solving long-hand identifies the sig figs, or TIP: the answer will always have the same number of sig figs as the measurement with the fewest total sig figs.

For the computation

$(6.341 \times 9.24) = ?$

The calculator gives me: 58.59084

The actual answer is 3 sig figs (due to the 9.24, as it has the least number of sig figs).

Answer is 58.6