**Significant Digits**

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Measure it with a micrometer, mark it with a chalk line, then cut it with an axe. You probably experience some form of this every day. It's common to mix analytical instrumentation, glassware, and reagents that have varying degrees of accuracy. Which one of us hasn't used a graduated cylinder in a colorimetric procedure then reported a result with four significant digits? The colorimeter may be that accurate, but the graduated cylinder has a much lower level of accuracy. In the end, results are reported that are nowhere near the accuracy implied by the written result. If you know how significant the digits are in any measurement, then you may be able to reduce your workload and produce more accurate and usable numbers in your laboratory.

That is why understanding significant digits is crucial to producing and reporting accurate results. A result of an analysis cannot be reported using more significant digits than the number of significant digits in the least accurate measurement used in the procedure. For example, 85 mL of a sample (using a 100 mL graduated cylinder with an accuracy to two significant digits) is diluted with water into a 500.0 mL volumetric flask (with an accuracy to four significant digits). This solution is then reacted with a reagent and the resulting color change is measured on a colorimeter (accurate to four digits). Since the graduated cylinder is the least accurate link in this procedure at two significant digits, the reported result should have only two significant digits.

Determining significant digits is fairly easy to do:

Any nonzero integer is significant. For example, 54.89 has four significant digits. 15 has two significant digits.

Zeros may be significant depending on where they are in the number.

Any zero between nonzero integers is significant. 504 has three significant digits. 9008 has four significant digits.

Zeros to the right of a nonzero integer may or may not be significant. 5000 may have one, two, three, or four significant figures. With the available information, it cannot be determined. However, zeros to the right of a nonzero integer and after a decimal point are significant. 5.00 has three significant digits, 500.0 has four significant digits.

Finally, zeros to the left of a number are not significant. 0.005 has one significant digit. 0.675 has three significant digits.

Refer to our article **Rounding Numbers** which covers calculations using numbers with different significant digits to give an accurate and reportable result.

The information in this article is very general. As usual, check your federal, state, and local regulations. You may have additional regulations or requirements that you must meet.

References:

*Standard Methods for the Examination of Water and Wastewater* 23rd edition 2017, part 1050 Expression of Results, section 1050 B. Significant Figures.

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