About Significant Figures
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About Significant Figures

What are SIGNIFICANT FIGURES?

- Significant figures of a number are the digits that are known with certainty through measurements.

Introduction

In many cases, the numbers that you stumble upon are measured quantities. These quantities are measured to a certain degree based on the scientific instrument(s) used. Bearing that in mind, you should appreciate the importance of carrying the degree of precision for measured quantities throughout subsequent calculations. By applying the rules of significant figures, the calculated quantities will carry the same accuracy as the initial measured quantities.

Have you ever noticed that when you punch a set of numbers into a calculator, it spits out a final answer with a lot of digits? You may have asked yourself this question: how many digits should I include in my answer? 1, or 3, or all of them? Well, by following the rules outlined in this learning object, you will be able to determine the proper number of significant figures to express in your answers.

Rules of Significant Figures

Determining the Number of Significant Figures

- The ability to identify the correct number of significant figures in a given number is a fundamental skill that you need to master. It is critical for you to become familiar with the rules before applying them in a calculation problem.

Rule #1 – All non-zero integers are always considered significant

Rule #2 – All zeros bounded by non-zero integers are always considered significant
Rule #3 – Leading zeros are non-significant

Rule #4a – Trailing zeros are non-significant in numbers without a decimal point

Rule #4b - Trailing zeros are significant in numbers with a decimal point

Rule #5 – Exact numbers and defined numbers have an infinite number of significant figures

**Significant Figures and Scientific Notations**

- A number is often expressed in scientific notation to make the number of significant figures more apparent.

- By convention, when a number is expressed in scientific notation, any type of zero (either leading or trailing zeros) is considered to be significant.

**Significant Figures in Calculations**

**Significant Figures in Calculations**

- In a calculation problem, the number of significant figures to be expressed in each step of the calculation, and in the final answer, is dependent on the number of significant figures provided by the question’s stated values. There are certain rules to follow for specific mathematical operations, including addition, subtraction, multiplication, and division.

**Addition and Subtraction**

- For addition and subtraction, the answer must be rounded to the same decimal place as the operand with the fewest decimal places.

- *Note*: the number of significant figures may change during the course of a multi-step calculation.
Multiplication and Division

- For multiplication and division, the answer must be rounded to the same number of significant figures as the operand with the least number of significant figures.

- **NB**: If exact numbers are involved in the calculation, they are ignored, and do not affect the number of significant figures in the final answer.

Combining Operations

- If a calculation involves a combination of mathematical operations (i.e., addition, subtraction, multiplication, and division), the best strategy is to evaluate each step independently while applying the appropriate rule(s) for determining the correct number of significant figures.

- It should also be noted that when one performs multistep calculations, it is optional, but recommended, to carry an extra significant figure to avoid rounding errors in the calculations. There are a couple of methods of indicating the extra significant figure:
  1) Put the extra significant figure in subscript notation
  2) Put brackets around the extra significant figure

Logarithms and Anti-Logarithms

- In dealing with logarithms and anti-logarithms, identifying the number of significant figures to be used in a final answer may seem confusing. However, through understanding logarithms better and following a few rules, the process becomes a lot easier.

**Recall:**

**Logarithm:**
\[
\log_{10} x = a \quad \text{where } x = 10^a
\]

**Anti-logarithm:**
\[
\text{Antilog } a = x \quad \text{where } x = 10^a
\]
(also, antilog a = 10^a)
A logarithmic answer consists of 2 components, separated by a decimal point:

1) Characteristic of the logarithm – number(s) to the left of the decimal point
2) Mantissa of the logarithm – numbers to the right of the decimal point

Rule #1 – In a logarithmic answer, the characteristic is not significant; but the mantissa is significant

Rule #2 – The number of significant figures in the mantissa should have the same significant figures as the number whose logarithm is to be found.
Glossary

Leading Zeros: the most-left zeros.

Operand: one of the inputs of an operator; in \(5 + 2 = 7\), the 5 and 2 are the operands.

Trailing Zeros: the most-right zeros.
References

http://www.phys.unt.edu/PIC/significant_figures.htm

http://www.campbell.edu/faculty/fetterman/Significant%20Figures.htm

http://www.ndt-ed.org/GeneralResources/SigFigs/SigFigs.htm