SLE 155
Chemistry for the Professional Sciences

DEAKIN COLLEGE
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DEAKIN UNIVERSITY

Significant figures in calculations

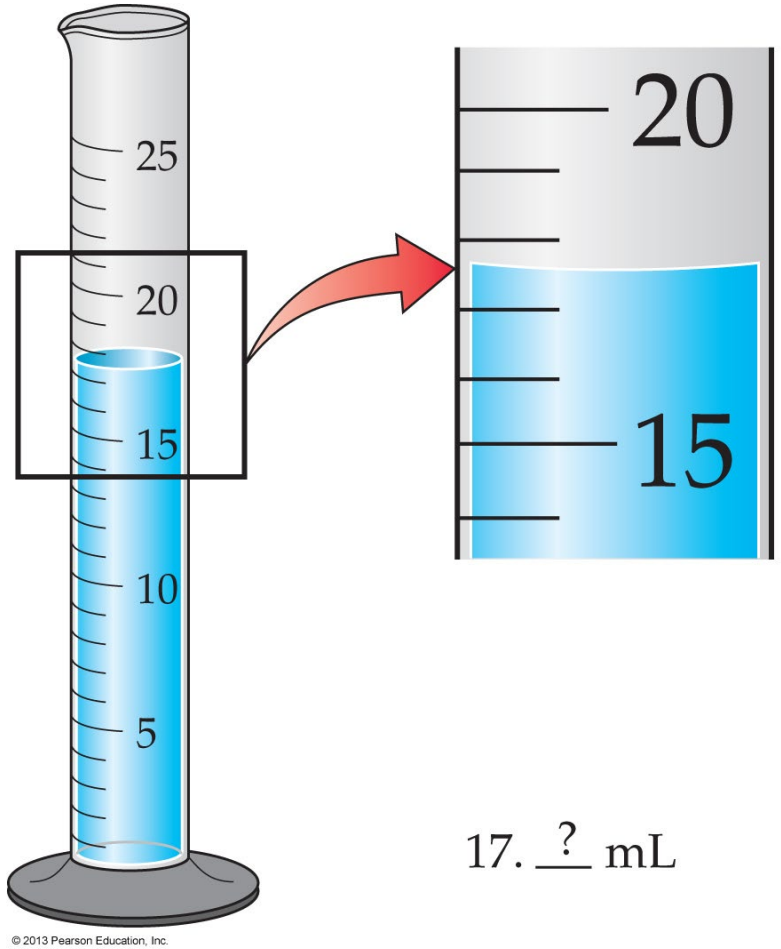
Rules for significant figures

Exact numbers

Significant figures in mathematical operation and problem solving

Measurement and Significant Figures

- **Every experimental measurement has a degree of uncertainty.**
- **The value recorded should use all the digits known with certainty, plus one estimated digit.**
- **Significant figures—The number of meaningful digits used to express a value.**



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Measurement and Significant Figures

Rules for Significant Figures Learn them!

Rule 1: Zeros in the middle of a number are like any other digit; they are always significant.

Rule 2: Zeros at the beginning (left) of a number are not significant; they act only to locate the decimal point.

Rule 3: Zeros at the end (right) of a number and *after* the decimal point *are significant*. It is assumed that these zeros would not be shown unless they were significant.

Rule 4: Zeros at the end (right) of a number and *before* an implied decimal point may or may not be significant.

Measurement and Significant Figures

Some numbers are *exact* and effectively have an unlimited number of significant figures.

- **A class might have *exactly* 32 students (not 31.9, 32.0, or 32.1!).**

- **1 kilogram is defined to have *exactly* 1000 grams.**

Scientific Notation

- **Scientific notation—A number expressed as the product of a number between 1 and 10, times 10 raised to a power.**

$$215 = 2.15 \times 100 = 2.15 \times (10 \times 10) = 2.15 \times 10^2$$

- **The exponent on the 10 tells how many places the decimal point was moved to position it just after the first digit**

❖**Product is the result of one number times a second number**

Scientific Notation

- **To express a number *smaller* than 1 in scientific notation, the decimal point is moved *to the right* until it follows the first digit. The number of places moved is the negative exponent of 10.**

$$1.56 \times 10^{-8} = 0.000\,000\,015\,6$$

Negative exponent of −8, so decimal point is moved to the left eight places.

Scientific Notation

- **To convert a number written in scientific notation to standard notation, the process is reversed.**
  - ***positive*** **exponent—The decimal point is moved to the *right* a number of places equal to the exponent.**
  - ***negative*** **exponent—The decimal point is moved to the *left* a number of places equal to the exponent.**
- **Only significant numbers are used.**

Rounding off Numbers

Calculators often display more digits than are justified by the precision of the data, but sometimes they do not display enough digits.

Rounding off—A procedure used for deleting nonsignificant figures.

- **Rule 1: In carrying out multiplication or division, the answer cannot have more significant figures than the original numbers.**
- **Rule 2: In carrying out addition or subtraction, the answer cannot have more digits after the decimal point (called decimal places) than the original numbers.**

Problem Solving: Unit Conversions & Estimating Answers

A simple way to carry out calculations involving different units is to use the factor-label method.

- **The factor-label method is a problem-solving procedure in which equations are set up so that unwanted units cancel and only the desired units remain.**
- **The conversion factor is an expression of the numerical relationship between two units.**

Problem Solving: Unit Conversions & Estimating Answers

- **Conversion factors are numerically equal to one.**
- **Units are treated like numbers and can thus be multiplied and divided.**
- **Set up an equation so that all unwanted units cancel.**
- **Think through a rough estimate, or *ballpark estimate*, as a check on your work.**

Conversion factors between kilometers and miles

$$\frac{1\text{ km}}{0.6214\text{ mi}} = 1 \quad \text{or} \quad \frac{0.6214\text{ mi}}{1\text{ km}} = 1$$

Not a conversion you need to know!