

Common Prefix Multipliers in the SI System

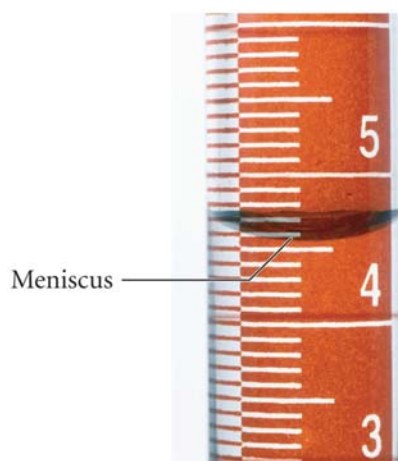
Prefix	Symbol	Decimal Equivalent	Power of 10
mega-	M	1,000,000	Base x 10^6
kilo-	k	1,000	Base x 10^3
deci-	d	0.1	Base x 10^{-1}
centi-	c	0.01	Base x 10^{-2}
milli-	m	0.001	Base x 10^{-3}
micro-	μ or mc	0.000 001	Base x 10^{-6}
nano-	n	0.000 000 001	Base x 10^{-9}
pico	p	0.000 000 000 001	Base x 10^{-12}

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What Is a Measurement?

- quantitative observation
- comparison to an agreed-upon standard
- every measurement has a number and a unit



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A Measurement

- the unit tells you what standard you are comparing your object to
- the number tells you
 1. what multiple of the standard the object measures
 2. the uncertainty in the measurement
- scientific measurements are reported so that every digit written is certain, except the last one which is estimated
- All digits, even the uncertain one, are SIGNIFICANT!

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Significant Figures

- the non-place-holding digits in a reported measurement are called **significant figures**
 - ✓ some zeros in a written number are only there to help you locate the decimal point
- significant figures tell us the range of values to expect for repeated measurements
 - ✓ the more significant figures there are in a measurement, the smaller the range of values is

12.3 cm
has 3 sig. figs.
and its range is
12.2 to 12.4 cm

12.30 cm
has 4 sig. figs.
and its range is
12.29 to 12.31 cm

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Counting Significant Figures

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Counting Significant Figures

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Significant Figures and Exact Numbers

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Example 1.5 Determining the Number of Significant Figures in a Number

How many significant figures are in each of the following?

0.04450 m

5.0003 km

10 dm = 1 m

1.000×10^5 s

0.00002 mm

10,000 m

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Multiplication and Division with Significant Figures

$$5.02 \times 89,665 \times 0.10 =$$

$$5.892 \div 6.10 =$$

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Addition and Subtraction with Significant Figures

$$5.74 + 0.823 + 2.651 =$$

$$4.8 - 3.965 =$$

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Rounding

- when rounding to the correct number of significant figures, if the number after the place of the last significant figure is
 1. 0 to 4, round down
 - ✓ drop all digits after the last sig. fig. and leave the last sig. fig. alone
 - ✓ add insignificant zeros to keep the value if necessary
 2. 5 to 9, round up
 - ✓ drop all digits after the last sig. fig. and increase the last sig. fig. by one
 - ✓ add insignificant zeros to keep the value if necessary
- to avoid accumulating extra error from rounding, round only at the end, keeping track of the last sig. fig. for intermediate calculations

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Both Multiplication/Division and Addition/Subtraction with Significant Figures

$$3.489 \times (5.67 - 2.3) =$$

$$3.489 \times 3.\underline{3}7 = 12$$

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Example 1.6 Perform the following calculations to the correct number of significant figures

a) $1.10 \times 0.5120 \times 4.0015 \div 3.4555$

b)

$$\begin{array}{r} 0.355 \\ +105.1 \\ \hline -100.5820 \end{array}$$

c) $4.562 \times 3.99870 \div (452.6755 - 452.33)$

d) $(14.84 \times 0.55) - 8.02$

Precision
and Accuracy

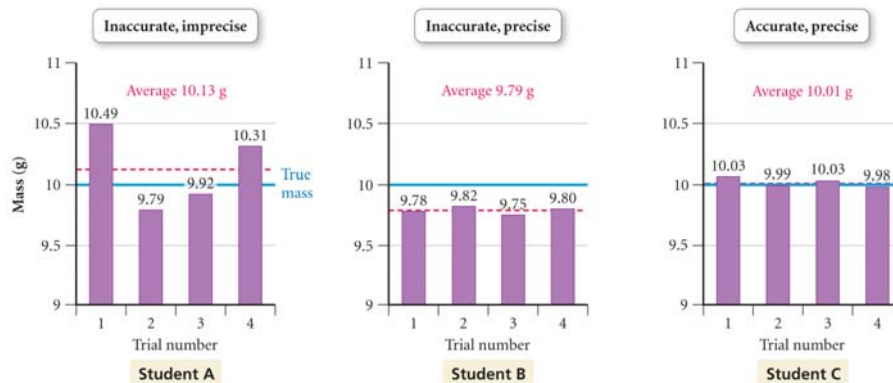
Uncertainty in Measured Numbers

- uncertainty comes from limitations of the instruments used for comparison, the experimental design, the experimenter, and nature's random behavior
- to understand how reliable a measurement is we need to understand the limitations of the measurement
- **accuracy** is
- **precision** is

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Accuracy vs. Precision



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Problem Solving and Dimensional Analysis

- Many problems in chemistry involve using relationships to convert one unit of measurement to another
- Conversion factors are relationships between two units
 - ✓ May be exact or measured
- Conversion factors generated from equivalence statements
 - ✓ e.g., 1 inch = 2.54 cm can give $\frac{2.54\text{cm}}{\text{in}}$ or $\frac{\text{in}}{2.54\text{cm}}$

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Problem Solving and Dimensional Analysis


- Arrange conversion factors so given unit cancels
 - ✓ Arrange conversion factor so given unit is on the bottom of the conversion factor
- May string conversion factors
 - ✓ So we do not need to know every relationship, as long as we can find something else the given and desired units are related to

$$\cancel{\text{given unit}} \times \frac{\text{desired unit}}{\cancel{\text{given unit}}} = \text{desired unit}$$

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Example 1.7 Convert 1.76 yd. to centimeters

• Sort information	Given: Find:	1.76 yd length, cm
• Strategize	Concept Plan: Relationships:	 1 yd = 1.094 m 1 m = 100 cm
• Follow the concept plan to solve the problem	Solution:	$1.76 \text{ yd} \times \frac{1 \text{ m}}{1.094 \text{ yd}} \times \frac{100 \text{ cm}}{1 \text{ m}} = 160.8775 \text{ cm}$
• Sig. figs. and round	Round:	160.8775 cm = 161 cm
• Check	Check:	Units & magnitude are correct

Practice – Convert 30.0 mL to quarts

$$(1 \text{ L} = 1.057 \text{ qt})$$