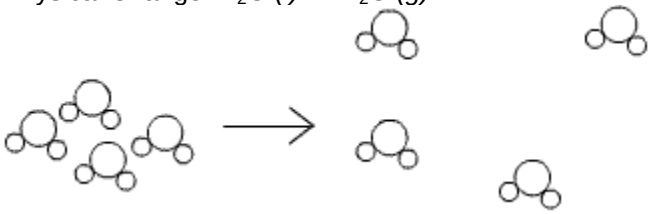
CHEM 1411 – Chapter 1 Lecture Notes

Elements, Atoms, Compounds, Molecules, Symbols, and Formulas

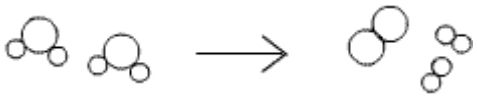
- Elements come in units of atoms
  An element is anything listed in the periodic table.
  Gold is an **element**. Its **symbol** is Au. We can refer to "an **atom** of gold".
- Compounds are combinations of elements, like H_2O
  Water is a **compound**. Its **formula** is H_2O. We can refer to "a **molecule** of water".
  One water molecule is made up of 3 atoms (2 atoms of hydrogen and 1 atom of oxygen).

Physical vs. Chemical (section 1-4)

- Physical Change: H_2O *(l)* → H_2O *(g)*



- Chemical Change: $2H_2O \rightarrow O_2 + 2H_2$

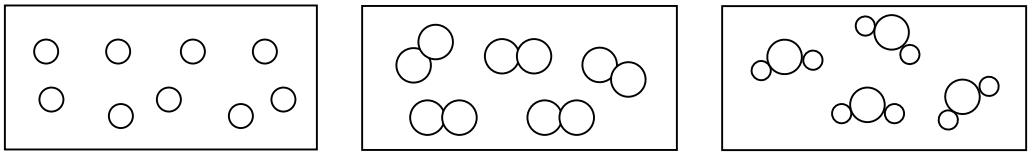


Chemical Reactions

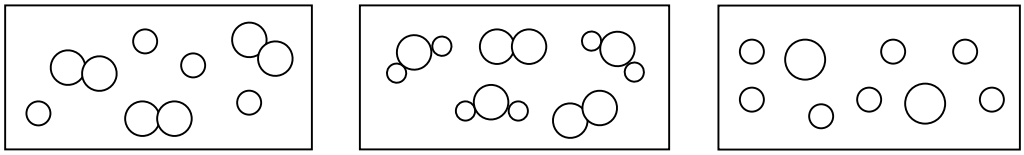
- Reactants → Products
- Conservation of Mass

Mixture vs. Pure (section 1-5)

- Pure = only one kind of molecule
  Examples: He, or H_2O, or O_2



- Mixture = more than one kind of molecule
  Examples: He mixed with O_2, or O_2 mixed with H_2O



- Mixtures can be separated by physical changes.
- Compounds can only be separated into their atoms by chemical changes.

Scientific notation (section 1-8)

- Scientific notation uses powers of ten to write very large or very small numbers more easily.
- Examples:
  $299800000 = 2.998 \times 10^{8}$ decimal moves 8 places to the left
  $0.0000425 = 4.25 \times 10^{-5}$ decimal moves 5 places to the right
- Remember: big numbers get a positive exponent, little numbers get a negative exponent.
- Make sure you know how to enter scientific notation into your calculator.

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Counting Significant Figures (section 1-8)

- Count all digits except for leading zeros.
  503 has 3 sig figs
  503.0 has 4 sig figs
  0.0503 has 3 sig figs
  0.05030 has 4 sig figs
- Exception: zeros at the end of non-decimal numbers are ambiguous
  200 could have 1, 2, or 3 sig figs depending on whether we write it as $2x10^2$, $2.0x10^2$, or $2.00x10^2$
- Determine the number of significant figures in each of these numbers:
  0.020, 15.0, 5000, 5001

Rounding Rules (section 1-8)

- Addition / Subtraction:
  Round answer to the least precise *decimal place* in the given problem.
  0.5 + 2.0597125 = 2.5597125 (round to the tenths place) = 2.6
  3828 + 45.2 = 3873.2 (round to the ones place) = 3873
  29.102 + 0.0045 = 29.1065, after rounding =

- Multiplication / Division:
  Round answer to the least number of *significant figures* in the given problem.
  0.038 * 2 = .076 (round to 1 sig fig) = 0.08
  21.5 * 11 = 236.5 (round to 2 sig fig) = 240
  0.43 * 10.27 = 4.4161, after rounding =

- Round the following:

  8.02 – 1.036 = 6.984 =

  12.5 x 1.5 = 18.75 =

  0.009 + 6.88 = 6.889 =

  3.01/0.20 = 15.05 =

  72.8 – 7.0 = 65.8 =

Dimensional Analysis (section 1-9)

- You can multiply any quantity by 1 without changing the value
- If the numerator and denominator of a fraction are equal, then the fraction is equal to 1.
- A fraction that is equal to 1 is called a **unit factor**.

- 1 inch = 2.54 cm. 4.7 cm = _____ inches? 8.2 in = _____ cm?

- 1 gal = 3.785 L, how many gallons are in a 2 L of Coke?

- How many minutes are in 5 years?

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Metric System Base Units (section 1-6)

- Mass gram g
- Length meter m
- Volume liter L

Metric System Prefixes (section 1-6)

- mega M 10^{6}
  kilo k 10^{3}
  centi c 10^{-2}
  milli m 10^{-3}
  micro μ 10^{-6}
  nano n 10^{-9}

- 40 km = _____ cm?

- 20 mL = _____ μL?

- 5.6 kg = _____ g?

- 8 nm = _____m?

- 8500 pixels = _____ megapixels?

Density (section 1-11)

- The density of a substance is its mass per unit volume. Usually measured in g/mL. note: 1 mL is the same as 1 cm^3, sometimes called a "cc".
- Water has a density of 1.00 g/mL.
- D = m/V (density = mass over volume)
- 30 mL of a substance weighs 15 grams. What is its density?

- The density of salt is 2.16 g/mL. How much does 3 cm^3 of salt weigh?

- The density of aluminum is 2.70 g/mL. What volume does 2 grams of Al occupy?

Practice Problems for Chapter 1

Exercises: 17c, 27, 28, 30, 32, 34, 35, 38-41, 66-69

In each pair, which number is greater: 8E15 or 9E14, 5E-5 or 5E-6, 2E12 or 200E11