Objectives

- 5. Calculate the density of a substance.
- 6. State the density of water in g/mL.
- 7. Use density and specific gravity to describe and differentiate substances.

Problems: 1.69, 1.71-1.72, 1.75-1.82
Additional problems for chapter 1: 83-93, 99-101, 104

Density

- Density: the ratio of mass to volume
  \[ d = \frac{m}{V} \]
  - \( d \) = density
  - \( m \) = mass
  - \( V \) = volume
- Most commonly used units are g/mL for liquids and solids, and g/L for gases.
- What are some other possible units for density?
- Example: If 73.2 mL of a liquid has a mass of 61.5 g, what is its density in g/mL?
Density of water

- You measure 100 mL of water in a graduated cylinder. You determine the mass to be 99.8 g. What is the density of the water?

  - We will use the general value of 1.00 g/mL as the density of water unless a different value is given in a problem.

Density of solids

- Objects that are _______ dense than a fluid float in the fluid.
- Objects that are _______ dense than a fluid sink in the fluid.

Density of fluids

- Gases and liquids can be described with densities as well.
- Do all liquids have the same density as water?
  - Liquids density column
  - Assign the given density to the appropriate substance according to the density column:
    - 0.90 g/mL: _______
    - 1.04 g/mL: _______
    - 1.00 g/mL: _______
Density and Temperature

- Temperature affects density, particularly in fluids (both liquids and gases).
  - Why do you think this is the case?

- Density of water and temperature
  - 4°C :
  - 0°C :
  - Again, we will use the value of 1.00 g/mL for water.

Specific Gravity

- A common way of referring to densities is in a unitless ratio.
- Specific gravity – ratio of the density of any substance to the density of water (1.00g/mL)
  \[ \text{specific gravity} = \frac{\text{density of material}}{\text{density of water}} \]

- How is it unitless?
- Does it matter what density units are given?

Specific Gravity

- What is the specific gravity of water?
- What is the specific gravity for oil? For milk?
- What is true if specific gravity < 1?
- What is true if specific gravity >1?
- As specific gravity increases, density _______
Comparing densities with specific gravity

- The specific gravity of gold is approximately 19. How does the density of gold compare to that of water?
- The specific gravity of silver is 10. How does the density of silver compare to that of gold?

Temperature

- We can’t use a simple conversion factor for temperature measurements.
- Celsius and Fahrenheit don’t start at the same temperature.
- Also, the distance between units is different.

Celsius and Fahrenheit

- A Celsius degree is almost 2 X larger than a Fahrenheit degree (more Fahrenheit degrees are needed to make up the same heat temperature change) so to convert C to F, we multiply the Celsius.
- Since Fahrenheit starts 32 degrees above C, we also have to add 32 to the C.
  \[ ^\circ F = (1.8)^\circ C + 32 \]
Celsius and Fahrenheit

- The lowest temperature recorded on the earth is -129°F in Antarctica on July 21, 1983. What is this temperature in Celsius?

The Kelvin Scale

- Kelvin and Celsius have the same distance between units.
- The only difference is the zero point.
- $K = ^\circ C + 273$
- Remember, you have to convert to Celsius first!
- What is the record temperature expressed in Kelvin?