Solutions **Name**_____

Dilution and Percent Problems

Read from **Lesson 2: Concentration** in the **Chemistry Tutorial Section, Chapter 13** of **The Physics Classroom**:
Part b: Dilution Part c: Percent by Mass and Volume

Dilution

Dilution is a common process in both daily life and chemistry. Adding water to juice, melting ice in iced tea, or mixing milk into coffee all reduce concentration without changing the amount of solute.

In chemistry, solutions are often stored in a concentrated form called stock solutions. When a less concentrated solution is needed, a portion of stock solution is mixed with additional solvent, usually water. Since the amount of solute remains unchanged but the total volume increases, the concentration decreases.

If the amount or moles of the solution is the same after dilution, we can use this equality in the dilution equation.

$n_1 = n_2$ (n_1 is before the dilution and n_2 is after the dilution)

Since both sides of the equation represent the same quantity, and **$n = M \cdot V$, (**the volume can be measured in any unit, as long as it is consistent throughout the calculation) - this leads to the dilution equation.

$$M_1 \times V_1 = M_2 \times V_2$$

Dilution Problems

1. A 50.0 mL sample of a 1.80 M NaOH solution is diluted to a total volume of 250.0 mL. What is the final concentration of NaOH?

2. A 1.50 L solution of 0.500 M NaCl is left out overnight, and 400.0 mL of water evaporates. Assuming no solute is lost, what is the new molarity of the solution?

3. Sally Kon is the Chemistry Lab Tech. She performs a two-step dilution for the upcoming chem lab. She starts by diluting 100.0 mL of a 5.00 M HCl solution to 500.0 mL. Sally then takes 250.0 mL of the resulting solution and dilutes it to 1.00 L. What is the final concentration of HCl?

4. A 250.0 mL sample of 2.80 M K_2SO_4 is mixed with 150.0 mL of a 1.20 M K_2SO_4 solution. Assuming volumes are additive, what is the final concentration of K_2SO_4 in the combined solution?

Solutions

Concentration: Percent by Mass and Percent by Volume

Molarity is the most common way to handle concentration of components in a solution. Two other methods of expressing concentration are percent by mass and percent by volume.

Percent by Mass

$$\text{Mass\%} = \frac{\text{Mass of solute}}{\text{Mass of solution}} \bullet 100$$

Percent by Volume

$$\text{Volume\%} = \frac{\text{Volume of solute}}{\text{Volume of solution}} \bullet 100$$

Percent Problems

1. To simulate seawater, Bo Rheum prepares a 3.5% NaCl solution. If he starts with 10.0 g of NaCl, what should be the final total mass of the solution?

2. Crystal Lettuce is preparing a KNO_3 solution to grow crystals for a chem lab. If 12.5 g of KNO_3 is dissolved in water to make 250.0 g of solution, calculate the percent by mass of KNO_3.

3 In a follow up lab, Crystal Lettuce now makes a solution by dissolving 15.0 g of KNO_3 in enough water to make 250.0 mL of solution. The density of the solution is 1.03 g/mL.
   a. What is the molarity of the solution?

   b. What is the mass percent of KNO_3?

4. Swept Away Cleaning Solutions uses a 70.0% (volume, not mass) isopropyl alcohol solution as a surface disinfectant. If one of their cleaners needs 100.0 mL of this solution, how many mL of isopropyl alcohol and how many mL of water should they mix together to make the needed solution?