Chemistry Name

Concentration of Solutions

Introduction

Anything that dissolves in water creates a **solution**. But solutions often behave quite differently depending on how much **solute** is dissolves in water, which is the **solvent**. Solutions which have a lot of solute are said to be **concentrated** or **strong solutions**. Solutions which have relatively little solute in them are said to be **dilute** or **weak solutions**.

One way to describe the concentration of a solution **quantitatively** is by its **percent concentration.** If a substance is **pure** (has nothing else in it), it is said to be **100%**. This call also be written as **1.00**. A solution that is half substance and half water is said to be a 50% solution (0.50).

A 10% solution (0.10) would be in a **ratio** of 1 drop of solution: 9 drops of water. As solutions become more dilute, we often write them in **scientific notation**. So 10% = 0.10 = 1×10^{-1}. A 1% solution would have 1 drop of solution: 99 drops of water, and be described as 1% = 0.01 = 1×10^{-2}.

Some chemicals—especially dangerous **toxins (poisons)**—can be harmful to people in very dilute concentrations. These can be as small as 1 **part per million (ppm)**. One way to understand what this means is to image 1 red ping pong ball in a railroad freight car of white ping pong balls. Environmental chemists sometimes have to measure concentrations in **parts per billion (ppb)** for some of the nastiest pollutants in air, water, soil, and foods.

Activity

To learn more about concentration, obtain the following materials:

- 12-cavity plastic plate
- Medicine dropper
- Food coloring
- Water
- Piece of white paper

1. Put the 12-cavity plate on the white paper.
2. Put 10 drops of the food coloring into cavity #1. This is the "pure" substance. You will use this for comparisons.

MAKE NOTES ABOUT EACH SOLUTION ON THE OTHER SIDE OF THIS PAGE.

3. Put 5 drops of food coloring and 5 drops of water in cavity #2. This is a 50% solution.
4. Put 1 drop of the food coloring in cavity #3. This is a 10% solution.
5. Take 1 drop from cavity #3 and put it in cavity #4. Add <u>9 drops</u> of water. This is a 1% solution.
6. Take 1 drop from cavity #4 and put it in cavity #5. Add <u>9 drops</u> of water. This is a 0.1% solution.
7. Take 1 drop from cavity #5 and put it in cavity #6. Add <u>9 drops</u> of water. This is a 0.01% solution.

8. Take 1 drop from cavity #6 and put it in cavity #7. Add 9 drops of water.
   This is a 0.001% solution.
9. Take 1 drop from cavity #7 and put it in cavity #8. Add 9 drops of water.
   This is a 0.0001% solution.
10. Take 1 drop from cavity #8 and put it in cavity #9. Add 9 drops of water.
   This is a 0.00001% solution.

Notes:

Concentration (%)	Decimal form	Sci. notation	Comments
"Pure" (100%)	1.00	1×10^{0}	
50%	0.50	5×10^{-1}	
10%	0.10	1×10^{-1}	
1%		1×10^{-2}	
0.1%			
0.01%			
0.001%			
0.0001%			
0.00001%			

Questions

1. What is the “solvent”? ____

   What is the “solute”? ____

   Is this a heterogeneous or homogeneous solution? _________________________________

2. Do you think the pattern would be different if you started with 20 drops, instead of 10? Explain.

3. How does the color of the 100% solution compare with the color of the 50% pure solution?

4. How does the color of the 100% solution compare with the color of the 10% pure solution?

5. How does the color of the 100% solution compare with the color of the 1% pure solution?

6. How does the color of the 10% solution compare with the color of the 1% pure solution?

7. At what concentration does the solution seem to become completely clear?

Other questions:

1. What does it mean when we say we are buying “whole milk”? a “1% fat milk”?

2. What is the average concentration of dissolved salts in ocean water?

3. What is the average concentration of carbon dioxide in air?