

4 • Classifying Chemicals

READING NOTES 4.2

16-2 Solutions

The Point:

Solutions are homogeneous mixtures made by dissolving a solute into a solvent. Water is the most common solvent.

1. Solutions are _____ mixtures. It looks like one phase. Well-stirred salt water looks like pure water. In a **heterogeneous** mixture, you can see the different components. Salad dressing is a good example.
2. Solutions in which water is the solvent are called _____ solutions. These are very common.
3. Solutions in which alcohol is the solvent are called _____. Iodine dissolved in alcohol is called a _____ of iodine.

16-3 Types of Solutions

The Point:

In class we often use liquid solutions, but examples of gas solutions and solid solutions are part of our daily lives.

4. A **gas solution** consists of _____ or _____ dissolve in one another. _____ is a common example made of _____ gas dissolved in _____ gas. Water vapor is also a component of air.
5. **Liquid solutions** can be solid, liquid, or gases dissolved in a liquid. Sugar water is an example of a _____ dissolved in water. Antifreeze is an example of a _____ (ethylene glycol) dissolved in water. Carbonated beverages are examples of _____ dissolved in water.
6. Liquids can be dissolved in other liquids. These are called **emulsions**. When two liquids mix, they are said to be _____. Alcohol and water is a good example of this. Oil and water do *not* mix; we say they are _____.
7. Solid solutions are also very common. An _____ is a mixture of two or more metals. Jewelry is not usually pure silver or pure gold because the pure metal is too soft. _____ is a common solid

solution made of copper and zinc. Silver and mercury will mix and can be used to fill cavities in your teeth. A solid mixture that includes a metal and mercury is called an _____.

16-12 Expressing Concentration -- Molarity

The Point:

A solution can be dilute or concentrated. It is important to be able to quantify how concentrated a solution is. Molarity is one common way to do this.

1. Molarity = $\frac{\text{_____ of solute}}{\text{Liters of _____}}$
2. A 1.0 molar solution is abbreviated as _____.
3. Look at Figure 16-16. This is a special flask used especially to make solutions. It is called a _____ flask. (ask in class) Notice that to make the solution, the chemist does not add 1 Liter of water, she/he “adds enough water to make 1 Liter of solution.” This subtle distinction is important because the _____ may take up some room. If you add 1 Liter of solvent, you may have more than 1 Liter of solution.
4. The molar mass of NaCl is _____
 - a) If you dissolved 5.85 g NaCl in enough water to make 1.00 L of solution, the [NaCl] = _____ M.
 - b) If you dissolved 5.85 g NaCl in enough water to make 0.100 L of solution, the [NaCl] = _____ M.
 - c) If you dissolved 58.5 g NaCl in enough water to make 5.00 L of solution, the [NaCl] = _____ M.
 - d) If you dissolved 43.9 g NaCl in enough water to make 0.500 L of solution, the [NaCl] = _____ M.

5. Molarity can also be used as a **conversion factor** to change volume to moles or moles to volume.

a) Given: 3.5 Liters of a 2.0 M solution NaCl

Desired: ? moles solute

$$3.5 \text{ L} \times \frac{2.0 \text{ mol NaCl}}{1.0 \text{ Liter solution}} =$$

b) Given: 550 mL solution

Desired: ? moles solute

$$550 \text{ mL} \times \frac{1 \text{ L}}{1000 \text{ mL}} \times \frac{2.0 \text{ mol NaCl}}{1.0 \text{ Liter solution}} =$$

c) To make 1.7 Liters of a 2.0 M NaCl solution, how many grams of NaCl would you need?

Given: 1.7 L solution

Desired: ? grams solute

$$1.7 \text{ L} \times \frac{2.0 \text{ mol NaCl}}{1.0 \text{ Liter solution}} \times \frac{58.5 \text{ g NaCl}}{1 \text{ mol NaCl}} =$$

6. In a solution, we might want to focus on the **ions** in solution.

a) If $[\text{NaCl}] = 2.0 \text{ M}$

$[\text{Cl}^-] = \underline{\hspace{2cm}}$ and $[\text{Na}^+] = \underline{\hspace{2cm}}$

b) If $[\text{Na}_2\text{SO}_4] = 2.0 \text{ M}$

$[\text{SO}_4^{2-}] = \underline{\hspace{2cm}}$ and $[\text{Na}^+] = \underline{\hspace{2cm}}$

c) If $[\text{Al}_2\text{S}_3] = 2.0 \text{ M}$

$[\text{Al}^{3+}] = \underline{\hspace{2cm}}$ and $[\text{S}^{2-}] = \underline{\hspace{2cm}}$

7. Vol x Molarity = # moles. If you dilute a solution by adding water, the moles of solute remain the same.

$$\text{So: } V_i \times M_i = V_f \times M_f$$

where i = "initial" (before dilution) and f = "final" (after dilution).

a) 5.0 mL of 6.0 M HCl is diluted to 25 mL. The concentration of the diluted solution is: M

b) To what volume must 24 mL of 1.5 M HCl be diluted to lower the concentration to 1.0 M?

20-7 Acid-Base Titration

The Point:

We can use the ideas that

- *acids neutralize bases,*
- *acid-base indicators allow us to observe acids, bases, and neutral solutions, and*

• *Vol x M = moles*

to do a useful analytical technique.

This technique is called an acid-base titration.

8. An **acid-base titration** is a _____ procedure used to determine the _____ concentration of an _____ or a _____.
9. Either the acid or base solution must be of known concentration. This is called the _____ solution.
10. When you add enough base to an acid solution, the acid is neutralized. This can be observed by using an acid-base _____ such as phenol red.
11. The solution is neutralized when the $[\text{H}^+]$ is _____ (greater than/less than/equal to) the $[\text{OH}^-]$. This is called the _____ or the **equivalence point**.
12. Look at Figure 20-15. The instruments used to hold and measure the acid and base solutions are called _____.
13. Similar to dilutions, a simple formula can be used to determine the concentration of the unknown:
- $$V_{[\text{H}^+]} \times M_{[\text{H}^+]} = V_{[\text{OH}^-]} \times M_{[\text{OH}^-]}$$
- This works because at the end point, $[\text{H}^+] = [\text{OH}^-]$.
Example: 10.0 mL of HCl is titrated with 35.0 mL of 0.500 M NaOH. $[\text{HCl}] = \underline{\hspace{2cm}}$
- $$(10.0 \text{ mL}) (x) = (35.0 \text{ mL}) (0.500 \text{ M})$$
- $$x = \frac{(35.0 \text{ mL})(0.500 \text{ M})}{10.0 \text{ mL}} = \boxed{1.75 \text{ M}}$$
14. Here are two practice problems:
- a) A 25.0 mL sample of HCl is titrated with 42.5 mL of 0.300 M NaOH. $[\text{HCl}] = \underline{\hspace{2cm}}$.
- b) A 10.0 mL sample of 0.833 M vinegar solution is titrated with 0.200 M NaOH. What volume of NaOH solution will be needed?