NAMES:

SECTION:

HONORS CHEMISTRY

PERCENT SOLUTIONS

In Chapter 8, you learned that molarity is a common method of describing solution concentration. Another method of expressing the concentration of a solution is to state the percentage by mass of the solution that is solute. Unless otherwise specified, a solution concentration expressed in percent is interpreted by chemists to mean grams of solute per 100 g of solution. For example, a 10% solution of dextrose contains 10 g of dextrose in a total 100 g of solution. These concentration units are frequently used in pharmacies and hospitals.

---

1. What mass of NaCl would be found in 100 g of 3.50% solution?

2. What mass of K_2SO_4 should be dissolved in sufficient water to make 200 g of 5.32% solution?

3. A pharmacist needs to prepare a medicinal ointment. She mixes 3.7 g of solid D with 43.6 g of ointment base Q. What is the percentage of D by mass in the ointment?

The concentrations of solutions containing organic compounds are sometimes presented as mass percents. These concentration figures are followed by (m/m), which is sometimes written (w/w) in an older convention. The expressions (m/v), (v/m) and (v/v), meaning "mass over volume," "volume over mass," and "volume over volume," are also used. The masses are measured in grams, and the volumes in cubic centimeters (1 cm^3 = 1 mL). For example, 1/10 m/v KCl in H_2O would mean 1 g KCl dissolved in 10 cm^3 H_2O.

4. Describe what is meant by the following solution concentrations.
   a. 5/50 m/v $C_{12}H_{22}O_{22}$ in H_2O

   b. 10/100 v/m CH_3CH_2OH in H_2O

   c. 50/50 v/v CH_3OH in H_2O

   d. 1/4/5 v/v/v $CH_3COOH/CH_3(CH_2)_3OH/H_2O$

Solution expressions involving volume proportions can be changed to a percentage basis if the liquid densities are known. For example, suppose we have a solution of methanol (a.k.a formaldehyde, CH_2O) in 2-propanone (acetone, CH_3COCH_3) that is 30/70 m/v and we want to write the m/m percent. The volume of the solvent is first converted to mass, using the definition of density (D = mass/volume). The density of 2-propanone is 0.790 g/cm^3.

$$m = DV$$

$$= \frac{0.790g}{cm^3} \times 70cm^3 = 55.3\ g\ \ 2\text{-}propanone$$

$$30.0g\ methanal + 55.3\ g\ \ 2\text{-}propanone = 85.3\ g\ solution$$

$$\frac{30.0\ g\ methanal}{85.3\ g\ solution} \times 100 = 35.2\%\ (m/m)\ methanal$$

5. Given the following densities, convert the solution concentrations from PROBLEM 4 to (m/m) percentages.

   H_2O = 1.00 g/cm^3 CH_3OH = 0.791 g/cm^3 $CH_3(CH_2)_3OH$ = .810 g/cm^3
   CH_3CH_2OH = 0.789 g/cm^3 CH_3COOH = 1.05 g/cm3

   a. 5/50 m/v $C_{12}H_{22}O_{22}$ in H_2O

   b. 10/100 v/m CH_3CH_2OH in H_2O

   c. 50/50 v/v CH_3OH in H_2O

   d. 1/4/5 v/v/v $CH_3COOH/CH_3(CH_2)_3OH/H_2O$