CHAPTER 13, Sections 5 and 6: Solution concentrations

Given formulas: 

\[
\text{Percent by mass} = \frac{\text{mass solute}}{\text{mass solution}} \times 100\%; \quad \text{Molarity} = \frac{\text{moles}}{L}
\]

1. Calculate the mass percent of a solution made by dissolving 10.0 g of acid into 100.0 g of alcohol.

\[
\text{mass percent} = \frac{\text{mass acid}}{\text{mass solution}} \times 100\% = \frac{10.0 \text{ g acid}}{110.0 \text{ g solution}} \times 100\% = 9.09\% \text{ acid}
\]

2. Calculate the mass percent of a solution prepared by dissolving 13.0 mL of ethanol (density of 0.80 g/mL) into 87.0 g of water.

\[
\text{mass ethanol} = 13.0 \text{ mL} \left(\frac{0.80 \text{ g}}{\text{mL}}\right) = 10.4 \text{ g ethanol}
\]

\[
\text{mass percent} = \frac{10.4 \text{ g ethanol}}{87.0 \text{ g H}_2\text{O} + 10.4 \text{ g ethanol}} \times 100\% = 11\% \text{ ethanol}
\]

3. Cow’s milk is 4.5% lactose by mass. How much milk (in grams) contains 7.9 g of lactose?

*** First, re-write the concentration as a conversion factor:

\[
\frac{4.5 \text{ g lactose}}{100 \text{ g milk}}
\]

\[
7.9 \text{ g lactose} \left(\frac{100 \text{ g milk}}{4.5 \text{ g lactose}}\right) = 170 \text{ g milk}
\]

4. Calculate the molarity of a solution prepared by starting with 5.5 g of NaCl and adding enough water to create 500 mL of solution.

\[
M = \frac{\text{moles NaCl}}{L \text{ solution}} = \frac{5.5 \text{ g NaCl}}{58.44 \text{ g NaCl}} \left(\frac{1 \text{ mole NaCl}}{58.44 \text{ g NaCl}}\right) = \frac{0.188 \text{ mol NaCl}}{1 \text{ L}}
\]

5. How many grams of CaCl\(_2\) would be in 1.8 L of a 0.1000 M CaCl\(_2\) solution?

*** First, re-write the concentration as a conversion factor:

\[
\frac{0.1000 \text{ mole CaCl}_2}{L \text{ solution}}
\]

\[
1.8 \text{ L solution} \left(\frac{0.1000 \text{ mole CaCl}_2}{1 \text{ L solution}}\right) \left(\frac{110.983 \text{ g CaCl}_2}{1 \text{ mole CaCl}_2}\right) = 20.0 \text{ g CaCl}_2
\]
6. What volume, in mL, of a 0.12 M NaNO₃ solution would contain 0.88 grams of sodium nitrate?

*** First, re-write the concentration as a conversion factor:

\[
\frac{0.12 \text{ mole NaNO}_3}{1 \text{ L solution}} \times \frac{1 \text{ mole NaNO}_3}{84.995 \text{ g NaNO}_3} \times \frac{1 \text{ L solution}}{0.12 \text{ moles NaNO}_3} \times \frac{1000 \text{ mL}}{1 \text{ L}} = 86 \text{ mL solution}
\]