**Problem Set Dealing with Concentration Units**

1. If 15.0 grams of sodium sulfate is dissolved in water to form 400.0 grams of water. The density of the solution is 1.056 g/mL at 25 °C.

 a. mass percent (w/w%) of sodium sulfate

 b. molarity of sodium sulfate

 c. molality of sodium sulfate

 d. parts per thousand sodium sulfate

 e. parts per million sodium ion

 f. mole fraction sulfate ion

2. A 12.0 M solution of HCl has a density of 1.107 g/mL at 25° C. Calculate:

 a. mass percent (w/w%) of HCl

 b. molality

 c. mole fraction HCl

3. Given a 0.300 m solution of calcium nitrate with a density of 1.009 g/mL at 25°C, calculate:

 a. mass percent (w/w%) of calcium nitrate

 b. mass percent (w/w%) of nitrate ion

 c. mass percent (w/w%) of calcium ion

 d. molarity of calcium nitrate

 e. molarity of nitrate ion

 f. mole fraction of calcium ion

 g. mole fraction of nitrate ion

4. Given a solution containing magnesium chloride with a concentration of 25.0 ppm magnesium ion and a solution density of 1.00 g/mL at 25 °C, calculate:

 a. mass percent (w/w%) of magnesium ion

 b. mass percent (w/w%) of chloride ion

 c. mass percent (w/w%) of magnesium chloride

 d. molarity of magnesium chloride

 e. molarity of magnesium ion

 f. molarity of chloride ion

 g. molality of magnesium chloride

Answers:

1 a. 3.61% Na2SO4 3. a 4.69% Ca(NO3)2 4. a. 0.00250 %Mg2+

 b. 0.270 M Na2SO4 b. 3.55% NO3¯ b. 0.00729 % Cl¯

 c. 0.265 m Na2SO4 c. 1.14 %Ca2+ c. 0.00929 %MgCl2

 d. 36.1 ppt Na2SO4 d. 0.288 M Ca2+ d. 0.00103 M MgCl2

 e. 1.24 x 104 ppm Na+ e. 0.576 M NO3¯ e. 0.00103 M Mg2+

 f. 0.0117 = mole fraction of f. 0.00532 = mole fraction of f. 0.00206 M Cl¯

 sulfate ion calcium ion g. 0.00103 m MgCl2

2 a. 39.5% HCl g. 0.0106 = mole fraction of

 b. 17.4 m HCl nitrate ion

 c. 4.18 = mole fraction of HCl