## Solutions and Quantitative Analysis Review

1. Rubbing alcohol is an aqueous solution of 70% v/v isopropanol, $C_3H_7OH_{(l)}$, also called isopropyl alcohol.
   a. How much isopropanol is required to make 500-mL of rubbing alcohol?
   b. What mass of isopropanol is required to make 500-mL of rubbing alcohol? (ρ_{C3H7OH} = 0.79 g/mL)
   c. Calculate the percent mass: volume concentration of rubbing alcohol.
   d. What is the molar concentration of rubbing alcohol?

2. Brass is an alloy (a solution of metals) composed of copper and zinc with a striking appearance similar to gold. Depending on the properties required and the application of the alloy, various compositions are prepared, but standard brass is a 33% m/m solution of zinc in copper.
   a. How much zinc would be present in a 15.0-g brass ring?
   b. How many moles of zinc are in the ring? How many moles of copper are in the ring?
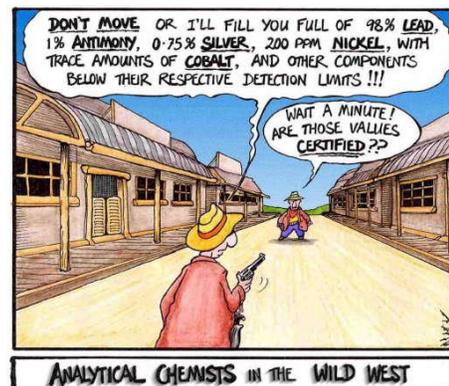
   Another method for quantifying the composition of a solution in chemistry is the mole fraction, X_i. The number of moles of substance i, n_i, is divided by the total number of moles of all substances, n_{total}, in the solution. The sum of the mole fractions in a solution should equal 1.
   c. Determine the mole fraction of zinc, X_{Zn}, and copper, X_{Cu}, in the ring.

3. In preparation for an analytical lab, a student needs to prepare 250-mL of an aqueous solution of 0.250 mol/L chromium(III) nitrate.
   a. Provide a list of materials and a procedure for the preparation of this standard solution. Include calculations with your procedure.

   The student realizes that they also need 0.010 mol/L of aqueous chromium(III) nitrate and decides to dilute the first solution to prepare it. However, they do need at least 225-mL of the 0.250 mol/L aqueous chromium(III) nitrate solution and are concerned about using too much.
   b. Determine how much of the dilute chromium(III) nitrate solution is possible to prepare under these circumstances.
   c. What is the concentration in parts per million (ppm) of 0.010 mol/L aqueous chromium(III) nitrate?

4. An old bottle containing a clear solution is discovered in the lab and studied through a series of qualitative tests.

   Table 1. Qualitatively identifying an unknown solution

Mixed with toluene	Conductivity	Colour of solution	Flame test	Add $NaCl_{(aq)}$	Add $AgNO_{3(aq)}$
forms 2 layers	high	colourless	greyish-white	white precipitate	no precipitate

   a. Provide the most likely identity of this solution and explain how each test supports this identity.

   A strip of zinc metal of known mass is placed into a measured volume of the unknown solution and left overnight. The following day, the strip of zinc is removed from the solution, cleaned and its new mass is measured to determine how much mass was lost.

   Table 2. Determining an unknown solution concentration

Appearance of materials	Volume of unknown solution	Mass of zinc before	Mass of zinc after
• zinc became coated with a dark grey layer of solid • after cleaning and drying, strip of zinc had deteriorated • solution remained colourless throughout the reaction	0.100 L	2.898 g	2.804 g

   b. Write the balanced net ionic equation for the reaction occurring in solution.
   c. What was the concentration of the unknown solution?