Handin 2: Concentration

1. Calculate the molarity of a 0.238 m solution of citric acid ($\mathfrak{M}$(citric acid) = 192.12 g mol^{-1}). The density of the solution is 1.0186 g mL^{-1}.

2. Calculate the molarity and molality of a 2.50% by weight solution of cobalt chloride, $CoCl_2 \cdot 6\,H_2O$. The molar mass of the hydrated compound is 129.85 g mol^{-1}. The density is 1.0228 g mL^{-1}.

3. Often in practical applications of membrane diffusion the membrane thickness is not known. When the membrane thickness is not known, the flux across the membrane from Eqs. 2.3.3 and 2.3.4 is written as:

$$J_m = -D\,\frac{(c' - c)}{\delta} = -P\,(c' - c)$$

where the permeability, P, is defined as $P = D/\delta$, and δ is the thickness of the membrane, and assuming a linear concentration gradient. The permeability of a cellulose-based dialysis membrane was found to be 3.3×10^{-4} m s^{-1} for NaCl. Calculate the initial flux of NaCl through the membrane if one side of the membrane is a well-stirred solution of 0.100 M NaCl and the other side is 0.00100 M NaCl.

4. Bipyridine forms an intense red color when mixed with aqueous solutions of Fe(II):

$$3\text{ bipy} + Fe^{2+} \rightleftarrows Fe(bipy)_3^{2+}$$

This complex is commonly used for low level spectrophotometric determinations of Fe(II) in natural waters. A standard solution of 5.04×10^{-4} M Fe(II) was added, using volumetric pipettes, to a series of 50.0-mL volumetric flasks and diluted to the mark with excess bipyridine solution according to the following table. The absorbance of the solutions was determined at the wavelength of maximum absorbance, 522 nm, using a cuvette path length of 1.00 cm. (a). Determine the molar absorption coefficient. Include a printout of your Excel spreadsheet including the linest() output. (c). A 20.000-mL sample of water from a stream that drains a bog was treated in the same fashion producing an absorbance of 0.342. Calculate the concentration of Fe(II) in the stream.

Fe(II) added, (mL)	2.00	4.00	6.00	8.00	10.00
A	0.176	0.345	0.523	0.702	0.870