CHEM214 Summary Notes

Lecture 1 - Intro

“ANALYTE”, “X”= what we are analysing for
“MATRIX” = everything else in the sample
“QUANTITATIVE” = How much is there?
“STANDARD of X” = a known concentration of X
“BLACK BOX” is a term used to describe an instrument when the operator does not understand how it works. It is just an instrument to measure X.
“Uncertainty in X” = the amount by which the concentration of X might vary from the stated
“Gross Error” = something that might cause the best estimate of X to be wrong (by more than the estimated uncertainty).
“Method blank” = sample containing everything except the analyte that undergoes all steps in analytical process
“Field blank” = similar to method blank but also exposed to the site of sampling.

All quantitative chemical measurements depend upon comparing an instrument’s response to the unknown sample with its response to known concentrations of the analyte.

To calculate the concentration of an unknown using a standard:
1. Make a measurement of the standard solution.
2. Make a measurement of the unknown sample (& repeat).
3. Dilute unknown sample (if need be) to within the range of the standard
4. By **dilution of the standard** solution make up at least 5 different solutions of known concentration that span the concentration of the unknown sample.
5. Using the 5 solutions of known concentration, make up a **calibration curve.**
6. If possible also make a series of measurements of a **blank** sample (where conc. of X is zero)
7. Use the calibration curve to determine the **unknown concentration** and an estimate of the uncertainty in your answer.

Uncertainty
- Repeatability of instrument (precision) – including drift
- Uncertainty in standard concentration → bias
- Dilution of standards → extra uncertainty
- Interpolation between calibration points

Gross errors
- Interfering components (lack of selectivity)
- Matrix effects
- Sampling losses
- Contamination

Sampling

- A sample must be a meaningful representation from a heterogenous mixture.
- It makes an enormous difference how and where the sample is collected.
- The 'lot' = The total material from which the sample is collected
- A "bulk" or "gross" sample = Obtained from the 'lot' for analysis or storage
- A "Laboratory" sample = Smaller, homogenous sample prepared from the bulk sample and used for analyses

Water Quality & Water Purity

- "RO water" has had salts and other impurities removed via Reverse Osmosis
- "Milli-Q water" is a trademark name to describe 'ultrapure' water that has been filtered and deionized

Hardness

- Ca & Mg concentrations in ppm from 0-55 to 201-500 ppm

Salinity

- dissolved salts in g per kg water
- higher salinity lowers the freezing point

Conductivity

- A measure of total dissolved substances
- Good measure of human impact:
- organically enriched rivers > 500 µS cm-1 vs Distilled water: 0.5-4 µS cm-1

Turbidity

- optical clarity of water

1. dissolved: affects water colour and changes phytoplankton dynamics
2. particulate: suspended particles & algae which reduces water clarity

Gas solubility in water

Henry's Law constants K_H at 25°C in mol L-1 atm-1

O2 1.28 x 10-3

CO2 3.38 x 10-2

N2 6.48 x 10-4

Eg. Calculate the equilibrium concentration of oxygen in fresh water at 25C.

$$K_H = \frac{[X_{(aq)}]}{P_X}$$

Where; K_H = law constant, $X_{(aq)}$ = concentration of gas, P_x = partial pressure

PO2 = 0.21 atm

[O2] = 0.21atm x 1.28×10^{-3} mol L-1 atm x 32g.mol^{-1}

= 8.58 mg.L^{-1}