$$R = k[I^-][S_2O_8^{-2}]$$

Part C — Activation energy

$$k = Ae^{-E_a/RT}$$

$$\ln k = -\frac{E_a}{R} \cdot \frac{1}{T} + \ln A$$

$$m = \frac{-E_a}{R} \quad - \quad 8.314$$

$\ln k$ (vertical axis)
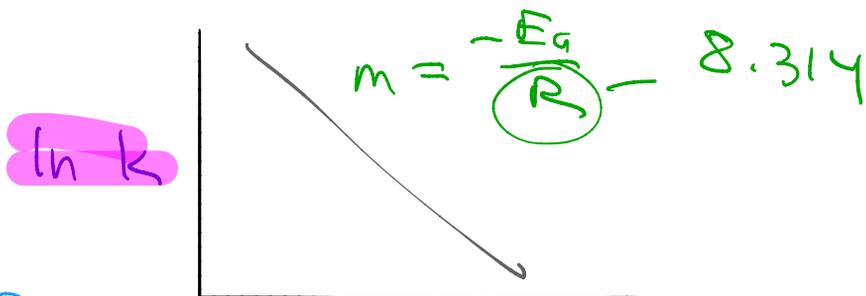
from data → $1/T$ — must be in Kelvin!

$$R = k[I^-][S_2O_8^{-2}] = 0.00063/T$$

$$[I^-]_{used} = \frac{V_{used}}{V_{total}} \times [I^-]_{stock}$$

$$[S_2O_8^{-2}]_{used} = \frac{V_{used}}{V_{total}} \times [S_2O_8^{-2}]_{stock}$$

$$k = \frac{R}{[I^-][S_2O_8^{-2}]}$$

No part D

Equilibrium Constant

$$Fe^{+3}_{(aq)} + SCN^-_{(aq)} \rightleftharpoons [Fe(SCN)]^{+2}$$

thiocyanate   transition
metal
complex
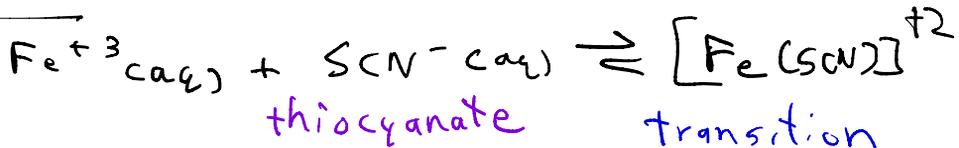
$$K_c = \frac{[complex]}{[Fe^{+3}][SCN^-]}$$

Spectroscopy


light   Cuvette   detector
sample
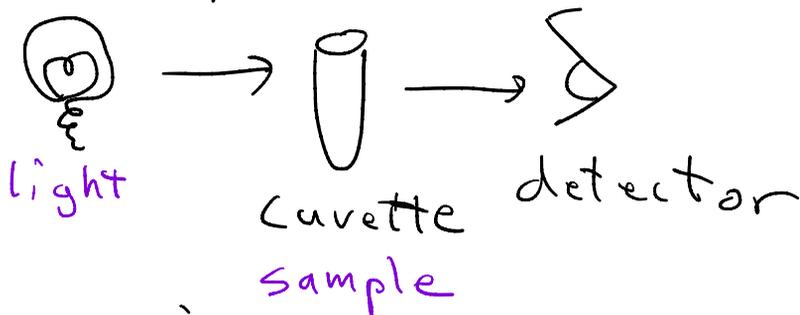
transmittance — % of light that
passes through a sample

absorbance - amount of light absorbed

$$A = -\log_{10} T\%$$

decimal, not %

At any one wavelength, 0% and 100%
transmittance are first established by
calibrating the spectrometer when no light
passes through and then by measuring a
"blank" to account for any behavior of the solvent

Spectrum   "Peak"   L3

A
(absorbance)
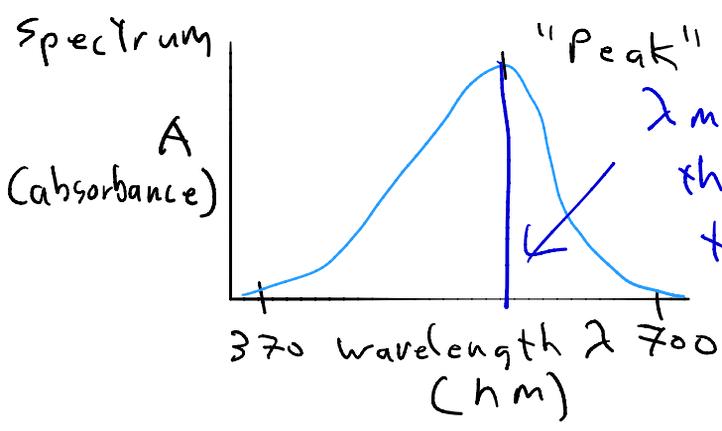
λ_{max} — the wavelength
the sample responds
to most strongly

$\rightarrow$ used to
determine [ ]

370 wavelength λ 700
     (nm)

Beer's law

$$A = \varepsilon \cdot c \cdot \ell$$

path length — the
distance light
travels through the
sample $\rightarrow$ 1.00 cm

concentration
of complex
formed

Concentration

extinction coefficient
$\rightarrow \varepsilon = 6120 \ M^{-1} cm^{-1}$

$$c = A/\varepsilon \cdot \ell = A/6120$$

sol'n	A Fe^{+3}	B SCN
1		
2	1.00 mL	2.50 mL
3		
...		
9		

$$[Fe^{+3}]_{used} = \frac{V_{used}}{V_{total}} \cdot [Fe^{+3}]_{stock}$$

$$[SCN^-]_{used} = \frac{V_{used}}{V_{total}} \cdot [SCN^-]_{stock}$$

	$Fe^{+3} (aq)$	$SCN^- (aq)$	$[Fe(SCN)]^{+2} (aq)$
I	$[Fe^{+3}]_{init}$	$[SCN^-]_{init}$	0
C	$-x$	$-x$	$+x$
E	$[Fe^{+3}]_{init} - x$	$[SCN^-]_{init} - x$	x
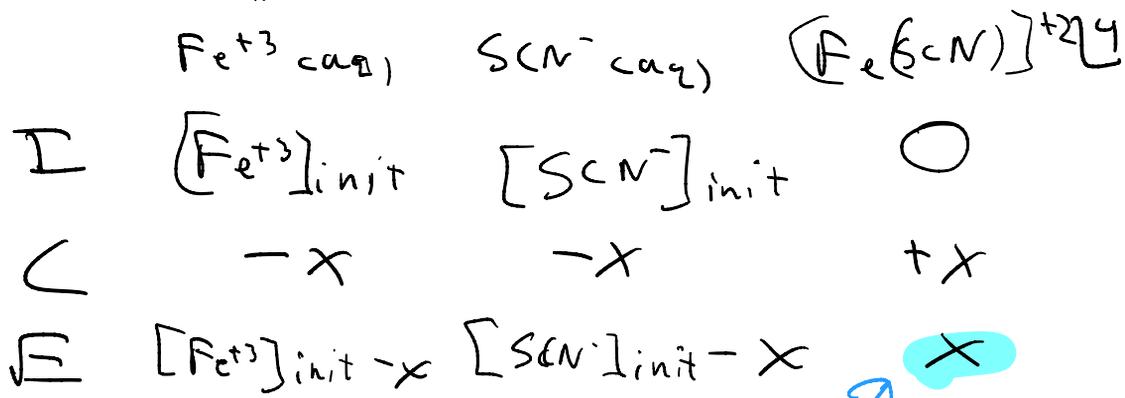
substitute and solve for K

Determine by spectroscopy

100% A   100% B

50/50

stoichiometry and there is a fixed total # of ions.
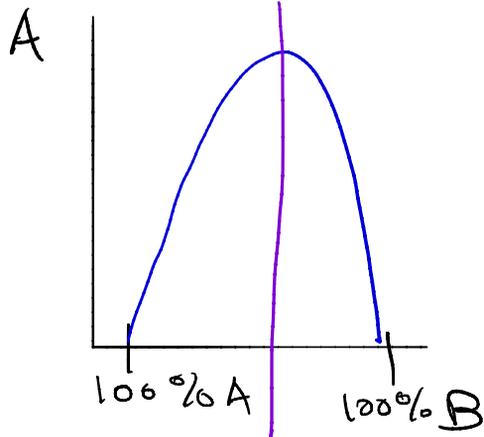
The maximum absorbance occurs when the rxn starts with equal concentrations of ions, because the complex is formed with 1:1 stoichiometry and there is a fixed total # of ions.

Indicators

An indicator is an acid or base that dramatically changes colors depending on pH.

In this experiment, bromo cresol green is used, which becomes yellow in acidic media (pH < 4), blue in more basic media (pH > 5), and green in between.

$$\text{In-H} \rightleftharpoons \text{In}^- + H^+$$

acid conjugate   base conjugate

Assume that somehow half of the acidic indicator has been neutralized and converted into its conjugate base.

$$[InH] = [In^-]$$

$$K_{In} = \frac{[H^+][In^-]}{[HIn]}$$

$$K_{In} = [H^+]$$

$$pK_{In} = pH$$

Strength (acid) of indicator

Buffers

An ideal buffer is a mixture of equal moles of a weak acid and its conjugate base.

Example! CH_3COOH / CH_3COO

Buffers resist changes in pH due to the addition of small quantities of acid and base.

$$K_a = \frac{[H^+][A^-]}{[HA]}$$

$$-\log_{10} K_a = -\log_{10}\left(\frac{[H^+][A^-]}{[HA]}\right)$$

$$-\log_{10} K_a = -\log_{10}[H^+] - \log_{10}\left(\frac{[A^-]}{[HA]}\right)$$

$$pK_a = pH - \log_{10}\left(\frac{[A^-]}{[HA]}\right)$$

$$pH = pK_a + \log_{10}\left(\frac{[A^-]}{[HA]}\right)$$

Henderson-Hasslebalch equation