Experiment 21 - Equilibria

Part I - this is application of LeChatelier's Principle

for example

#1 $2\,CrO_4^{2-}(aq) + 2\,H_3O^+(aq) \rightleftharpoons Cr_2O_7^{2-}(aq) + 3\,H_2O(l)$

add H_2SO_4 add H_3O^+ drives RXN →

add NaOH removes H_3O^+ drives RXN ←

#4 $CH_3COOH(aq) + H_2O(l) \rightleftharpoons H_3O^+ + CH_3COO^-(aq)$

add CH_3COO^- drives RXN ←

#5 @

$Cu^{+2}(aq) + 4\,NH_3(aq) \rightleftharpoons Cu(NH_3)_4^{2+}(aq)$

$NH_3(aq) + H_2O \rightleftharpoons NH_4^+(aq) + OH^-(aq)$ (adds OH^-)

$Cu(NH_3)_4^{2+} + 2OH^- \rightleftharpoons Cu(OH)_2(s) + 4\,NH_3$ (drives → / drives ←)

$H_3O^+ + OH^- \rightleftharpoons 2H_2O$ (removes OH^-)

Part II

$$Fe^{3+} + SCN^- \rightleftharpoons Fe(SCN)^{2+}$$

$$K = \frac{[Fe(SCN)^{2+}]}{[Fe^{+3}][SCN^-]}$$

we are doing an ICE problem with known Fe^{+3}, known SCN^- initial & know $Fe(SCN)^{2+}$ from your Spec 20 results & calibration curve p. 75 [to go from Absorbance(s) to Concentration in m (x-axis)]

example test tube #1

5.0 ml of 0.020 m $Fe(NO_3)_3$ + 5.0 ml H_2O + 10.0 ml of 0.00050 m KSCN → V_{final} = 20.0 ml

$$M_f\ Fe(NO_3)_3 = \frac{(0.020\ m\ Fe^{+3})(5.0\ ml)}{20.0\ ml}$$

(From dilution into test tube #1)

$M_f\ Fe^{+3} = 5.0 \times 10^{-3}\ m$ — initial concentration of Fe^{+3} in ICE table

M_f KSCN = $\frac{(0.00050\ M\ KSCN)(10.0\ mL)}{(20.0\ mL)}$ (page 3)

from dilution into test tube #1

M_f KSCN = $2.5 \times 10^{-4}\ M$ ← initial concentration in ICE table of KSCN

$$Fe^{+3} + SCN^- \rightleftharpoons Fe(SCN)^{2+}$$

	$[Fe^{+3}]$	$[SCN^-]$	$[Fe(SCN)^{2+}]$
initial	5.0×10^{-3}	2.5×10^{-4}	0
change	$-x$	$-x$	$+x$
equilibrium	$5.0 \times 10^{-3} - x$	$2.5 \times 10^{-4} - x$	x

x ← from UV measurement + calibration curve on p. 75 (lab book)

x = not a variable

lab book has setup for excel spreadsheets for these calculations