Equilibrium Constant

Lab Activity Calculations

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

1. Initial $[Fe^{3+}]$

a) Well D3 (standard)

$[Fe^{3+}] = 0.200 \times \frac{5}{10} = 0.100\ mol/L$

b) Well A1

6 drops Water + 4 drops $0.200\ mol/L\ Fe^{3+}$ → C3

$0.200 \times \frac{4}{10} = 0.08\ M$

$0.080\ M \times \frac{5}{10} = 0.040\ mol/L$

c) Well A2

$0.080\ M\ Fe^{3+} \times \frac{4}{10} = 0.032\ M$

Well D4 $= 0.032 \times \frac{5}{10} = 0.016\ M$

d) Well A3 → E3

$= 0.0064\ M$

e) Well A4 → D2

$= 0.00256\ mol/L$

Calculations Continued

2. Initial $[SCN^-]$

$0.200 \times \frac{5}{10} = \boxed{0.100\ M}$

3. Find equilibrium $[FeSCN^{2+}]$

D3 Standard

I.C.E. Chart

	Fe^{3+}	+ SCN^-	$\rightleftharpoons$ $FeSCN^{2+}$
I	0.100	0.001	0
C	-0.001	-0.001	0.001
E		0	0.001

assume SCN^- is all used

4. Find $[FeSCN^{2+}]$ in wells.

C3 $[] = 0.001 \times \frac{8}{10}$

$= 0.0008$ M

D4 $[] = 0.001 \times \frac{6}{10} = 0.0006$ M

E3 $= 0.001 \times \frac{5}{10} = 0.0005$ M

D2 $= 0.001 \times \frac{4}{10} = 0.0004$ M

4. Find all concentrations

Well C3

	Fe^{3+}	+ SCN^-	$\rightleftharpoons$ $FeSCN^{2+}$
I	0.040	0.0010	0
C	-0.0008	-0.0008	0.0008
E	0.0392	0.0002	0.0008

Well D4

Well E3

Well D2

Analysis Questions – Find a pattern using equilibrium []

$\frac{[FeSCN^{2+}]}{[Fe^{3+}]+[SCN^-]}$ $\frac{[Fe^{3+}][FeSCN^{2+}]}{[SCN^-]}$ $\frac{[FeSCN^{2+}]}{[Fe^{3+}][SCN^-]}$

Mass Action Expression

Lab calculations we find

$$\frac{[FeSCN^{2+}]}{[Fe^{3+}][SCN^-]}$$

products

is constant at equilibrium

reactants

Mass Action Expression

General-

equil. const.

$$aA + bB \rightleftharpoons cC + dD$$

$$K_{eq} = \frac{[C]^c[D]^d}{[A]^a[B]^b}$$

Examples-

1. Write a mass action expression for $N_2O_{4(g)} \rightleftharpoons 2NO_{2(g)}$

$$K_{eq} = \frac{[NO_2]^2}{[N_2O_4]}$$ at equilibrium

2. $2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)}$

$$K_{eq} = \frac{[SO_3]^2}{[SO_2]^2[O_2]}$$

For heterogeneous equilibrium substances in liquid or solid state are not included in the expression.

Questions P. 497 #1-5