Chem 212

Unit 2 Jeopardy

Activity

- 200
- 400
- 600
- 800
- 1000

Activity - 200

Write the solubility product for $La(IO_3)_3$ activity coefficients.

$K=[La3+]\gamma_{La+}[IO_3-]^3\gamma_{IO_3-}$

Activity - 400

What is the equation to solve for Ionic Strength?

$\mu = \frac{1}{2}\Sigma cz^2$

Activity - 600

A solution contains H^+, CN^-, Mg^{2+}, ClO_4^-, and H_2O. What is the Charge Balance equation for this solution?

$[H^+]+2[Mg^{2+}]=[CN]+[ClO_4^-]$

Activity- 800

What is the initial Mass Balance equation for an equilibrium of $CaCl_2$, Ca2+, Cl-, CaCl+, and CaOH+?

$2([CaCl_2]+[CaCl+]+[CaOH+]+[Ca2+])=2[CaCl_2]+[Cl-]$

Activity - 1000

What are the six steps of the Systematic Treatment of Equilibrium?

1. Write the chemical reactions
2. Write charge balance
3. Write Mass Balance, possibly more than one
4. Write equilibrium expression for each chemical reaction
5. Count equations and unknowns
6. Solve for all unknowns

Acid-Base Equilibrium

- 200
- 400
- 600
- 800
- 1000

Acid-Base Equilibrium 200

Match

Acid dissociation constant

Base hydrolysis constant

$$\frac{[BH^+][OH^-]}{[B]}$$

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

Acid-Base Equilibrium 400

How do they work?

- Buffers work by having both the acid/base and its conjugate base/acid respectively. They resist change because when a different acid or base is added, the acid/base and its conjugate react with the added acid/base and neutralize it, making the overall change in [H +] near zero.

Acid-Base Equilibrium 600

When is it appropriate to use the Handerson-Hasselbalch Equation? Write the Handerson Hasselbalch Equation

- Handerson-Hasselbalch equation can be used when [A-]=[HA], and therefore pH=pKa
- pH=pKa + log ([A-]/[HA])

Acid-Base Equilibrium 800

Find the Ka of a weak acid, which has pH=5.31 in a 0.1M solution

10^(-5.31)=[H+]=4.90e-6

$$Ka=\frac{(4.90e\text{-}6)^2}{0.1-4.90e\text{-}6}= 2.40e\text{-}10$$

Acid-Base Equilibrium 1000

To produce a buffer with pH of 5.27, starting from a solution of 0.1M acetic acid, what concentration of sodium acetate is needed? (pKa=4.76)

pH=pKa + log ([A-]/[HA])

5.27=4.76+log(x/0.1)

log(x/.1)=.51

x=.1(10^.51)=.32M

Thermodynamics

- 200
- 400
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Thermodynamics 200

For a reaction to be spontaneously favored, ΔH should be? ΔS? ΔG? And what do ΔH, ΔS, and ΔG stand for?

ΔH (Enthalpy) = -, ΔS (Entropy) = +, ΔG (Gibbs Free Energy) = -

Thermodynamics 400

What is the difference between K and Q? What happens when K=Q?

K is the equilibrium constant, whereas Q is the reaction quotient, and it is evaluated at whatever the concentrations happen to be. When K=Q, the system is at equilibrium

Thermodynamics 600

What is the equation for determining Gibbs free energy?$\Delta G = \Delta H - T\Delta S$

Thermodynamics 800

Le Chatelier's Principle states that if heat were added to an endothermic reaction, which way would the reaction proceed?

To the right. Endothermic: Heat + reactants = products

Thermodynamics 1000

What is K for a reaction if ΔG = -50kJ/mol and the reaction occurs at 25ºC

K= e^-(-50x10^3 J/mol)/ [8.314472J/(K*mol)](298.15K) = 5.75 x 10^8

EDTA

200
400
600
800
1000

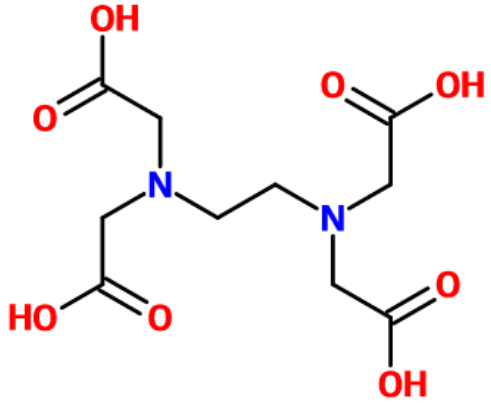
EDTA 200

What does EDTA stand for, what is it's structure and why is it important?

EDTA stands for EthyleneDiamineTetraacetic Acid

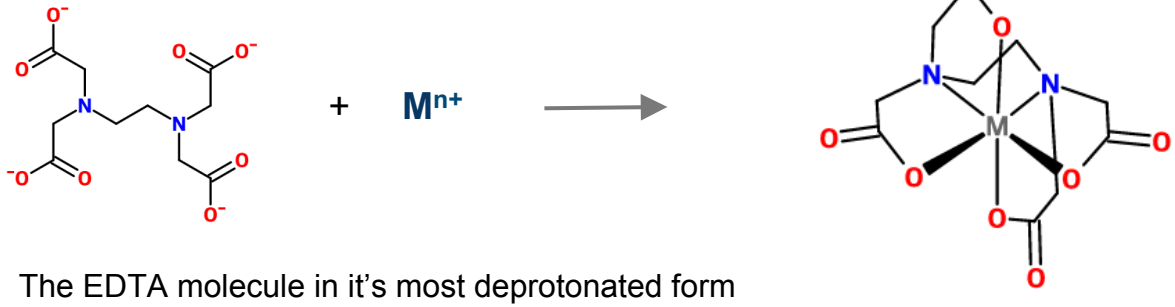
It is important because it has up to 6 available electron pairs which it can use to form unusually stable complexes with metal cations.
Virtually all elements on the periodic table can be measured directly or indirectly with EDTA.

Neutral H_4Y form



EDTA 400

How Does EDTA react with cations?



The EDTA molecule in it's most deprotonated form acts as a lewis base donating electron pairs from it's carboxylate and ammonia groups.
The metal center acts as a Lewis Acid electron pair acceptor forming a metal complex. Many geometries are possible in the product but most metals will form an octahedral complex with their d orbitals.

EDTA 600

$$M^{n+} + Y^{4-} \rightarrow MY^{n-4} \quad K_f = [MY^{n-4}]/([M^{n+}]\,[Y^{4-}])$$

This is the expression for complex formation however the concentration of Y^{4-} varies with acidity.
α_{Y-4} Was empirically determined at various pH values as the proportion of EDTA molecules found in the active form Y^{4-}

If $\alpha_{Y-4} = 0.041$ at pH 9, what will the conditional Formation constant be for the following reaction?

$Ca^{2+} + Y^{4-} \rightarrow CaY^{2-} \quad K_f = 4.467x10^{10}$

$[EDTA]*\alpha_{Y-4} = Y^{4-}$ so: $K_f = [MY^{n-4}]/([M^{n+}][EDTA]*\alpha_{Y-4}) = K_f*\alpha_{Y-4} = K'_f$

$$K'_f = (0.041)4.467x10^{10} = 1.83x10^{9}$$

EDTA 800

In titration the equivalence point is the point where the concentration of the analyte is the same as that of the titrant.
if 1.5L of 0.079M Cu^{2+} is titrated with 0.2M EDTA what will the equivalence point of the reaction be?
What will the Concentration of CuY^{2-} be at the equivalence point?

1.5L(0.079M) =V_{eq}(0.2M)
V_{eq} = 0.5952L

When the titration reaches V_{eq} Virtually all the Cu is in the form CuY^{2-} so:
$[CuY^{2-}]$ = (original concentration Cu^{2+})(dilution factor) =0.079M(1.5/(1.5+0.595)) =0.0567M

EDTA 1000

100ml of 0.05M AgCl is titrated with 0.05M EDTA at pH 10
what is the concentration of Ag^+ at V= 50? (V_{eq} = 100ml)
What is the concentration of Ag^+ at V=100ml

$Ag^+ + Y^{4-} \rightarrow AgY^{3-}$ $K_f = 1.58 \times 10^7$ $\alpha_{Y-4} = 0.30$ at pH 10

$K_f * \alpha_{Y-4} = K'_f = 1.58 \times 10^7 (0.3) = 4.75 \times 10^6$

at V=50ml: $[Ag^+]$= ((proportion of Equivalence point)(Original Concentration Ag^+)(dilution factor)
=(100-50)/100)(0.05)((100/(100+50))=0.0167M

at V=100ml $[Ag^+]$ is very small and unknown

$4.75 \times 10^6 = [AgY^{3-}]/([Ag^+][Edta])$, $[AgY^{3-}]$=(Original Concentration Ag^+)(dilution factor)=0.05M(100/200)=0.025M

$4.75 \times 10^6 = (0.025M - x)/x^2$, Solving with quadratic formula yields $x = [Ag^+] = 7.24 \times 10^{-5}$