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Creative Project 2
Practice Exam

1) Lex Luthor has discovered a way to make a more powerful form of Kryptonite by mixing green kryptonite with pink kryptonite at 500 K.

	Ion Size	Ionic Strength	Charge	Concentration
Green Kryptonite	1020 pm	.1	0	.25M
Pink Kryptonite	1075 pm	.1	+1	.5
Chartreuse Kryptonite	1100 pm	.1	-1	.45

   a. Using the information in table 1, calculate the activity coefficient for Green Kryptonite, Pink Kryptonite, and Chartreuse Kryptonite.
   Green: 1, since this is a neutral molecule
   Pink: .8389
   Chartreuse: 8407
   b. Using your answers from part a, find K for this reaction.
   K=3.6077

2) The Green Arrow is trying to develop a new kind of trick arrow, one that will spray acid on his enemies. The 1L solution has a molarity of .25 M HNO_2.

$HNO_2 + H_2O \rightarrow H^+ + NO_2^-$ $K_a=7.1x10^{-4}$

$H_2O \rightarrow H^+ + OH^-$ $K_w=1x10^{-14}$

   a. What is the charge balance of this reaction?
   $[H^+]=[NO_2^-]+[OH^-]$
   b. What is the mass balance of this equation?
   $F=[HNO_2]+[NO_2^-] => .25=[HNO_2]+[NO_2^-]$
   c. Ignoring activity coefficients, write the equilibrium expressions needed for this problem
   $Ka=[H^+][NO_2^-]/[HNO_2]$
   $Kw=[H^+][OH^-]$
   d. Solve for the concentrations of HNO_2, H^+, NO_2^-, and OH^-. For simplicities sake, assume that [H]>>[OH] since we have an acid. Therefore, you can ignore the $[OH^-]$ when solving the monster of an equation.
   [H]=Kw/[OH]
   Kw/[OH]=[NO2]+[OH] => [NO2]=kw/[OH]-[OH]
   [HNO2]=.25-[OH]+kw/[OH]
   $7.1x10^{-4}=(1x10^{-14}/[OH])((1x10^{-14}/[OH]-[OH])/(.25-[OH]+ 1x10^{-14}/[OH])$
   but we simplify so
   $.00071=(1x1^{-14}/[OH])^2/(.25-1x10^{-14}/[OH])$
   $.00071=[H]^2/.25-[H]$

x=.01368
[H]=.01368
[OH]=7.3099x10^{-13}
[NO2]=.03299
[HNO2]=.2363

3) Krona is a scientist from Oa, whose work focuses on energy and entropy in the universe. He was studying the reaction between Inerton and Fluorine. The K of this reaction is .10 at 298 K
   a. Find ΔG^0 (reminder, R=8.314 J/(K*mol))
      K=e^(-deltaG/RT)
      *DeltaG=-lnK*RT*
      Delta G=5704.82
   b. ΔH^0=500 J/mol. Find ΔS^0.
      5704.82=500-298(delta S)
      Delta S=-17.466
   c. Is this reaction exothermic or endothermic?
      Very endothermic

4) Barry Allen (aka The Flash) is working in the lab, working with the newly discovered chartreuse kryptonite. He's found that if an aqueous solution containing 1 M chartreuse kryptonite has a pH of 11.3 or greater, the kryptonite does not affect Kryptonians. What is the K_b for chartreuse kryptonite? Remember that $K_b=x^2/(F-x)$
   chartreuse kryptonite +H_2O→ OH- + weaker kryptonite
   pOH=14-pH
   pOH=2.7
   [OH]=.001995
   Kb=x^2/(F-x)
   F=1M
   Kb=3.9890E-6

5) While Batman was drugged by Scarecrow's hallucinogen, Lucius Fox had to come up with an antidote. Fox needed to use a buffer system to make sure that the antidote was not too acidic or basic for human tolerance. He used 4.35 g of [BH+] (FM 156.41) and 8.00g of [B] (FM 220.67). If the pKa is 13.32 what is the pH?

   pH=13.32+log((8/220.67)/(4.35/156.41))=13.43

   Is this antidote reasonable? Why or Why not?
   No its way too basic.

6) Poison Ivy was trying to create stronger plants and was experimenting with the idea of adding metal to them. She came across a situation that required

her to do a titration. At a point in the titration after the equivalence point she needed to know the concentration of the 0.080 M EDTA in the solution after 15ml of EDTA was added. The initial volume of the metal was 38ml and the total volume at the equivalence point was 51ml.

[EDTA]=0.080(2/53)=3.02x10^-3*

7) Superman had found out about Lex Luther's new creations of chartreuse kryptonite and got to work on a counter attack. Barry Allen had told him about the pH, and so superman decided to carry around a bottle of a basic solution to cancel the effects of the kryptonite. He wanted to carry around the smallest possible amount of liquid, but have enough to be effective. If the safe pH was 11.3 or higher how much solution should superman carry around? (see previous problems for information. The initial concentration of HA is .030 and the initial volume of HA is 75ml)

pH=-log (Kw/x)
11.3=-log ($1x10^{-14}$/x)
x=.001995
.001995^2/F-.001995=3.9890E-6
F=.9997
.9997=.030 (75/y)
Y=2.25 ml

8) Ray Palmer a.k.a. the Atom was tinkering with his shrink ray in an attempt to figure out why it worked on him and came across a situation that required a diprotic buffer system. However he got carried away with his experiment and forgot to write down the grams of one of his substances[P^2-]. He knows it has a formula mass is 197.01, and he knows there was 6.01g of the other substance [HP-] with a formula mass of 210.60. He tests the pH and finds it to be 4.77. If he looks up the pK2 value and finds it to be 4.51 how many grams of the [P^2-] did Dr. Palmar have to begin with?

4.77=4.51+log ((x/197.01)/(6.01/210.60))=
X=10.23g

1D. Kb is known as the base _____ constant.
Hydrolysis

1A. The material balance is another name for the _____ because it is a statement of the conservation of matter.
Mass Balance

2D. If Delta H is negative, then the reaction is_____
Exothermic

3D. Activity is the concentration of a species multiplied by its ____.

Activity Coefficient

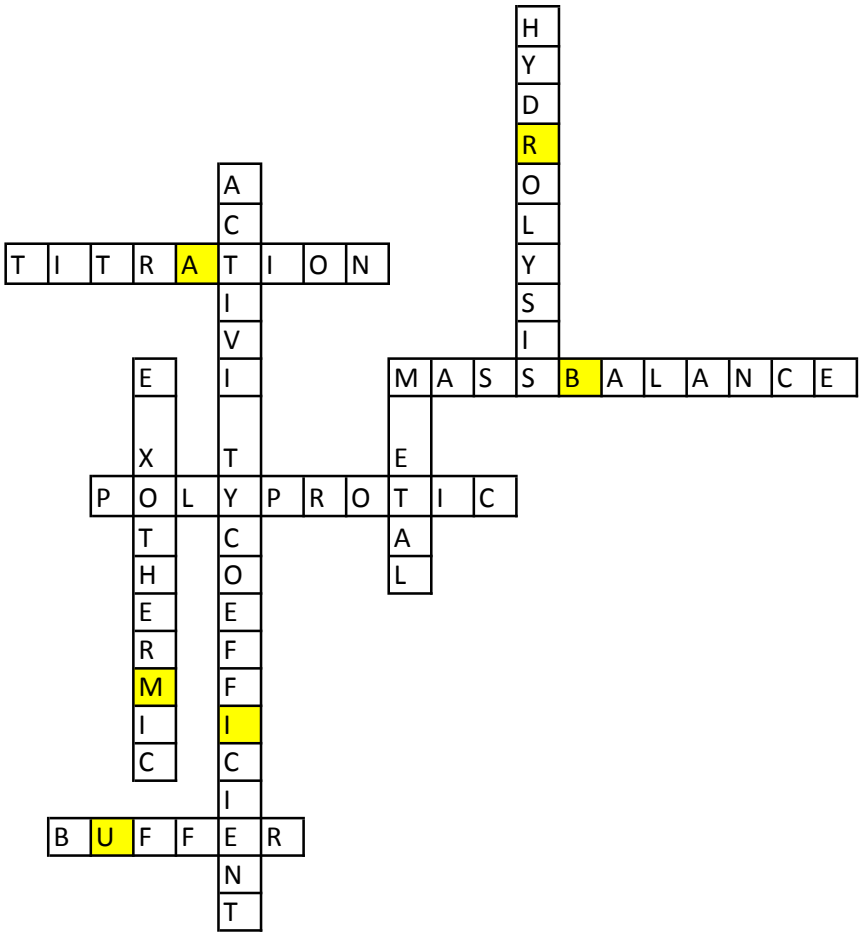
2A. ___ acids or bases can donate or accept more than one proton.
Polyprotic

3A. The addition of one substance to another until a complete reaction has occurred is called ___.
Titration

4D. EDTA likes to bond to ___ ions.
Metal

4A. A ____ solution resists change to pH when acids or bases are added.
Buffer

1D. Hydrolysis
1A. Mass Balance
2D. Exothermic
3D. Activity Coefficient
2A. Polyprotic
3A. Titration
4D. Metal
4A. Buffer



What do you do with a dead chemist?
*You B_ A_ R_ I_ U_ M_*
A B C D E F