

1. Calculating simple buffers

Calculation using $H^+ = K_a \frac{C_a}{C_b} \approx OH^- = 10^p \frac{C_b}{C_a}$

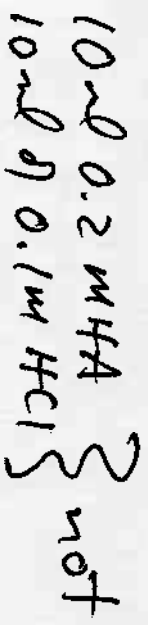
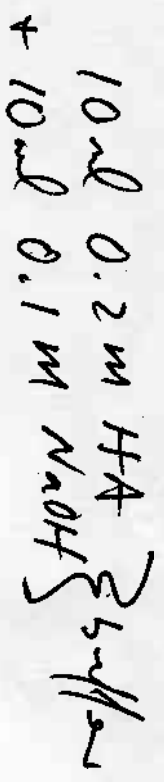
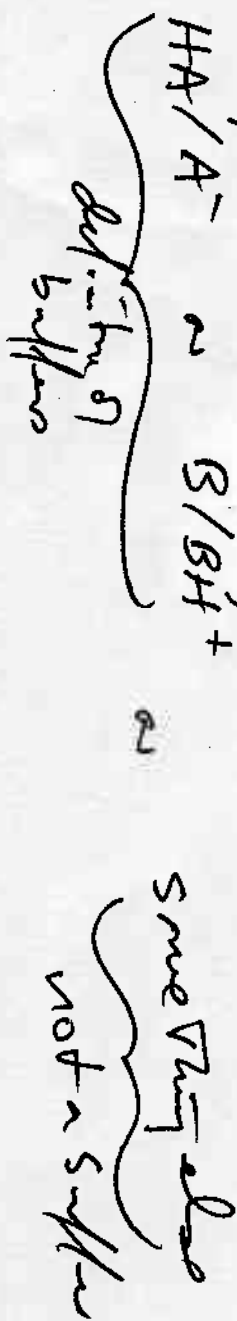
It is the 7 step A/B problem w/ NO neutralization.

Very easy. Except

Be careful about your volumes. Put the ratios into the same volume if they aren't the same.

2. Identifying buffers (after neutralization)

I will give you mixtures of acid and bases. After neutralizing you will either have



3. Ranking acidity and basicity based on equilibrium constants

I give you a list of K_a or K_b or pK_a or pK_b values.
 you rank based on pK_a

β The ~~lowest~~ pK_a The strongest pK_a acid 10^{-7} , ~~10^{-5}~~ 10^{-5}
 β The ~~strongest~~ pK_a The strongest pK_a acid pK_a 7 pK_a 5
 Stronger

Hint: it is not this simple

β The stronger pK_a acid, pK_a weaker pK_a conjugate base
 so expect that I will give you acids and
 ask about their bases, or vice versa

4. Buffer capacity

this is easy I give you a buffer with a
 certain amount, in moles of



Then if you add strong acid, its capacity to remove A^-
 if you add strong base, its capacity to remove HA

always turn
 you into moles

Think for every problem
 you ever do

5. Buffer neutralization calculation

This is when there is HA/A^- or B/BH^+ in soln along with either H^+ or OH^- then it all into water, neutralize, find the ~~limit~~ reagent. This will get rid of H^+ or OH^- . Leaves a buffer.

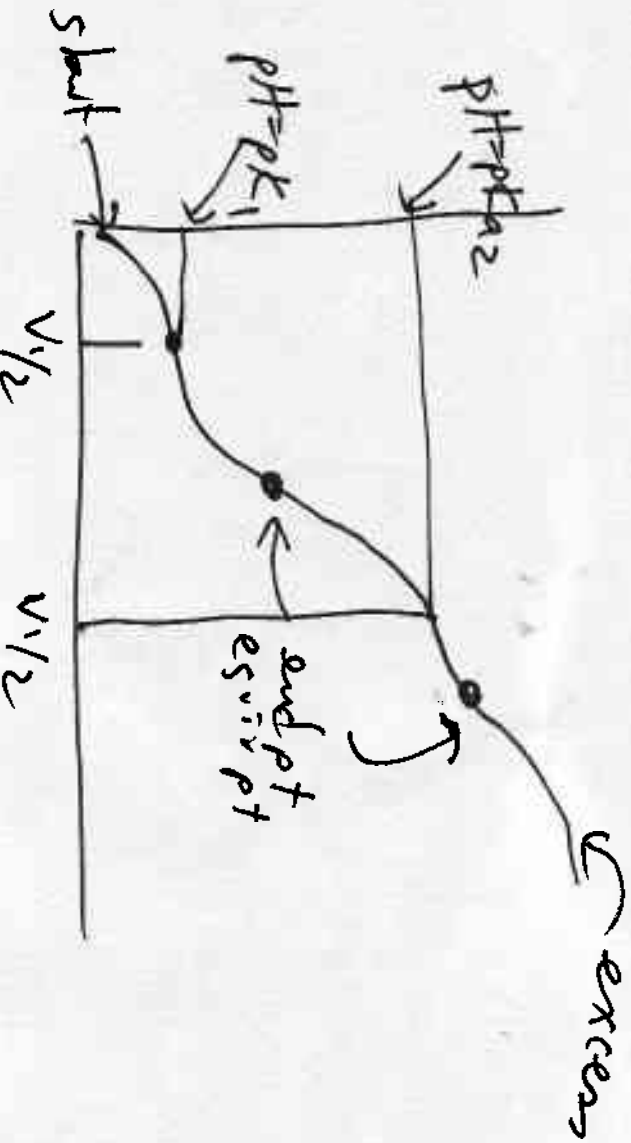
Hint. $pH \approx pK_a$

for as above so you may need to do the calculation

Example: 1:1 buffer with $pK_a = 5$. add 1.1M HCl, the pH is now ≈ 4.9

The volumes are 1:1 you can do this. Read the volumes and do what you can say

6. Identifying features of a titration curve



7. Titration calculation

You can set there will be a calculation at

- a buffer region



$$H^+ = K_a \frac{C_a}{C_b}$$

Do the steps for A/B calc and it is easy.

8. Titration calculation

- The equiv pt.



$$OH^- = (K_b C_b)^{1/2} \quad \text{or} \quad H^+ = (K_a C_a)^{1/2}$$

Do the steps for A/B calc and it is easy

Think. Now I will be exam in the calculation. The acid = weak acid. The equiv pt. is at the midpoint.

9. Estimating solubility from K_{sp}

I will give you 4 K_{sp} s, 7 various forms AB , AB_2 , AB_3 , A_2B_3 etc. you need to estimate the solubility.

Hint
no calc necessary

Example $AB \approx \sqrt{K_{sp}}$
 $AB_2 \approx \sqrt[3]{K_{sp}}$
 $AB_3 \approx \sqrt[4]{K_{sp}}$ etc

The one with the largest $\sqrt[n]{K_{sp}}$ is most soluble, the one with smallest $\sqrt[n]{K_{sp}}$ is least soluble

10. Calculating molar solubility from K_{sp}

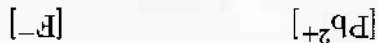
I give you a K_{sp} for a compound
 Form AB , AB_2 , AB_3 etc. you calculate
 from the equation x^2 , $4x^3$, $27x^4$ etc,
 x which is the molar solubility.

- Explanation:**
1. $Pb_2 > Fe(OH)_2 > Bi_2S_3 > HgS$ correct
 2. $Fe(OH)_2 > Pb_2 > HgS > Bi_2S_3$
 3. $Bi_2S_3 > Fe(OH)_2 > HgS > Pb_2$
 4. $HgS > Pb_2 > Fe(OH)_2 > Bi_2S_3$
 5. $Pb_2 > Fe(OH)_2 > HgS > Bi_2S_3$

Msci 20 0316

010 10.0 points

What is the concentration of Pb^{2+} and F^- in a saturated solution of PbF_2 ? ($K_{sp} = 3.7 \times 10^{-8}$)



1. $9.6 \times 10^{-5} M$ $1.9 \times 10^{-4} M$

2. $2.1 \times 10^{-3} M$ $2.1 \times 10^{-3} M$

3. $2.1 \times 10^{-3} M$ $4.2 \times 10^{-3} M$ correct

4. $1.9 \times 10^{-4} M$ $3.8 \times 10^{-4} M$

5. $1.05 \times 10^{-3} M$ $2.1 \times 10^{-3} M$

6. $3.3 \times 10^{-3} M$ $6.6 \times 10^{-3} M$

Explanation:

Msci 20 0310

011 10.0 points

K_{sp} for ZnS is 1.1×10^{-21} . At what S^{2-} concentration will ZnS precipitate for a 0.20 M solution of $Zn(NO_3)_2$? $Zn(NO_3)_2$ is a very soluble salt.

1. $2.4 \times 10^{-10} M$

2. $2.2 \times 10^{-20} M$

3. $5.5 \times 10^{-21} M$ correct

4. $3.3 \times 10^{-11} M$

5. $5.5 \times 10^{-20} M$

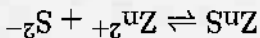
1. $1.8 \times 10^{-10} M$

Since $Zn(NO_3)_2$ is very soluble, there will be an extra 0.20 M Zn^{2+} in solution.

$1.1 \times 10^{-21} = (x + 0.20)(x)$

We can disregard x in $x + 0.20$ because the K_{sp} is very small, which means ZnS doesn't dissociate much. So the equation now becomes

$K_{sp} = [Zn^{2+}][S^{2-}]$



K_{sp} for $ZnS = 1.1 \times 10^{-21}$

Explanation:

$K_{sp} = (0.2 + x)(x) = 1.1 \times 10^{-21}$

x will be very small compared to 0.2, so $0.2 + x \approx 0.2$, and

$K_{sp} = 0.2x = 1.1 \times 10^{-21}$

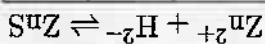
$x = \frac{0.2}{1.1 \times 10^{-21}} = 5.5 \times 10^{-21}$

Msci 20 0401

012 10.0 points

The solubility product constant of $AgCl$ is 1.8×10^{-10} and that of $AgBr$ is 3.3×10^{-13} . Solid $AgNO_3$ is slowly added to a solution containing 0.0010 M each of $NaCl$ and $NaBr$. What concentration of Br^- would remain in solution when $AgCl$ begins to precipitate?

Initial	Change	Final
0.2	x	$0.2 + x$
-	x	x
-	-	-



$K_{sp} ZnS = [Zn^{2+}][S^{2-}] = 1.1 \times 10^{-21}$

Alternate Solution:

$1.1 \times 10^{-21} = (0.20)(x)$
 $x = 5.5 \times 10^{-21} M$

11. Common ion calculation

I give you a system with

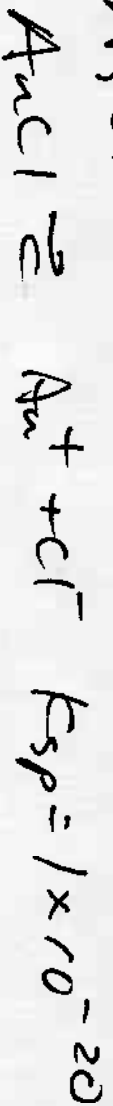
- a rock that has a K_{sp} value
- a common ion from a soluble salt.

Example $AgCl$ $K_{sp} = 1 \times 10^{-10}$ $NaCl \approx 0.1 M$

From the RICE calculation for the K_{sp} equilibrium, stick in the common ion conc., approx., and solve. See over + over.

12. Selective precipitation

I give you multiple K_{sp} equilibria and ask you ~~to~~ to estimate the amount of a common ion that selectively ppt's one salt from another.



you tell me how much of common ion, what [] ppt the other.

13. Approximations of acid base equations "you've got to be minimum"

Look at the full equations without any approximations and be able to explain how

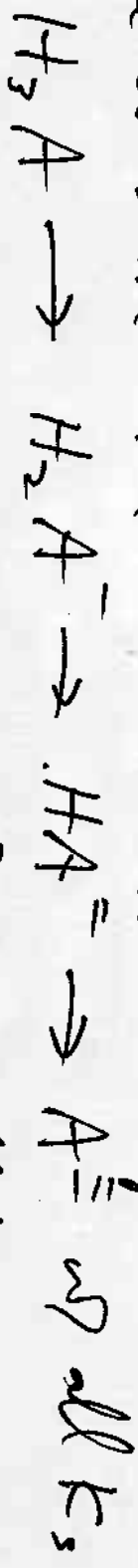
a cubic \rightarrow quadratic \rightarrow linear eqn

These \rightarrow become $[H^+] = (K_a C)^{1/2}$

K_s are far apart, $[C]$ are high, water doesn't matter K_{w} is small

14. polyprotic acid equilibria

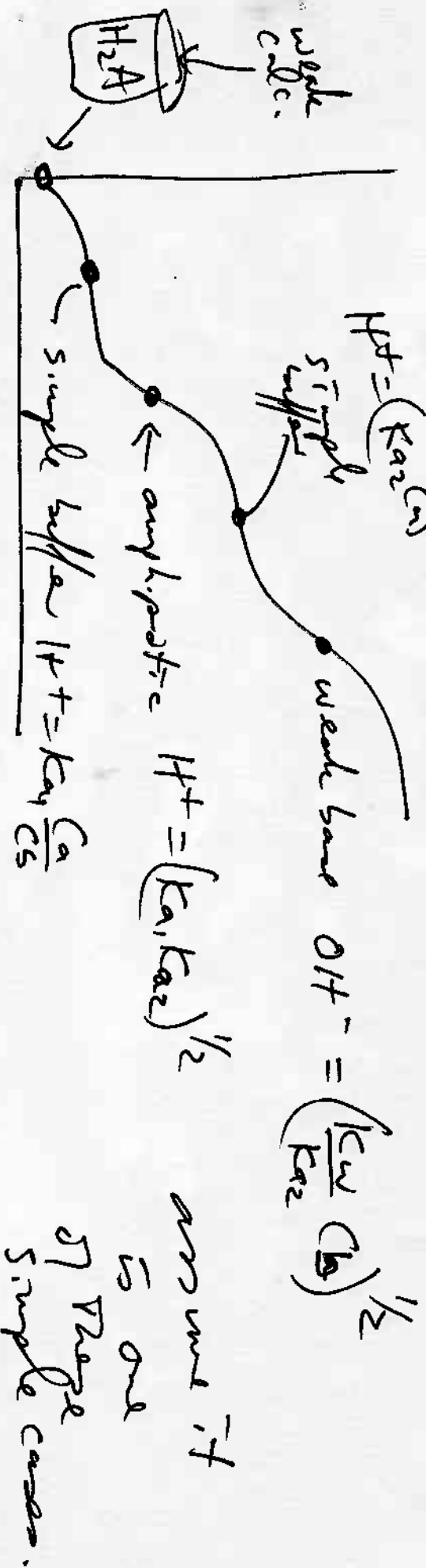
take a diprotic or triprotic acid and be able to write the dissociation steps



Really easy. I ask you to label a K_{a1} , or K_{a2} or K_{a3} for an acid.

15. polyprotic acid calculations

will be a simpl. find calculation



16. Mass and charge balance

again, way to easy. I apologize

$$\underbrace{\text{all } H_2O + \text{ions}} = \underbrace{\text{all } H_2O - \text{ions}}$$

Example
 HCl in H_2O $\rightarrow [H^+] = [Cl^-] + [Cl^-]$

$$C_{HCl} = [Cl^-] + [Cl^-]$$

some atom
 all forms of atom at eqn

$$C_{HCl} = [Cl^-]$$

17. Setting up complex equilibrium problems

I will give you a bunch of acids & salts. You turn them in H_2O and tell me how many different species are present. That is the # of eqns to solve a complex system.



18. Equilibrium expressions for a polyprotic acid

I will turn a polyprotic acid in some form into water. I want you to rank the relative concentrations of the forms.

Example H_2SO_4 in solution. $H_2SO_4 \rightleftharpoons H^+ + HSO_4^-$ it will be H_2SO_4

all H^+ forms $\rightarrow HSO_4^-$ but some H_2SO_4 forms $H^+ + SO_4^{2-}$

$\therefore H^+$ is largest than HSO_4^- than SO_4^{2-}

This will be the most missed problem.

19. Equilibria Calculations: dilute solutions

Look for $10^{-7} \rightarrow 10^{-9}$ M sol'n of acids or bases. Then the answer is slightly more or less the cubic sol'n, but could make you do the cubic sol'n, but that wouldn't be nice.

So
easy.
Don't -
make it
hard

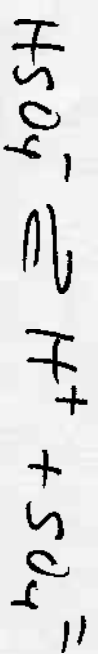
20. Equilibrium Calculations: sulfuric acid case

I put some H_2SO_4 in H_2O . you tell me the [] of the species.



$C_{H_2SO_4}$	\emptyset	\emptyset
$-C$	$+C$	$+C$
\emptyset	C	C

$$K_{a2} = \frac{(C+x)(x)}{(C-x)}$$



C	C	\emptyset
$-x$	$+x$	$+x$
$C-x$	$C+x$	x

21. Balancing redox reactions ~~(in acid or base)~~

Follow the simple change in ox method. This one is really easy.

1. determine ox #
 2. assign the red, assign the ox
 3. Find the L.C.M.
 4. assign coeff.
 5. Done
- SO Very easy

22. Balancing redox reactions (in acid or base)

Follow the change in ox method.

1-4 as above

Very simple ahead
5. If acid, find side missing O, add 1 H_2O for each and $2H^+$ each to other

6. If base find side missing O, add $2OH^-$ to other and 1 H_2O for each to opposite side.

23. Ranking oxidizing and reducing strengths

≡ parallels to rank-1

K_a values.

Always given $E_{1/2}^0$ of reduction. There will be few as 50 random values like

$$E_{1/2} = -.3, +.7, -.6, +1.7$$

Row
most easily reduced
(best oxidizing agent is)

$$-.6 < -.3 < +.7 < +1.7$$

weakest *strongest*

24. Assigning EC cell nomenclature

≡ most easily oxidized
is best reducing agent
and numbers are reversed

$$-.6 > -.3 > .7 > 1.7$$

strongest *weakest*

Cell	name	AG	K	catr	anod	fin	catr	anod
+	substitutional electrode	-	> 1	red	ox	to catr	+	-
-	electrode	+	< 1	red	ox	to catr	-	+

Remember

Plus is all ym need for 24. +25

25. Assigning EC cell nomenclature

see 24.

26. Calculating Ecell at standard conditions

I will give a couple $\frac{1}{2}$ rxns. you determine if Ecell is + or - , then knowing which is $E_{\frac{1}{2} \text{ cath}}$ and $E_{\frac{1}{2} \text{ anode}}$

$$E_{\text{cell}}^{\circ} = E_{\text{cath}}^{\circ} - E_{\text{anode}}^{\circ}$$

Just stick numbers in from $E_{\frac{1}{2}}$ red values \checkmark

27. Relating E, ΔG and K

I give you two $\frac{1}{2}$ rxn as red potentials
 you determine which is cathode + anode from E° 's

Then

$$\Delta G = -nFE^{\circ} = -RT \ln K.$$

Given E° , you will calculate other ΔG or K

Hint

E	ΔG	K
+	-	> 1
-	+	< 1

must be here

28. Stoichiometry calculation from current

I give you a rxn. I'll even give you
 n for the rxn because I'm feeling generous.

Then stoichiometry

? you don't know = what you know

constant involved so
 number of $e^- = \frac{\text{Amps}}{s}$

$$q \text{ of } \text{unk} = \text{amt known change} () ()$$

$$\text{amt } \text{unk} \text{ with charge} = q \text{ of known} () ()$$

29. Calculating cell potentials (Nernst)

$$E = E^{\circ} - \frac{0.059}{n} \log \frac{[\text{system}]}{[\text{system}]}$$

I will give you a balanced reaction. You write it knowing E° + ω^- , stick in n (# of e^- that are transferred) and some given $[]$ that are not 1 M or 1 atm.

30. Famous battery question

So easy. I will give you a battery lecture but you don't need to know it to solve the problem. Just know redox rxn concepts.