

18. Approximation for A/B

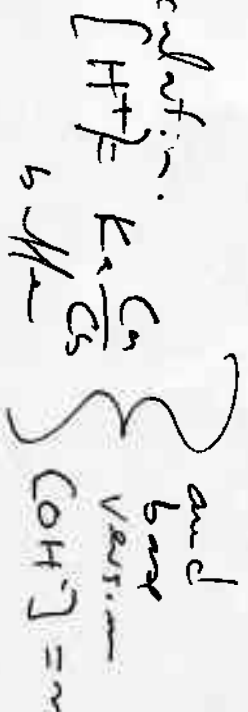
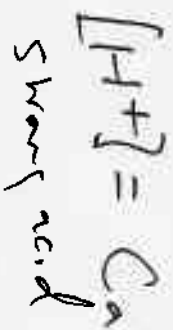
Be aware of the 3 things that reduce the complexity of an A/B calculation from a cubic to:

$$H^+ = (K_a C_a)^{1/2}$$
, a first-order approximation.

- The $[H^+]$ must be high (no dilute solutions) $\sim 0.1M$
- The water contribution from K_w is negligible ($K_a \approx K_b \gg K_w$)
- K values are far apart from each other $\sim 10^3$ to 10^4 apart

19, 20. Simple acid/base calculations.

This means: no neutralization in calculation.



use twice to solve

Use the 7 steps

1. remove spectators
2. Find strong $[H^+]$ or $[OH^-]$
3. Find the weak HA, A^-, B, BH^+

4. No neutralization !!

5. solve above part.

19.20. Examples:

What is pH of 0.1 M NH_4Cl if $K_b = 1 \times 10^{-5}$?

What is pOH of a 0.1 M HA and 0.2 M A^- solution if $K_a = 1 \times 10^{-6}$?

notice that after steps 1-3, no neutralization, so simply plug into the simple equation

$\text{H}^+ = [K_a C_a]^{1/2}$ after checking $K_b \rightarrow K_a$

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

21. I don't know buffers after neutralization. This has been done on all quizzes + tests.

Example. Which is a buffer?

0.1 M HCl + 0.1 M NaCl ← no, not weak A/B pair

0.1 M HA + 0.1 M HCl ← no, because all HA → A^- so no buffer left

0.1 M HA + 0.2 M NaOH ← yes because of the neutralization you have both HA, A^- present

0.2 M HA + 0.1 M NaOH ← yes because of the neutralization you have both HA, A^- present

HA, A^- present

22. Buffer neutralization.

There will be 3 things in solution.

- o a weak acid
- o a weak base
- o either strong acid or base

I think the answer will always be a little more or less than $pH = pK$

To get exact solution, Do 7 steps.

1. Spectator
 2. Strong A/B
 3. weak A/B
 4. neutralize?
- Indicators

5. Actually neutralize (yes in this question)

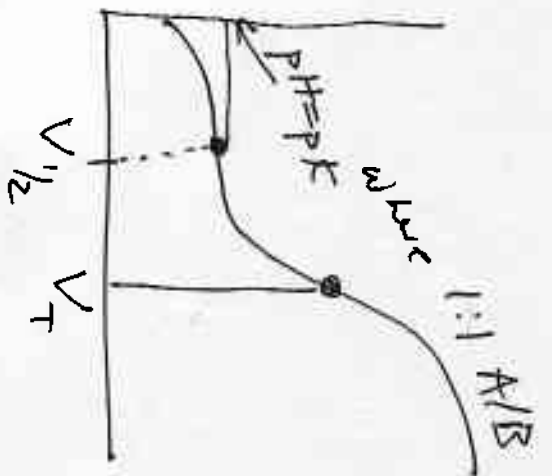
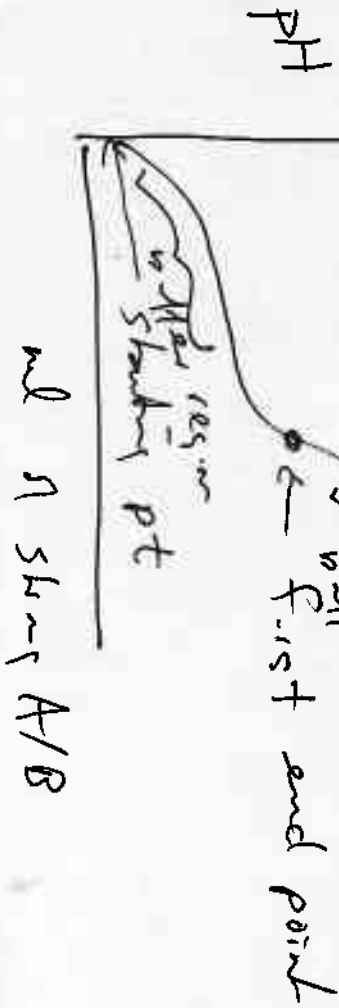
6. stick rest in to the simple acid/base equation.

7. Fixing the lestron (if they want H^+ give H^+ if they want OH^- , give OH^-)

Example: What is pH when 50 ml 0.1 M HClO₄ is added to 200 ml 0.1 M NH₃ and 0.1 M NH₄Cl
 if $K_a = 10^{-9.10}$.

The answer will be a little less than pH 10.

23. Titration curve features



24, 25 titrations.

Don't need these as titrations!! These are simply A/B calculations with neutralization. So do the

7 steps outlined in # 23.

How to neutralize

- write down neutralization reaction
- know everything into moles
- find limiting reagent
- subtract it from reactants, add to products
- do stoichiometry calculations on what is left

Example: T. Walker to end point.

What is pH when 50 ml of 1M HCl is added to 100 ml of 5M NH₃? $K_b = 1 \times 10^{-5}$.

1. ~~get~~ get rid of Cl⁻ S. H⁺ + B \rightleftharpoons BH⁺
2. you have H⁺
3. you have B
4. yes, react-er

0.05	0.05	0
-0.05	-0.05	+0.05
0	0	0.05 ←

$K_w = K_a K_b$

6. weak calc.

$$[H^+] = (K_a C_a)^{1/2} = \left(10^{-9} \frac{0.05}{0.100} \right)^{1/2} = 10^{-5}$$

26. estimating solubility from K_{sp} .

I will give a list of K_{sp} values. you estimate solubility by taking roots (2nd, 3rd, 4th etc.) No calculation needed.

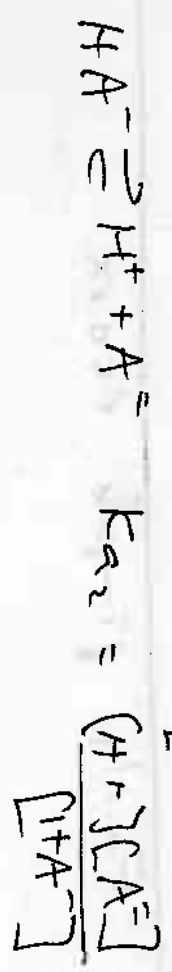
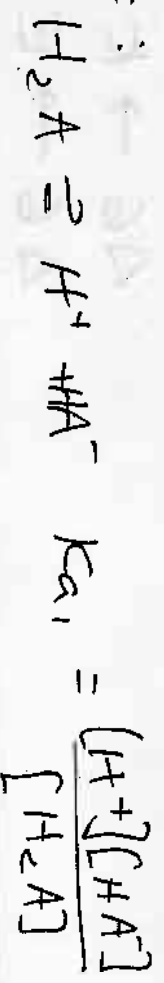
Which has largest solubility?

K_{sp}		
AB	$10^{-20} \rightarrow$	$\sim \sqrt{10^{-20}} \sim 10^{-10}$
AB ₂	$10^{-20} \rightarrow$	$\sim \sqrt[3]{10^{-20}} \sim 10^{-7}$
AB ₃	$10^{-20} \rightarrow$	$\sim \sqrt[4]{10^{-20}} \sim 10^{-5} \leftarrow$ most soluble

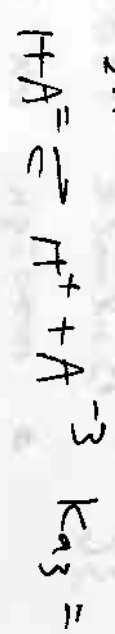
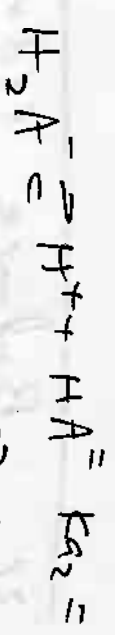
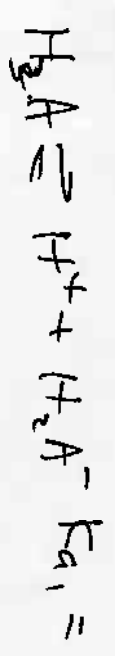
29. Expression for polyprotic acid.

you need to be able to write the K values, + expressions for d. protic + m. protic acids.

d. protic:



m. protic case:



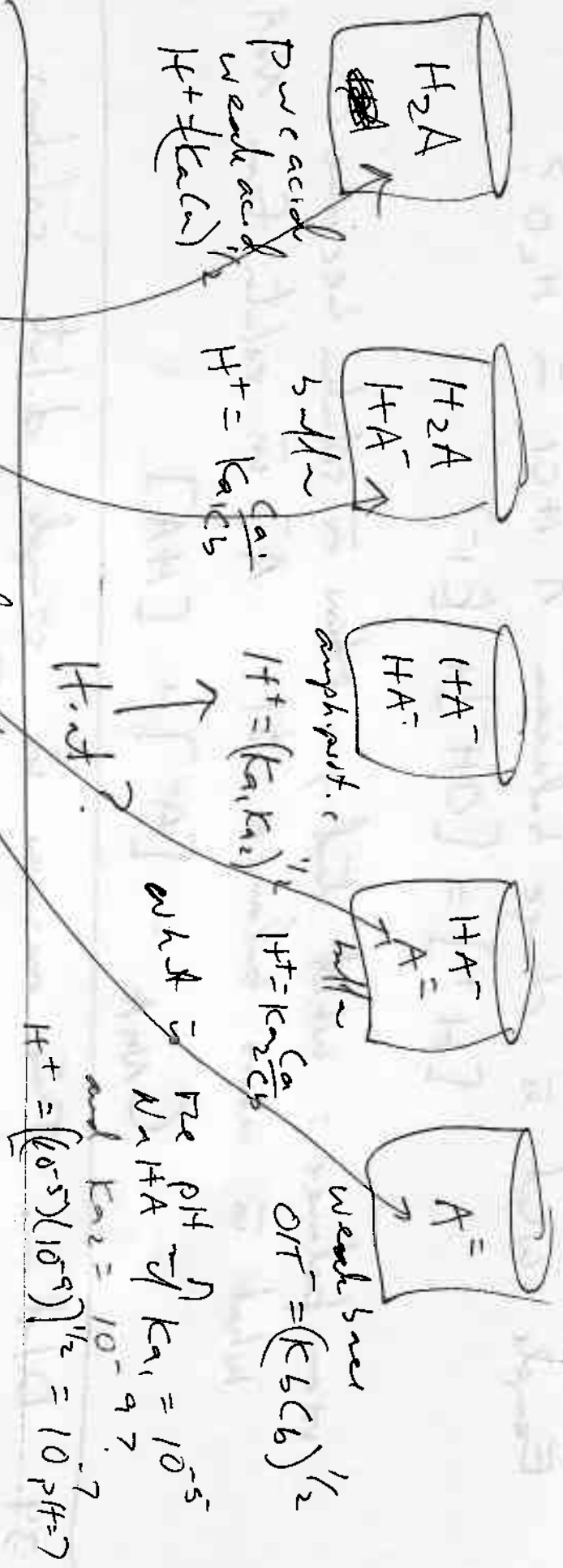
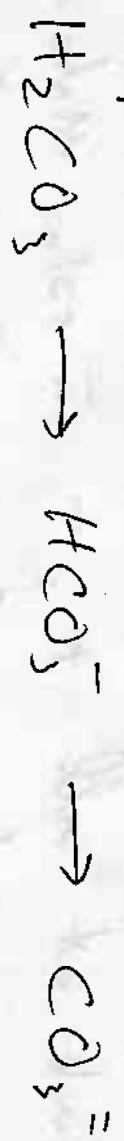
30. Ranking polyprotic species in solution.

Throw a weak acid (d. protic) in H_2O . what is in solution?



- mostly there is H_2CO_3 (weak)
- H^+ + HCO_3^- are ~ the same
- But $HCO_3^- \rightarrow H^+ + CO_3^{2-}$
so there is a little more H^+ from HCO_3^-
- CO_3^{2-} is the least because it is the least dissociated.
 $H_2CO_3 > H^+ > HCO_3^- > CO_3^{2-}$

31. Polyprotic acid calculation.



32. Opps. You will also have to do a calculation

For or or

What is pH of H_2CO_3 ? use buffer 1

What is pH of Na_2CO_3 ? use buffer 5

What is pH of $H_2CO_3 + NaHCO_3$? use buffer 2

and just follow 7 steps of A/B calculation.

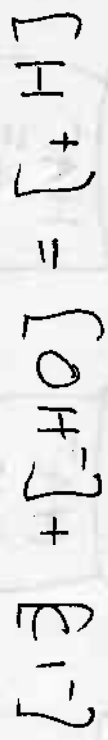
What is the pH of $NaHA$ if $K_{a1} = 10^{-5}$ and $K_{a2} = 10^{-9}$?

$$H^+ = [(10^{-5})(10^{-9})]^{1/2} = 10^{-7} \text{ pH} = 7$$

33. mass + charge balance. Every example with muprotic case.

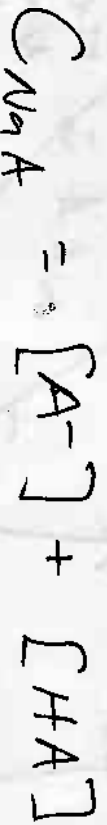
Charge balance. look at all +, - in soln. Make an eqn.

Example what is charge balance of HCl in H₂O?



mass balance: what did you start with in solution become?

what is mass balance of A⁻ in soln from NaA?



34. Dilution: This answer is simple, dilute solutions

house pH vs pOH near?

Example. What is pH of 10⁻⁸ M HA? a little less than 7

What is pH of 10⁻⁸ M NaOH? a little more than 7

35. relate ΔG to E to $K \equiv$ simply plug + chng

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

I will give you values + constants to convert e.V to

$$\Delta G \rightarrow K \quad K \rightarrow E$$

$$\Delta G \rightarrow E \quad E \rightarrow K$$

36. Balance redox. Fairly simple redox

- assign ox #
- identify ox. $\frac{1}{2}$ rxn, red $\frac{1}{2}$ rxn
- determine the Δe^- and find lowest common multiple
- multiply through by l.c.m. to assign coefficients
- fix the H^+ or OH^- to balance.

