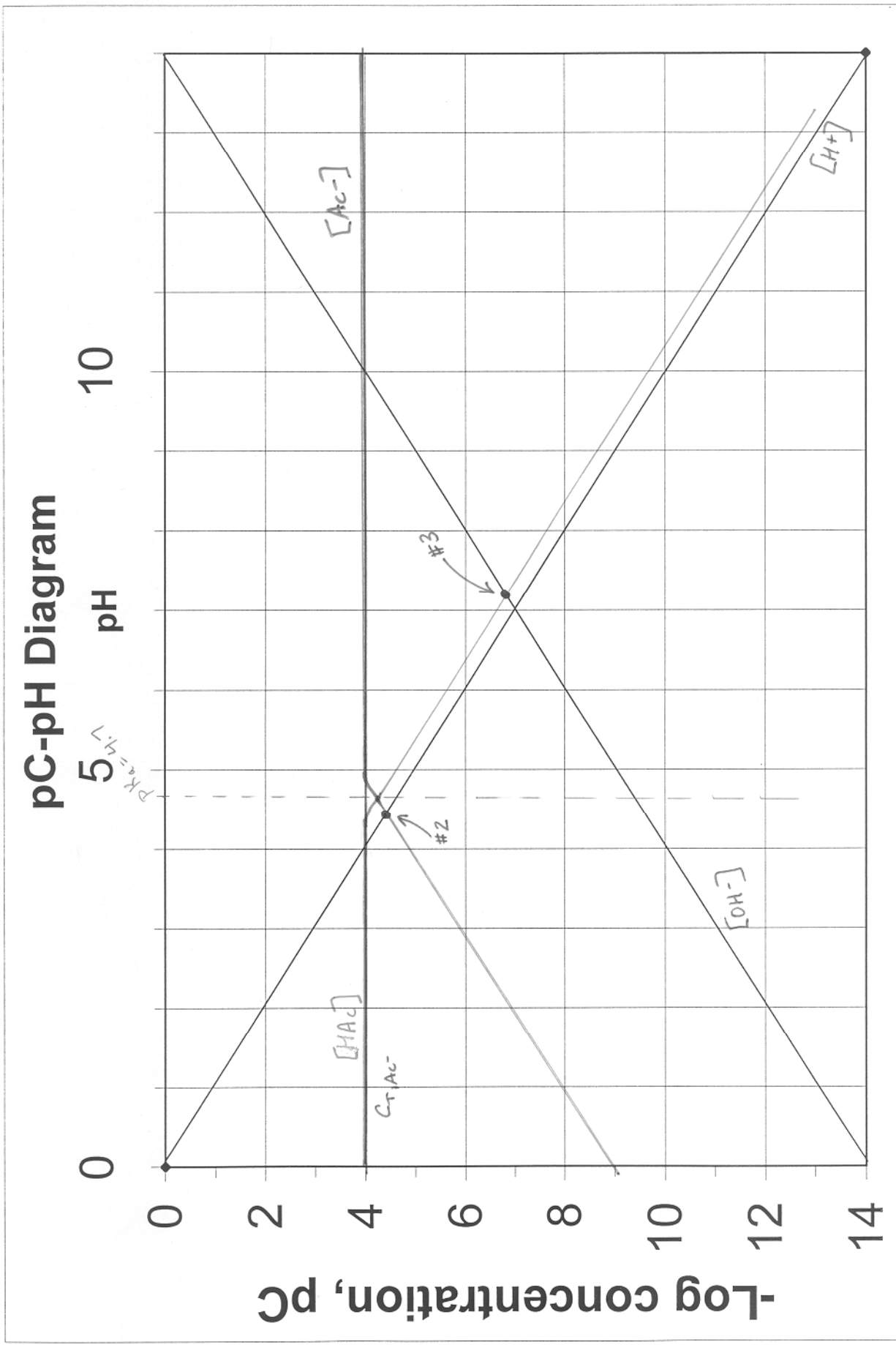


HW # 8 SOLUTIONS
#1

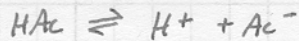


HW #8 SOLUTIONS

(1)

(#1) Develop pC-pH diagram for $10^{-4} M$ HAC

Equilibrium equations



$$K_a = 10^{-4.7} = \frac{[H^+][Ac^-]}{[HAc]}$$

$$K_w = [H^+][OH^-] = 10^{-14}$$

Mass Balance

$$[HAc] + [Ac^-] = C_{T,Ac^-} = 10^{-4} M$$

Charge balance (also the proton condition)

$$[H^+] = [OH^-] + [Ac^-]$$

PLOT ALL SPECIES vs. pH

- For K_w Expression \rightarrow IN log form

$$\log K_w = \log [H^+] + \log [OH^-]$$

$$pOH = 14 - pH \rightarrow \text{slope} = -1$$

$$y = b + mx$$

plot point on graph
w/ -1 slope
(0, 14)

when
 $pH = 0$
 $pOH = 14$

line labeled $[OH^-]$ on graph

- By definition $-\log [H^+] = pH$
 $pC = pH \rightarrow$ line labeled $[H^+]$
on graph

Now Draw lines for $[Ac^-]$ and $[HAc]$

Need to relate concentrations vs. pH and constants

- For Ac^-

Combine K_a and m.b. equations to eliminate $[HAc]$

$$K_a = \frac{[H^+][Ac^-]}{C_T - [Ac^-]}$$

solve for $[Ac^-]$

(2)

$$[Ac^-] = \frac{K_a C_T}{([H^+] + K_a)}$$

Now - check around system point

$$\text{If } K_a \gg [H^+] \Rightarrow pH > pK_a$$

$$[Ac^-] = C_T = 10^{-4}$$

$$pC_{Ac} = 4 \text{ when } pH > 4.7$$

$$\text{If } [H^+] \gg K_a \Rightarrow pK_a > pH$$

Again combine K_a + m.B equations

$$\frac{K_a C_{T,Ac^-}}{[H^+]} = [Ac^-]$$

$$-\log K_a - \log C_{T,Ac^-} - (-\log [H^+]) = -\log [Ac^-]$$

$$p[Ac^-] = \underbrace{pC_{T,Ac^-} + pK_a}_{b} - pH_{mx}$$

$$\text{slope} = -1$$

$$\text{when } pH = pK_a = 4.7$$

$$p[Ac^-] = pC_{T,Ac^-} = 4$$

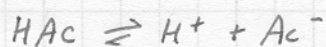
$$(4.7, 4) \text{ slope } -1$$

line marked $[Ac^-]$ in figure

- Use similar procedure for $[HAc]$ line - refer to lecture note handout
- remember to check around system point

(#2) Find equilibrium species conc?

3



PROTON CONDITION $[\text{H}^+]_{\text{LHS}} = [\text{OH}^-]_{\text{RHS}} + [\text{Ac}^-]_{\text{RHS}}$

see point on graph representing solution

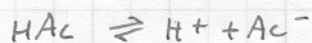
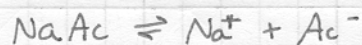
$$[\text{H}^+] = 10^{-4.4} \quad \text{pH} = 4.4$$

$$[\text{HAc}] = 10^{-4}$$

$$[\text{Ac}^-] = 10^{-4.4}$$

$$[\text{OH}^-] \approx 10^{-9.5}$$

(#3) FIND CONC OF SPECIES IF 10^{-4} M NaAc added



PROTON CONDITION $[\text{H}^+]_{\text{LHS}} + [\text{HAc}]_{\text{LHS}} = [\text{OH}^-]_{\text{RHS}}$

$$\text{pH} \approx 7.2 \quad [\text{H}^+] = 10^{-7.2}$$

$$[\text{HAc}] \approx 10^{-6.8}$$

$$[\text{Ac}^-] \approx 10^{-4}$$

$$[\text{OH}^-] \approx 10^{-6.8}$$