Name: **Period:** **Seat#:**

Directions: Try these problems. If you can DO them, check the box (☑).
If you CANNOT do them, write some notes TO YOURSELF about what you need to study to succeed at these problems.

S76 – Quick Check #1

☐ **Acid-Base Equilibria**

Consider the following equilibrium:

$HCN + H_2O(l) \leftrightarrows H_3O^+ + CN^-$ K_a for HCN = 4.0×10^{-10}

Identify the two **conjugate acid-base pairs**:

_____ _____ _____ _____

Draw a box around the more appropriate representation of this equilibrium:

$HCN + H_2O(l) \leftrightarrows H_3O^+ + CN^-$ $HCN + H_2O(l) \leftrightarrows H_3O^+ + CN^-$

Which acid is ***weaker***? _____

☐ **Conjugate Acids and Bases**

What is the…

conjugate ***base*** of H_2O? _____

conjugate ***acid*** of NH_3? _____

conjugate ***base*** of OH^-? _____

conjugate ***acid*** of HCO_3^-? _____

☐ **pH Calculations**

Fill in the chart below:

$[H_3O^+]$	$[OH^-]$	pH	pOH	Acidic or Basic
2.0×10^{-3}				
		6.25		
	5.6×10^{-2}			

S77 – Quick Check #2

☐ **Equilibrium Favors the Weaker Acid/Weaker Base**

Consider this equation: $HCN + H_2O \leftrightarrows H_3O^+ + CN^-$ $K_a = 4.0 \times 10^{-10}$.

The two bases are: _____ and _____. The weaker base is _____.

☐ **I.C.E. Box Problem**

Calculate the pH of a 0.100 M HCN solution. K_a for HCN = 4.0×10^{-10}

	HCN	$H_2O(l)$	⇆	H_3O^+	CN^-
Initial					
Change					
Equilibrium					

☐ **pH Problems**

Calculate the pH of a 0.100 M HBr solution. _____

Calculate the pH of a 0.100 M KOH solution. _____

Calculate the pH of a 0.100 M NH_3 solution. _____ K_b for $NH_3 = 1.8 \times 10^{-5}$

	NH_3	$H_2O(l)$	⇆	NH_4^+	OH^-
Initial					
Change					
Equilibrium					

☐ **Conjugate Bases**

CN- is the conjugate base of the weak acid, HCN. Finish the equation below:

$CN^- + H_2O \leftrightarrows$

S78 – Quick Check #3

☐ **Diprotic Acids**

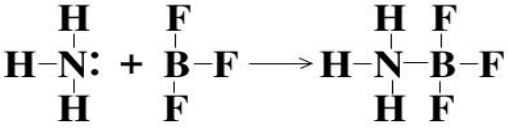
Sulfurous acid, H_2SO_3, is a diprotic acid. Write the step-wise dissociation equations for H_2SO_3.

	$K_{a1} = 1.5 \times 10^{-5}$
	$K_{a2} = 1.0 \times 10^{-7}$

Struggled? Got some wrong? Do some self-study!

☐ **Lewis Acids and Bases**

Consider the following picture. The Lewis acid is _____. The Lewis base is _____.



Consider the equation: $H^+ + OH^- \rightarrow H_2O$. The Lewis acid is _____. The Lewis base is _____.

☐ **Strengths of Acids**

Consider the acids: $HClO_2$, $HBrO_2$, HIO_2. Rank them from weakest to strongest.

Weakest				Strongest

Justification:

Consider the acids: HBrO, $HBrO_2$, $HBrO_3$. Rank them from weakest to strongest.

Weakest				Strongest

Justification:

Consider the acids: HCl, HBr, HI. Rank them from weakest to strongest.

Weakest				Strongest

Justification:

☐ **Diprotic Acid Calculations**

Sulfurous acid, H_2SO_3, is a diprotic acid. $K_{a1} = 1.5 \times 10^{-5}$; $K_{a2} = 1.0 \times 10^{-7}$

What is the $[SO_3^{2-}]$ in a 0.150 M solution of H_2SO_3? _____

Calculate the pH of a 0.150 M solution of H_2SO_3.

S79 – Quick Check #4

☐ **pH's are Logarithmic**

Solution A has a pH of 3. Solution B has a pH of 6. Which solution is more acidic? _____

How many times more acidic is the more acidic solution? _____

☐ **ICE Box with a Twist**

A 0.10 M solution of HF has a pH of 2.10. Calculate the K_a of HF.

S80 – Quick Check #1b

☐ **pH at the Starting Point of a Titration**

What is the pH of a 25.0 mL sample of 0.200 M HCl?

☐ **How Much Base is Needed to Neutralize an Acid**

How many mL of 0.100 M NaOH solution is needed to titrate a 25.0 mL sample of a 0.200 M HCl.

☐ **pH at the Endpoint of a Titration**

Acid	Base	pH at the Endpoint (circle choice)
strong	strong	less than 7 | 7 | more than 7
strong	weak	less than 7 | 7 | more than 7
weak	strong	less than 7 | 7 | more than 7

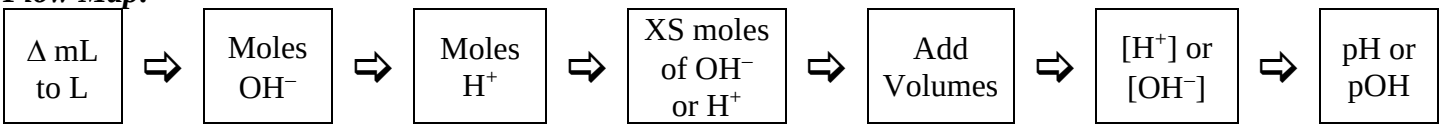
☐ **pH Beyond the Endpoint of a Titration**

Calculate the pH of a solution made by adding 30.0 mL of 0.100 M NaOH to 10.0 mL of 0.200 M HCl.

☐ **Same problem broken into steps for you**

Calculate the pH of a solution made by adding 30.0 mL of 0.100 M NaOH to 10.0 mL of 0.200 M HCl.

Flow Map:



$V \cdot \underline{M} = mol$ $V \cdot \underline{M} = mol$

Step 1: Change your volumes to Liters.

Vol NaOH = _____ Vol HCl = _____

Step 2: Calculate moles of OH^-. *(Note: volume x molarity = moles)*

Step 3: Calculate moles of H^+.

Step 4: Subtract moles of OH^- and moles H^+ to determine excess moles.
(Note: You are forming H_2O until H^+ or OH^- runs out. Be sure to label your answer as H^+ or OH^-.)

Step 5: Calculate the total volume (in Liters).

Step 6: Determine the concentration of H^+ or OH^- (whichever is in excess). *(Note: Molarity = moles/Liters)*

Step 7: Determine the pH or pOH. *(Note: This may involve one or two steps. State the equation used.)*

S81 – Quick Check #2b

☐ **pH of a weak acid solution**

Calculate the pH of a 0.200 M solution of nitrous acid, HNO_2. K_a of $HNO_2 = 4.0 \times 10^{-4}$.

☐ **Salt solutions**

A solution of $NaNO_2$ will be _____ (acidic, basic, neutral).

Write the ***net*** equation for the equilibrium involved when $NaNO_2$ dissolves in water.

Write the equilibrium expression for the above equation. Should this be labeled K_c, K_a, K_b, K_{eq}?

Calculate the pH of a 0.100 M solution of $NaNO_2$.

☐ **Acid-Base Neutralization**

Write the balanced net equation for:
A solution of sulfurous acid is added to a suspension of magnesium hydroxide

S82 – Quick Check #3b

☐ **Buffer basics**

What could you mix with 100. mL of 2.00 M HNO_2 (nitrous acid) to make a buffer?

What is the pH of the best buffer made from nitrous acid, HNO_2? K_a of $HNO_2 = 4.0 \times 10^{-4}$.

☐ **Adjusting the pH of a buffer**

The weak acid, HCN, could be used to make a buffer. The K_a for HCN is 6.2×10^{-10}.
What is the pH of the best buffer made from HCN?

What ratio of [HCN] to $[CN^-]$ is needed to have a buffer with pH = 9.00?

☐ **Multiple Choice Question:**

Which of the following mixtures would result in a buffer solution?

I. 10 mL 0.20 M HCl and 10 mL 0.40 M NH_3
II. 10 mL 0.20 M HF and 10 mL 0.20 M NaF
III. 10 mL 0.40 M $HC_2H_3O_2$ and 10 mL 0.20 M NaOH

A) II only
B) II and III only
C) I and III only
D) I, II and III
E) None of these will result in a buffer solution.

S83 – Quick Check #4b

1. Which statement is a logical consequence of the fact that a 0.10 molar solution of potassium acetate, $KC_2H_3O_2$, is less basic than a 0.10 molar solution of potassium cyanide, KCN?
   (A) Hydrocyanic acid (HCN) is a weaker acid than acetic acid.
   (B) Hydrocyanic acid is less soluble in water than acetic acid.
   (C) Cyanides are less soluble than acetates.
   (D) Acetic acid is a weaker acid than hydrocyanic acid.

2. Which solution would show the least change in pH upon addition of 3.0 mL of 1.0 M KOH? (Assume equal volumes of each solution are used. Ka for $HC_2H_3O_2 = 1.8 \times 10^{-5}$)

   (A) A solution that is 0.50 M acetic acid and 0.50 M sodium acetate.

   (B) A solution that is 0.10 M acetic acid and 0.10 M sodium acetate.

   (C) A solution that is 1.0 M acetic acid.

   (D) A solution that is 0.50 M sodium acetate.

3. A strong monoprotic acid is being titrated with a 0.500 M NaOH solution. Which statement is true for this titration?

   (A) The pH at the equivalence point cannot be determined without knowing the identity of the acid.

   (B) The pH at the equivalence point cannot be determined unless the concentration of the acid is known.

   (C) The pH at the equivalence point depends on neither the identity of the acid nor the concentration of the acid.

4. Which of the following would not make a good buffering system?

   (A) SO_4^{2-} and H_2SO_4 (B) HCO_3^- and H_2CO_3

   (C) NH_3 and NH_4^+ (D) CH_3COO^- and CH_3COOH

5. The amount (in grams) of sodium acetate (MW = 82.0) to be added to 500.0 mL of 0.200 molar acetic acid ($K_a = 1.80 \times 10^{-5}$) in order to make a buffer with pH = 5.000 is

   (A) 69 (B) 0.180 (C) 14.9 (D) 29.5 (E) None of these

6. Determine the pH of a solution in which 1.00 mol H_2CO_3 ($K_a = 4.2 \times 10^{-7}$) and 1.00 mole $NaHCO_3$ are dissolved in enough water to form 1.00 L of solution.

7. How many grams of $Mg(OH)_2$ are required to neutralize 50.0 ml of a 3.00 M HCl solution?

8. A sample of 20.0 mL of a 0.100-molar HCN solution is titrated with a 0.150-molar NaOH solution. (K_a HCN = 6.2×10^{-10})

   (A) What volume of NaOH is used in the titration in order to reach the equivalence point?

   (B) What is the molar concentration of CN^- at the equivalence point?

   (C) What is the pH of the solution at the equivalence point?

ANSWERS:
A / A / C / A / C / 6.4 / 4.37 / a. 0.0133L / b. 0.060M / c. 11.0

Struggled? Got some wrong? Do some self-study!