Dougherty Valley HS Chemistry - AP
Acid Base – Study Questions

Worksheet #8

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

Directions: Show all work. Box your final answer.

1) For the following aqueous equilibria, designate the Brønsted-Lowry conjugate acid-base pairs and establish the weaker side.

a.	**NH_3 (aq) + H_2O (*l*) ⇔ NH_4^+ (aq) + OH^- (aq)**		
Brønsted-Lowry conjugate acid:	*Brønsted-Lowry conjugate base:*	*Weaker side:*	
b.	**HCN (aq) + H_2O (*l*) ⇔ H_3O^+ (aq) + CN^- (aq)**		
Brønsted-Lowry conjugate acid:	*Brønsted-Lowry conjugate base:*	*Weaker side:*	
c.	**NH_4^+ (aq) + CO_3^{2-} (aq) ⇔ NH_3 (aq) + HCO_3^- (aq)**		
Brønsted-Lowry conjugate acid:	*Brønsted-Lowry conjugate base:*	*Weaker side:*	

2) Complete the Brønsted-Lowry equilibria, label the components acid or base, and pair up the conjugate acid-base pairs:

a.	HSO_4^- + H_2O ⇔
b.	NH_3 + H_2O ⇔
c.	CN^- + H_2O ⇔
d.	H^- + H_2O ⇔
e.	$HClO_4$ + H_2O ⇔

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3) Of the following acids, determine the items listed below

[i] HNO_3 (aq) + $H_2O(l) \Leftrightarrow H_3O^+$ (aq) + NO_3^- (aq) **K_a = very large**

[ii] HSO_4^- (aq) + $H_2O(l) \Leftrightarrow H_3O^+$ (aq) + SO_4^{2-} (aq) **$K_a = 1.2 \times 10^{-2}$**

[iii] HCN (aq) + $H_2O(l) \Leftrightarrow H_3O^+$ (aq) + CN– (aq) **$K_a = 4.0 \times 10^{-10}$**

[iv] H_2CO_3 (aq) + $H_2O(l) \Leftrightarrow H_3O^+$ (aq) + HCO_3^- (aq) **$K_a = 4.2 \times 10^{-7}$**

[v] NH_4^+ (aq) + $H_2O(l) \Leftrightarrow H_3O^+$ (aq) + NH_3 (aq) **$K_a = 5.6 \times 10^{-10}$**

[vi] HF (aq) + $H_2O(l) \Leftrightarrow H_3O^+$ (aq) + F^- (aq) **$K_a = 7.2 \times 10^{-4}$**

a. The strongest acid	**b.** The acid that produces the lowest [ ] of hydronium ions per mole of acid	**c.** The acid with the strongest conjugate base
d. The diprotic acid	**e.** The "strong" acid	**f.** The acid with the weakest conjugate base.

4) What is the pH of the following?

a. 0.0010 M HCl solution? *3.0*

b. 0.15 M KOH solution? *13.2*

c. 10^{-8} M HNO_3 solution? *6.96* **Hint – this is SUPER tricky...when very low [H+] you can't ignore the [H+] coming from the auto ionization of water! Remember... $H_2O \leftrightarrow H+ + OH-$, you should remember the [ ]'s of each substance from the auto ionization of water...*

5) Complete the table for each aqueous solution at 25°C. State whether the solutions are acidic or basic. You do not need to show your work for all of these, but you can always use binder paper if needed!

$[H_3O^+]$	$[OH^-]$	pH	pOH	Acidic or Basic
2.0×10^{-5}				
		6.25		
	5.6×10^{-2}			
			9.20	
8.7×10^{-10}				

6) If the pH of a sample of rainwater is 4.62, what is the hydronium ion concentration [H_3O^+] and the hydroxide ion concentration [OH^-] in the rainwater? *[H_3O^+] = 2.4E^{-5}, [OH^-] = 4.2E^{-10}*

7) Hydroxylamine is a weak base with a $K_b = 6.6 \times 10^{-9}$. What is the pH of a 0.36 M solution of hydroxylamine in water at 25°C? *9.69*

8) Which of the following salts, when dissolved in water to produce 0.10 M solutions, would have the lowest pH? Choose the correct multiple choice answer and then explain why.

a. Sodium acetate
b. Potassium chloride
c. Sodium bisulfate
d. Magnesium nitrate
e. Potassium cyanide

Explain why:

9) Cyanic acid HOCN has a $K_a = 3.5 \times 10^{-4}$, what is the K_b for the cyanate ion OCN^-? *$K_b = 2.86 \times 10^{-11}$*

10) Phenol is a relatively weak acid, $K_a = 1.3 \times 10^{-10}$. How does the strength of its conjugate base compare with the strength of ammonia ($K_b = 1.8 \times 10^{-5}$), the acetate ion ($K_b = 5.55 \times 10^{-10}$), and sodium hydroxide?