Dougherty Valley HS AP Chemistry
Acid Base – Study Questions Chemistry of Acids and Bases

WORKSHEET #7

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

Show all work for each question, box your final answer

[1] For the following aqueous equilibria, designate the Brønsted-Lowry conjugate acid-base pairs and establish the weaker side:

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

$HSO_4^- + H_2O \Leftrightarrow$

$NH_3 + H_2O \Leftrightarrow$

$CN^- + H_2O \Leftrightarrow$

$H^- + H_2O \Leftrightarrow$

$HClO_4 + H_2O \Leftrightarrow$

[3] Of the following acids,
[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) **$K_a = 7.2 \times 10^{-4}$**
Determine:

[a] The strongest acid	
[b] The acid that produces the lowest concentration 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

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

[5] Complete the table for each aqueous solution at 25°C. State whether the solutions are acidic or basic.

$[H_3O^+]$	$[OH^-]$	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?

a. sodium acetate	d. magnesium nitrate
b. potassium chloride	e. potassium cyanide
c. sodium bisulfate	**Explain why:**

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

[b] 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?