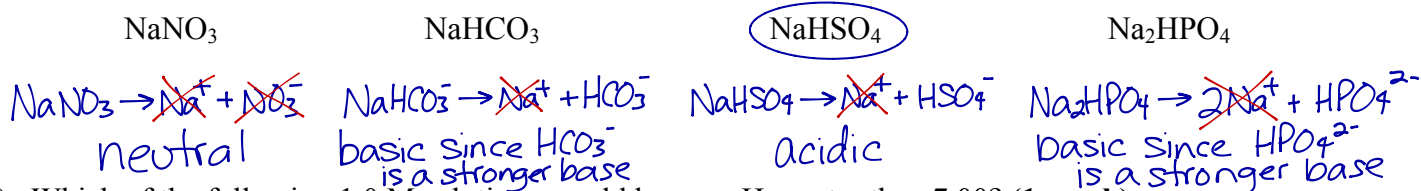
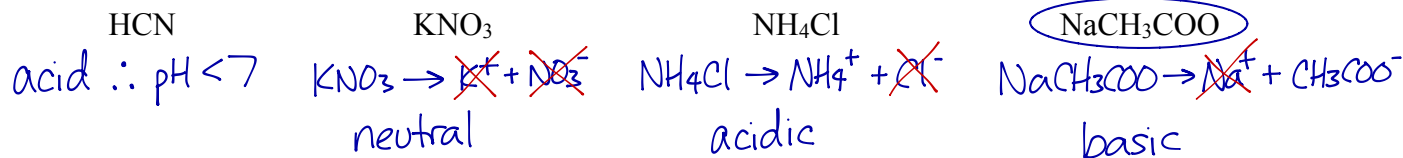


## CHEMISTRY 12 – HYDROLYSIS WORKSHEET

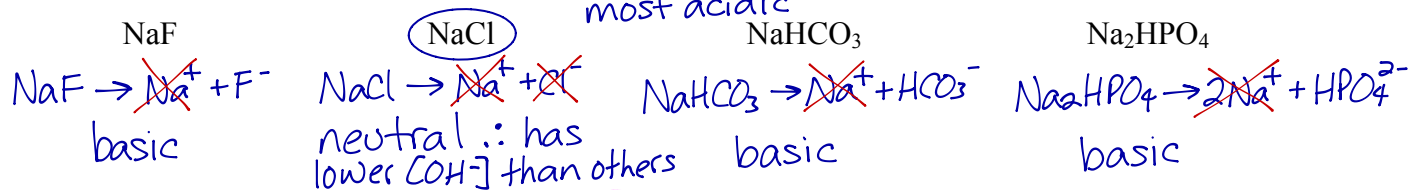
1) Which of the following 1.0 M salt solutions will be acidic? (1 mark)



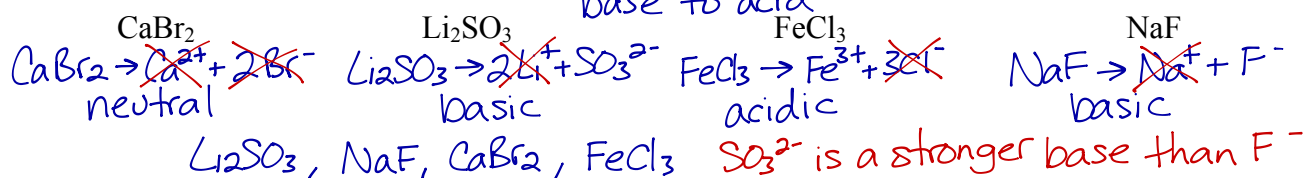
2) Which of the following 1.0 M solutions would have a pH greater than 7.00? (1 mark)



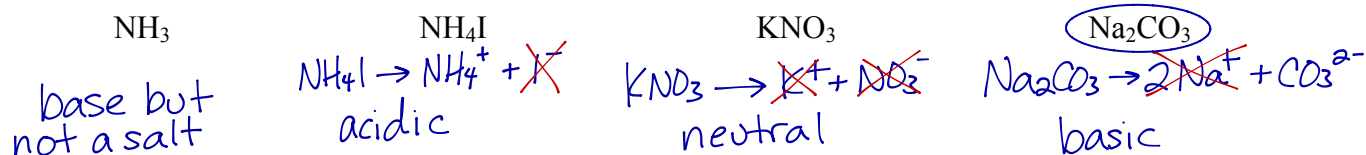
3) Which of the following solutions will have the lowest [OH<sup>-</sup>]? (1 mark)



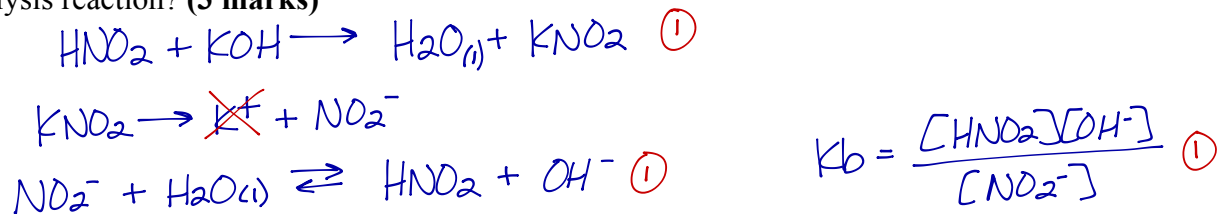
4) List the following 1.0 M solutions in order of decreasing pH. (1 mark)



5) Which of the following represents a basic salt solution? (1 mark)

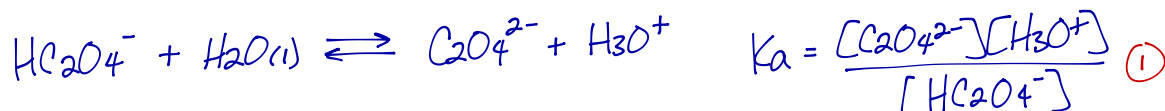


6) One of the products of the reaction between HNO<sub>2</sub>(aq) and KOH(aq) undergoes hydrolysis. Write the predominant equilibrium expression and the appropriate equilibrium constant expression for this hydrolysis reaction? (3 marks)



7) What is the equilibrium constant expression for the predominant reaction between the hydrogen oxalate ion, HC<sub>2</sub>O<sub>4</sub><sup>-</sup>, and water? (1 mark)

based on relative position on the table, HC<sub>2</sub>O<sub>4</sub><sup>-</sup> is a stronger acid than base



8) Consider the salt ammonium acetate,  $\text{NH}_4\text{CH}_3\text{COO}$ .

a) Write the equation for the dissociation of  $\text{NH}_4\text{CH}_3\text{COO}$ . (1 mark)



b) Write equations for the hydrolysis reactions that occur. (2 marks)



c) Explain why a solution of  $\text{NH}_4\text{CH}_3\text{COO}$  has a  $\text{pH} = 7.00$ . Support your answer with calculations. (2 marks)

$$K_a \text{ of } \text{NH}_4^+ = 5.6 \times 10^{-10}$$

$$K_b \text{ of } \text{CH}_3\text{COO}^- = \frac{K_w}{K_a} = \frac{1.0 \times 10^{-14}}{1.8 \times 10^{-5}} = 5.6 \times 10^{-10} \quad (1)$$

Since  $K_a = K_b$ , solution is neutral (1)

9) A chemist prepares a solution by dissolving the salt  $\text{NaIO}_3$  in water.

a) Write the equation for the dissociation reaction that occurs. (1 mark)



b) Write the equation for the hydrolysis reaction that occurs. (1 mark)



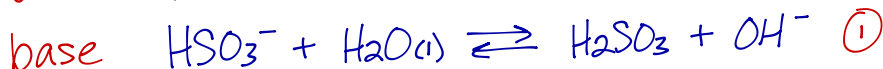
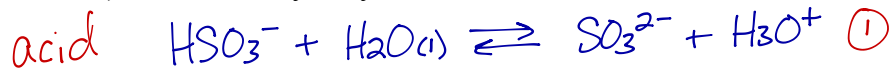
c) Calculate the value of the equilibrium constant for the hydrolysis in part b). (1 mark)

$$K_b = \frac{K_w}{K_a} = \frac{1.0 \times 10^{-14}}{1.7 \times 10^{-1}} = 5.9 \times 10^{-14}$$

10) Consider a 1.0 M solution of  $\text{NaHSO}_3$ .



a) Write both hydrolysis reactions that occur when  $\text{NaHSO}_3$  is dissolve in water. (2 marks)



b) Will the above  $\text{NaHSO}_3$  solution be acidic, basic or neutral? Support your answer with calculations. (2 marks)

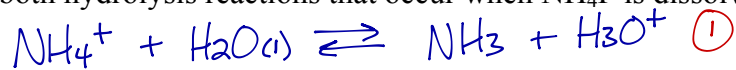
$$K_a \text{ of } \text{HSO}_3^- = 1.0 \times 10^{-7}$$

$$K_b \text{ of } \text{HSO}_3^- = \frac{K_w}{K_a} = \frac{1.0 \times 10^{-14}}{1.5 \times 10^{-2}} = 6.7 \times 10^{-13} \quad (1)$$

$K_a > K_b \therefore$  acidic (1)

10) Consider a 1.0 M solution of  $\text{NH}_4\text{F}$ .  $\text{NH}_4\text{F} \rightarrow \text{NH}_4^+ + \text{F}^-$

a) Write both hydrolysis reactions that occur when  $\text{NH}_4\text{F}$  is dissolved in water. (2 marks)



b) Will the above  $\text{NH}_4\text{F}$  solution be acidic, basic or neutral? Support your answer with calculations. (2 marks)

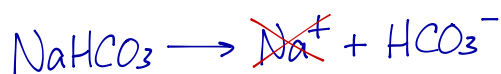
$$K_a \text{ of } \text{NH}_4^+ = 5.6 \times 10^{-10}$$

$$K_b \text{ of } \text{F}^- = \frac{K_w}{K_a} = \frac{1.0 \times 10^{-14}}{3.5 \times 10^{-4}} = 2.9 \times 10^{-11} \quad (1)$$

$$K_a > K_b \therefore \text{acidic} \quad (1)$$

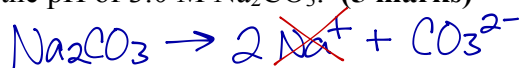
11) Which of the following is true as a result of the predominant hydrolysis of  $\text{NaHCO}_3$ ? (1 mark)

	Solution	Reason
A.	basic	$K_a > K_b$
<b>B.</b>	basic	$K_b > K_a$
C.	acidic	$K_a > K_b$
D.	acidic	$K_b > K_a$



based on relative position on the table,  $\text{HCO}_3^-$  is a stronger base than acid

12) Calculate the pH of 3.0 M  $\text{Na}_2\text{CO}_3$ . (5 marks)



I	3.0	0	0	} (1)
C	-x	+x	+x	
E	3.0-x	x	x	

assume  
 $3.0 - x = 3.0$

$$K_b = \frac{[\text{HCO}_3^-][\text{OH}^-]}{[\text{CO}_3^{2-}]}$$

$$K_b = \frac{K_w}{K_a} = \frac{1.0 \times 10^{-14}}{5.6 \times 10^{-11}} = 1.8 \times 10^{-4} \quad (1)$$

$$1.8 \times 10^{-4} = \frac{x^2}{3.0}$$

$$x = 0.023 \text{ M} \quad (1)$$

$$\text{pOH} = -\log [\text{OH}^-]$$

$$= -\log (0.023)$$

$$= 1.64 \quad (0.5)$$

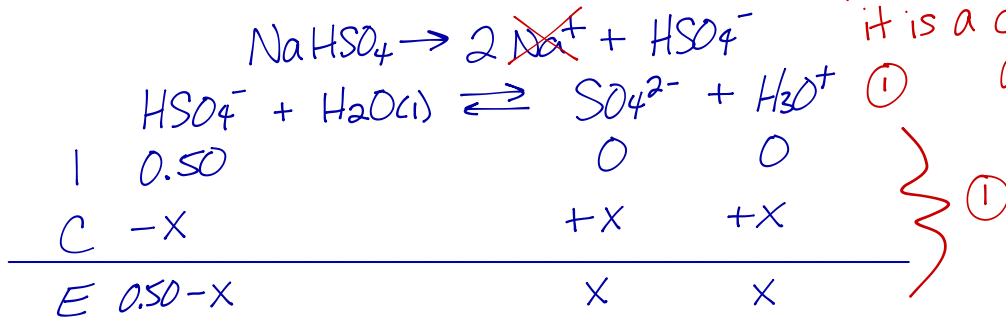
$$\text{pH} + \text{pOH} = 14.00$$

$$x + 1.64 = 14.00$$

$$x = 12.36 \quad (0.5)$$

13) Calculate the pH of 0.50 M NaHSO<sub>4</sub>. (4 marks)

HSO<sub>4</sub><sup>-</sup> never acts as a base since it is a conjugate of a strong acid ∴ HSO<sub>4</sub><sup>-</sup> undergoes cationic hydrolysis



assume  
0.50 - x = 0.50

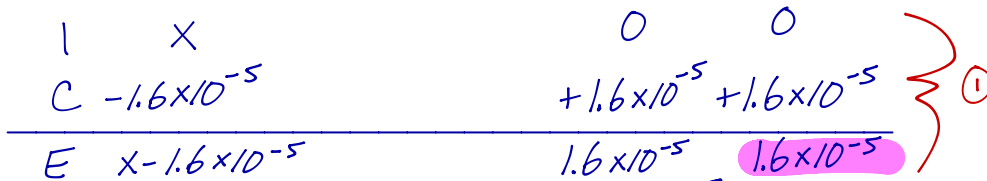
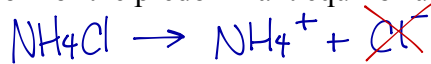
$$K_a = \frac{[\text{SO}_4^{2-}][\text{H}_3\text{O}^+]}{[\text{HSO}_4^-]}$$

$$1.2 \times 10^{-2} = \frac{x^2}{0.50}$$

$$x = 0.077 \text{ M}$$

$$\begin{aligned} \text{pH} &= -\log [\text{H}_3\text{O}^+] \\ &= -\log (0.077) \\ &= 1.11 \end{aligned}$$

14) Calculate the initial concentration of an NH<sub>4</sub>Cl salt solution that has a pH = 4.80. Begin by writing the equation for the predominant equilibrium reaction. (5 marks)



assume x - 1.6 × 10<sup>-5</sup> = x

[H<sub>3</sub>O<sup>+</sup>] = 10<sup>-pH</sup>  
= 10<sup>-4.80</sup>  
= 1.6 × 10<sup>-5</sup> M

$$K_a = \frac{[\text{NH}_3][\text{H}_3\text{O}^+]}{[\text{NH}_4^+]}$$

$$5.6 \times 10^{-10} = \frac{(1.6 \times 10^{-5})^2}{x}$$

$$x = 0.45 \text{ M}$$