

## Salt Hydrolysis Worksheet -

Name \_\_\_\_\_

### 1. Define the *hydrolysis of a salt*:

Hydrolysis occurs when the cation or anion of a salt react with water to form the conjugate base of the cation, which is the conjugate acid of a weak base, or the conjugate acid of the anion, which is the conjugate base of a weak acid.

### 2. Write dissociation equations for each of the following salts, state whether cation hydrolyzes, anion hydrolyzes and whether the salt solution is acidic, basic or neutral.



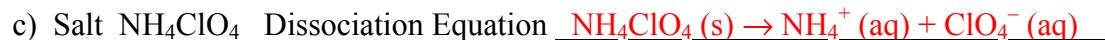
Cation (Acid or Neutral)  $\text{K}^+$ , neutral Anion (Base or Neutral)  $\text{CO}_3^{2-}$ , base

Is salt solution is acidic, basic or neutral? Basic



Cation (Acid or Neutral)  $\text{Al}^{3+}$ , acid Anion (Base or Neutral)  $\text{Br}^-$ , neutral

Is salt solution is acidic, basic or neutral? acidic



Cation (Acid or Neutral)  $\text{NH}_4^+$ , acid Anion (Base or Neutral)  $\text{ClO}_4^-$ , neutral

Is salt solution is acidic, basic or neutral? acidic



Cation (Acid or Neutral)  $\text{Cs}^+$ , neutral Anion (Base or Neutral)  $\text{NO}_3^-$ , neutral

Is salt solution is acidic, basic or neutral? neutral



Cation (Acid or Neutral)  $\text{Cr}^{3+}$ , acid Anion (Base or Neutral)  $\text{NO}_3^-$ , neutral

Is salt solution is acidic, basic or neutral? acidic

3. State whether each of the following substances are acidic, basic or neutral when mixed with water. (12 marks)

- a)  $\text{RbNO}_3$  neutral      b)  $\text{NH}_4\text{Br}$  acidic      c)  $\text{H}_2\text{SO}_4$  acidic  
 d)  $\text{KNO}_2$  basic      e)  $\text{NH}_4\text{NO}_3$  acidic      f)  $\text{NaOH}$  basic  
 g)  $\text{NH}_3$  basic      h)  $\text{LiCH}_3\text{COO}$  basic      i)  $\text{H}_3\text{PO}_4$  acidic  
 j)  $\text{CH}_3\text{COOH}$  acidic      k)  $\text{FeBr}_3$  acidic      l)  $\text{Ba}(\text{OH})_2$  basic

4. Find  $K_a$  and  $K_b$  of each of the following amphoteric anions and determine if they act as an acid or a base in water solution. (9 marks)

- a)  $\text{HPO}_4^{2-}$        $K_a = \underline{4.8 \times 10^{-13}}$        $K_b = \underline{1.61 \times 10^{-7}}$       A or B base  
 b)  $\text{HC}_6\text{H}_5\text{O}_7^{2-}$        $K_a = \underline{4.0 \times 10^{-6}}$        $K_b = \underline{5.6 \times 10^{-10}}$       A or B acid  
 c)  $\text{HSO}_4^-$        $K_a = \underline{1.02 \times 10^{-7}}$        $K_b = \underline{\approx 0}$       A or B acid

\*Note: to find  $K_b$ , calculate  $K_w/K_a$  for the conjugate acid

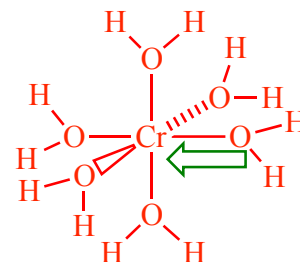
For  $\text{HPO}_4^{2-}$  :

$$K_b = \frac{1 \times 10^{-14}}{6.23 \times 10^{-8}} = 1.61 \times 10^{-7}$$

where  $6.23 \times 10^{-8}$  is the  $K_a$  for  $\text{H}_2\text{PO}_4^-$

5. Show the structure of the hexa-aquo-chromium ion and explain why it acts as an acid.

Structure: See diagram at right



Explanation: As the arrow indicates, the small, highly charged  $\text{Cr}^{3+}$  ion attracts electron density from the O-H on  $\text{H}_2\text{O}$ , making the bond more polar and the H easier for a base to remove.

6. Write the dissociation equations for each of the following. Look up/Determine the  $K_a$  for the cation and the  $K_b$  for the anion and state whether the salt makes solution acidic or basic in water.

a)  $(\text{NH}_4)_2\text{SO}_3 \rightarrow$

$$K_a (\text{cation}) = \underline{5.6 \times 10^{-10}} \quad K_b (\text{anion}) \underline{9.8 \times 10^{-8}}$$

Salt solution is basic

b)  $\text{Al}(\text{NO}_2)_3 \rightarrow$

$$K_a (\text{cation}) = \underline{1 \times 10^{-5}} \quad K_b (\text{anion}) \underline{2.5 \times 10^{-11}}$$

Salt solution is acidic

c)  $\text{FePO}_4 \rightarrow$

$$K_a (\text{cation}) = \underline{3.0 \times 10^{-3}} \quad K_b (\text{anion}) \underline{0.021}$$

Salt solution is basic