

Name \_\_\_\_\_ Block: \_\_\_\_\_ Date: \_\_\_\_\_

Chemistry 12  
**HYDROLYSIS**

KEY

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

a) Salt  $K_2CO_3$  Dissociation Equation  $K_2CO_3 \rightarrow 2K^+ + CO_3^{2-}$

Cation (Acid or Neutral) N Anion (Base or Neutral) B

Is salt acidic, basic or neutral? basic

b) Salt  $AlBr_3$  Dissociation Equation  $AlBr_3 \rightarrow Al^{3+} + 3Br^-$

Cation (Acid or Neutral) A Anion (Base or Neutral) N

Is salt acidic, basic or neutral? acidic

c) Salt  $NH_4ClO_4$  Dissociation Equation  $NH_4ClO_4 \rightarrow NH_4^+ + ClO_4^-$

Cation (Acid or Neutral) A Anion (Base or Neutral) N ↑ from strong acid

Is salt acidic, basic or neutral? acidic

d) Salt  $CsNO_3$  Dissociation Equation  $CsNO_3 \rightarrow Cs^+ + NO_3^-$

Cation (Acid or Neutral) N Anion (Base or Neutral) N

Is salt acidic, basic or neutral? neutral

e) Salt  $Cr(NO_3)_3$  Dissociation Equation  $Cr(NO_3)_3 \rightarrow Cr^{3+} + NO_3^-$

Cation (Acid or Neutral) A Anion (Base or Neutral) N

Is salt acidic, basic or neutral? acidic

2. State whether each of the following substances are acidic, basic or neutral when mixed with water.

a)  $RbNO_3$  N      b)  $NH_4Br$  A      c)  $H_2SO_4$  A

d)  $KNO_2$  B      e)  $NH_4NO_3$  A      f)  $NaOH$  C

g)  $NH_3$  B      h)  $LiCH_3COO$  B      i)  $H_3PO_4$  A

j)  $CH_3COOH$  A      k)  $FeBr_3$  A      l)  $Ba(OH)_2$  B

3. Of the following, circle the one with the **highest** pH:

a) i)  $\text{NH}_4^+$  ii) HF iii)  $\text{NH}_3$  iv)  $\text{CH}_3\text{COOH}$  v) HCl

b) i)  $\text{PO}_4^{3-}$  ii)  $\text{SO}_3^{2-}$  iii)  $\text{Al}^{3+}$  iv)  $\text{CH}_3\text{COO}^-$  v)  $\text{Cl}^-$

c) i) NaCl ii)  $\text{CrCl}_3$  iii)  $\text{NH}_4\text{I}$  iv)  $\text{CH}_3\text{COOH}$  v)  $\text{H}_2\text{S}$

4. Of the following, circle the one with the **lowest** pH:

a) i)  $\text{NH}_4^+$  ii) HF iii)  $\text{NH}_3$  iv)  $\text{CH}_3\text{COOH}$  v) HCl

b) i)  $\text{PO}_4^{3-}$  ii)  $\text{SO}_3^{2-}$  iii)  $\text{Al}^{3+}$  iv)  $\text{CH}_3\text{COO}^-$  v)  $\text{Cl}^-$

c) i) NaCl ii) KCN iii)  $\text{NH}_3$  iv)  $\text{Na}_2\text{CO}_3$  v)  $\text{Li}_2\text{C}_2\text{O}_4$

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

a)  $\text{HPO}_4^{2-}$        $K_a = 2.2 \times 10^{-13}$        $K_b = 1.6 \times 10^{-7}$       A or B base

b)  $\text{HC}_6\text{H}_5\text{O}_7^{2-}$        $K_a = 4.1 \times 10^{-7}$        $K_b = 5.9 \times 10^{-10}$       A or B acid

c)  $\text{HSO}_4^-$        $K_a = 1.2 \times 10^{-2}$        $K_b = \text{v. small}$       A or B acid

6. Write the dissociation equations for each of the following. Determine the  $K_a$  for the cation and the  $K_b$  for the anion and state whether the salt acts as an acid or a base in water.

a)  $(\text{NH}_4)_2\text{SO}_3 \rightarrow 2\text{NH}_4^+ + \text{SO}_3^{2-}$   
 $K_a$  (cation) =  $5.6 \times 10^{-10}$        $K_b$  (anion) =  $\frac{1 \times 10^{-14}}{1 \times 10^{-7}} = 1.0 \times 10^{-7}$

Salt is basic

b)  $\text{Al}(\text{NO}_2)_3 \rightarrow \text{Al}^{3+} + 3\text{NO}_2^-$   
 $K_a$  (cation) =  $1.4 \times 10^{-5}$        $K_b$  (anion) =  $\frac{1.0 \times 10^{-14}}{4.6 \times 10^{-4}} = 2.2 \times 10^{-11}$

Salt is acidic

c)  $\text{FePO}_4 \rightarrow \text{Fe}^{3+} + \text{PO}_4^{3-}$   
 $K_a$  (cation) =  $6.0 \times 10^{-3}$        $K_b$  (anion) =  $\frac{1 \times 10^{-14}}{2.2 \times 10^{-13}} = 4.5 \times 10^{-2}$

Salt is basic

7. Define **hydrolysis**. *the reaction of a salt (or ion) with water to produce  $H_3O^+$  or  $OH^-$*

8. Write the net ionic equation for the **predominant hydrolysis reaction** when each of the following salts is dissolved in water. For some questions, calculations may be needed.



9. Use a hydrolysis equation to explain why phosphates ( $PO_4^{3-}$ ) are used as cleaning agents.



Explanation:  $OH^-$  (base) is produced  
 $\Rightarrow$  dissolves grease & proteins  
base + fat  $\rightarrow$  soap + glycerol