

Chemistry 12
Worksheet 4-5
Hydrolysis

70

Name KEY

Due Date _____

Correct and Hand In by _____

This worksheet covers material from class notes and Student Workbook pages 144-148

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. (20 marks)

- 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)
 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 $Cr(NO_3)_3 \rightarrow Cr^{3+} + 3NO_3^-$
 Cation (Acid or Neutral) (A) Anion (Base or Neutral) (N)
 Is salt acidic, basic or neutral? Acidic

20 20

KEY

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

- a) RbNO_3 N b) NH_4Br A c) H_2SO_4 A
 d) KNO_2 B e) NH_4NO_3 A f) NaOH B
 g) NH_3 B h) LiCH_3COO B i) H_3PO_4 A
 j) CH_3COOH A k) FeBr_3 A l) $\text{Ba}(\text{OH})_2$ B

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

- a) i) NH_4^+ ii) HF iii) NH_3 iv) CH_3COOH v) HCl
 b) i) PO_4^{3-} ii) SO_3^{2-} iii) Al^{3+} iv) CH_3COO^- v) Cl^-
 c) i) NaCl ii) CrCl_3 iii) NH_4I iv) CH_3COOH v) H_2S

4. Of the following, circle the one with the **lowest** pH: (3 marks)

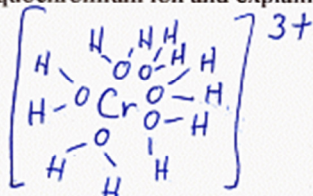
- a) i) NH_4^+ ii) HF iii) NH_3 iv) CH_3COOH v) HCl
 b) i) PO_4^{3-} ii) SO_3^{2-} iii) Al^{3+} iv) CH_3COO^- v) Cl^-
 c) i) NaCl ii) KCN iii) NH_3 iv) Na_2CO_3 v) $\text{Li}_2\text{C}_2\text{O}_4$

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) HPO_4^{2-} $K_a = 2.2 \times 10^{-13}$ $K_b = 1.6 \times 10^{-7}$ A or B (B)
 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 (A)
 c) HSO_4^- $K_a = 1.2 \times 10^{-2}$ $K_b = \text{v. small}$ A or B (A)

6. Show the structure of the hexaquo chromium ion and explain why it acts as an acid.

Structure: (1 mark)

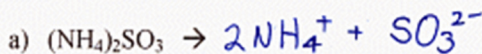


Explanation: (1 mark)

$\frac{29}{29}$

It will release a proton (H) from one of the "H₂O" groups and therefore act as an acid.

7. 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. (12 marks)



$$K_a(\text{cation}) = \frac{5.6 \times 10^{-10}}{1.0 \times 10^{-7}} \quad K_b(\text{anion}) = \frac{1.0 \times 10^{-14}}{1.0 \times 10^{-7}} = 1.0 \times 10^{-7}$$

Salt is Basic



$$K_a(\text{cation}) = \frac{1.4 \times 10^{-5}}{4.6 \times 10^{-4}} \quad K_b(\text{anion}) = \frac{1.0 \times 10^{-14}}{4.6 \times 10^{-4}} = 2.2 \times 10^{-11}$$

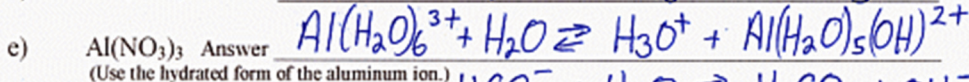
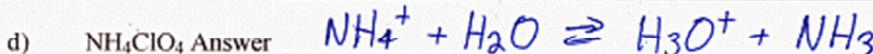
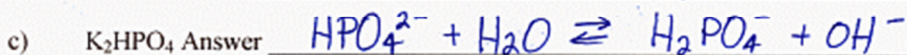
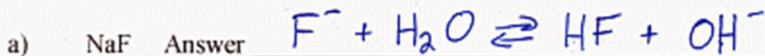
Salt is Acidic



$$K_a(\text{cation}) = \frac{6.0 \times 10^{-3}}{2.2 \times 10^{-13}} \quad K_b(\text{anion}) = \frac{1.0 \times 10^{-14}}{2.2 \times 10^{-13}} = 4.5 \times 10^{-2}$$

Salt is Basic

8. Define **hydrolysis**. (1 mark) the reaction of a salt (or ion) with water to produce H_3O^+ or OH^-
9. 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. (6 marks)



10. Use a hydrolysis equation to explain why phosphates (PO_4^{3-}) are used as cleaning agents. (2 marks)



Explanation: OH^- (base) is produced. This dissolves grease and proteins. (base + fat \rightarrow soap + glycerol)