Chemistry 12
Worksheet 4-5
Hydrolysis

Name KEY

Due Date _____

Correct and Hand In by _____

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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)

(12)

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) $Ba(OH)_2$ B

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

(3)

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)

(3)

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) $Li_2C_2O_4$

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

(9)

a) HPO_4^{2-} Ka = 2.2×10^{-13} Kb = 1.6×10^{-7} A or B (B)

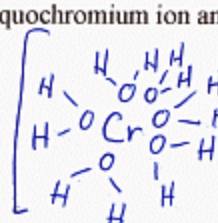
b) $HC_6H_5O_7^{2-}$ Ka = 4.1×10^{-7} Kb = 5.9×10^{-10} A or B (A)

c) HSO_4^- Ka = 1.2×10^{-2} Kb = V. small A or B (A)

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

(2)

Structure: (1 mark)



Explanation: (1 mark)

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It will release a proton (H) from one of the "H_2O" groups and therefore act as an acid.

7. Write the dissociation equations for each of the following. Determine the Ka for the cation and the Kb for the anion and state whether the salt acts as an acid or a base in water. (12 marks)

a) $(NH_4)_2SO_3$ → $2NH_4^+ + SO_3^{2-}$

Ka (cation) = 5.6×10^{-10} Kb (anion) $\frac{1.0\times10^{-14}}{1.0\times10^{-7}}$ = 1.0×10^{-7}

Salt is Basic

b) $Al(NO_2)_3$ → $Al^{3+} + 3NO_2^-$

Ka (cation) = 1.4×10^{-5} Kb (anion) $\frac{1.0\times10^{-14}}{4.6\times10^{-4}}$ = 2.2×10^{-11}

Salt is Acidic

c) $FePO_4$ → $Fe^{3+} + PO_4^{3-}$

Ka (cation) = 6.0×10^{-3} Kb (anion) $\frac{1.0\times10^{-14}}{2.2\times10^{-13}}$ = 4.5×10^{-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)

a) NaF Answer $F^- + H_2O \rightleftarrows HF + OH^-$

b) KNO_2 Answer $NO_2^- + H_2O \rightleftarrows HNO_2 + OH^-$

c) K_2HPO_4 Answer $HPO_4^{2-} + H_2O \rightleftarrows H_2PO_4^- + OH^-$

d) NH_4ClO_4 Answer $NH_4^+ + H_2O \rightleftarrows H_3O^+ + NH_3$

e) $Al(NO_3)_3$ Answer $Al(H_2O)_6^{3+} + H_2O \rightleftarrows H_3O^+ + Al(H_2O)_5(OH)^{2+}$
(Use the hydrated form of the aluminum ion.)

f) $LiHCO_3$ Answer $HCO_3^- + H_2O \rightleftarrows H_2CO_3 + OH^-$

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

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Equation: $PO_4^{3-} + H_2O \rightleftarrows HPO_4^{2-} + OH^-$ ($K_b = 4.5\times10^{-2}$)

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