IV.13 Hydrolysis

You will be able to:

- Write a dissociation equation for a salt in water
- Write net ionic equations representing the hydrolysis of ions in solution
- Predict whether a salt solution would be acidic, basic, or neutral (compare Ka and Kb values, when necessary)
- Determine whether an amphiprotic ion will act as an acid or base in solution (compare Ka and Kb values)
- Calculate the pH of a salt solution from relevant data, assuming that the predominant hydrolysis reaction is the only reaction determining the pH

HYDROLYSIS is _____

_____

Only the reactions between ions and water will be considered in this section. Yes, there may be reactions between the ions, but we are not looking at that for the moment.

Net Ionic Equation for hydrolysis: _____

SPECTATOR IONS: *Which ions DON'T react with water?*

Spectator **CATIONS** (look on periodic table)

Group 1 (Alkali Metal ions) eg. Li^+, Na^+, K^+, Rb^+, Cs^+, Fr^+
Group 2 (Alkaline Earth ions) eg. Be^+, Mg^{2+}, Ca^{2+}, Ba^{2+}, Sr^{2+}, Ra^{2+}

Spectator **ANIONS** (look on acid table)

- Conjugate bases of strong acids.
- **Top 5 ions on the right** side of table.
- ClO_4^- I^- Br^- Cl^- NO_3^-
  *(HSO_4^- is not a spectator – it is **amphiprotic** – will be dealt with later)*

Example 26: Write the net-ionic equation for the hydrolysis taking place in aqueous magnesium sulphate.

Step 1: Write the dissociation equation for the salt.	
Step 2: Determine any spectators.	
Step 3: Write acid-base reaction.	

WILL A SALT ACT AS AN ACID OR BASE IN WATER?

> Process – if given **SALT** (DISSOCIATE → ELIMINATE → EVALUATE)
>
> 1. Write **dissociation** equation
> 2. Eliminate **spectators**
> 3. Remaining ions   → **left** side of table – undergo **acid** hydrolysis is –produce H_3O^+
>   → **right** side of table – undergo **base** hydrolysis – produce OH
>   → **amphiprotic** – determine K_a and K_b to find *dominant hydrolysis.* (greater value = dominant hydrolysis)

If both ions in the salt are SPECTATORS, the solution will be _____.

- **Ex: KBr, NaCl, Ca(NO₃)₂, etc.**
- Dissociation equation: _____
- No ions will react with water, therefore _____.

Example 27: Is the salt Fe(H₂O)₆I₃ acidic, basic or neutral in aqueous solution?

Step 1: Write the dissociation equation for the salt.	
Step 2: Eliminate spectators.	
Step 3: Compare Ka and Kb values. The greater value will determine whether salt acts as acidic, basic, or neutral.	

Hydrolysis when there is an *AMPHIPROTIC* ion :

Example 28: Is the salt LiHCO₃ acidic, basic or neutral in aqueous solution?

Step 1: Write the dissociation equation for the salt.	
Step 2: Eliminate spectators.	
Step 3: For the AMPHIPROTIC ion, determine whether ion preferentially acts as acid or base. Compare Ka and Kb values.	

SUMMARY:

Hydrolysis When *BOTH* Cation and Anion hydrolyze:

Example 29: Determine whether the salt NH$_4$CN (ammonium cyanide) is acidic, basic or neutral.

Step 1: Write the dissociation equation for the salt	
Step 2: Determine which ion is the acid and which is the base. Find the Ka and Kb values for each ion.	
Step 3: Compare Ka and Kb values.	

SUMMARY:

Do Hebden set 30: Read examples on pp145-147.
Do p. 148 #69acegi, 70acegi, 73

PUTTING IT ALL TOGETHER

Calculate the pH of a 0.24 M solution of the salt aluminum nitrate. Show all your steps. State any assumptions used.