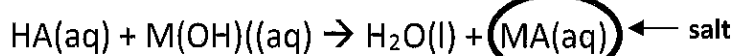


Feeling Salty? Acid-Base Properties of Salts

Any salt can be written as the product of an acid-base neutralization rxn.



Salts are NOT always neutral! Some salts hydrolyze water to produce aqueous solutions with pHs other than 7.00.

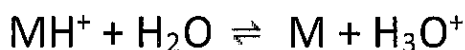
To determine if and how a salt will affect the pH of a solution, you must determine whether or not the salt ions will hydrolyze (Split) water to any significant extent.

Hydrolysis reaction of the conjugate base of the weak acid **HA**:



OH^- produced = alkaline solution: $\text{pH} > 7$

Hydrolysis reaction of the conjugate acid of the weak base **M**:



H^+ produced = acidic solution: $\text{pH} < 7$

How to Tell if an Ion will Hydrolyze Water

1. If given an anion (-),
 - a. Add 1 H⁺
 - b. Ask: is this conjugate acid a strong acid or weak acid?
 - i. Conjugate = strong acid? No water hydrolysis
 - ii. Conjugate = weak acid? Yes water hydrolysis
2. If given a cation (+),
 - a. Add OH⁻'s (as many as needed), unless NH_4^+ ! Its conjugate base = NH_3
 - b. Ask: is this conjugate base a strong base or weak base?
 - i. Conjugate = strong base? No water hydrolysis
 - ii. Conjugate = weak base? Yes water hydrolysis

Let's Practice!

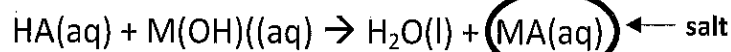
1. Will HCO_3^- hydrolyze water? Yes! H_2CO_3 is a weak acid.

$$\text{HCO}_3^-(\text{aq}) + \text{H}_2\text{O}(\text{e}) \rightleftharpoons \text{H}_2\text{CO}_3(\text{aq}) + \text{OH}^-(\text{aq}) \left. \vphantom{\text{HCO}_3^-(\text{aq})} \right] \text{basic sol'n}$$
2. Will NH_4^+ hydrolyze water? Yes! NH_3 is a weak base.

$$\text{NH}_4^+(\text{aq}) + \text{H}_2\text{O}(\text{e}) \rightleftharpoons \text{NH}_3(\text{aq}) + \text{H}_3\text{O}^+(\text{aq}) \left. \vphantom{\text{NH}_4^+(\text{aq})} \right] \text{acidic sol'n}$$
3. Will NO_3^- hydrolyze water?
Nope! HNO_3 is a strong acid.

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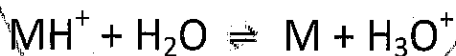
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(as many as needed)
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 - Conjugate = strong base? No water hydrolysis
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Let's Practice! Write hydrolysis rxn:

- Will HCO_3^- hydrolyze water? Yes! H_2CO_3 is a weak acid:

$$\text{HCO}_3^-(\text{aq}) + \text{H}_2\text{O}(\text{l}) \rightleftharpoons \text{H}_2\text{CO}_3(\text{aq}) + \text{OH}^-(\text{aq}) \quad \left. \vphantom{\text{HCO}_3^-(\text{aq})} \right] \text{basic sol'n!}$$
- Will NH_4^+ hydrolyze water? Yes! NH_3 is a weak base:

$$\text{NH}_4^+(\text{aq}) + \text{H}_2\text{O}(\text{l}) \rightleftharpoons \text{NH}_3(\text{aq}) + \text{H}_3\text{O}^+(\text{aq}) \quad \left. \vphantom{\text{NH}_4^+(\text{aq})} \right] \text{acidic sol'n!}$$
- Will NO_3^- hydrolyze water? Nope! HNO_3 is a strong acid.

Feeling Salty? How to recognize a salt

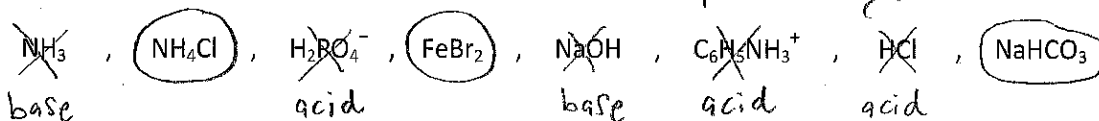
Remember, in chemistry, salts are neutral ionic compounds (not acids or bases, although an acid or base can be made into a salt ☺).

→ Look for the presence of commonly soluble cations (like alkali metal cations, especially Na^+) and commonly soluble anions (like halogen anions, especially Cl^-).

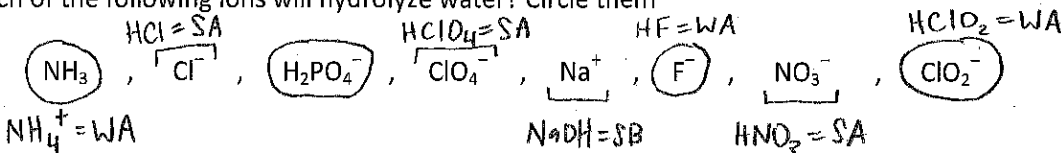
$\left. \begin{array}{l} \text{SA} + \text{SB} = \text{neutral salt} \\ \text{SA} + \text{WB} = \text{acidic salt} \\ \text{WA} + \text{SB} = \text{basic salt} \end{array} \right\} \rightarrow \text{Strong wins!}$

More Practice!

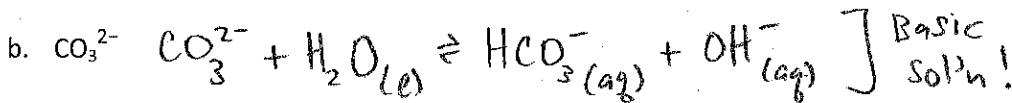
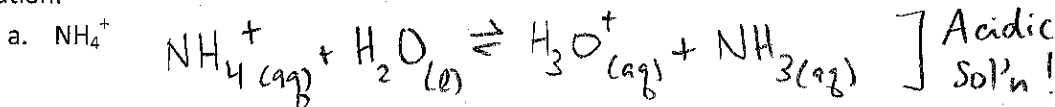
1. Which of the following are salts? Circle them.



2. Which of the following ions will hydrolyze water? Circle them



3. Write the hydrolysis reaction for each of the following ions, and determine if it will produce an acidic or basic solution:



4. Determine if the solution formed from each salt below is acidic, basic, or neutral. ⇒ Strong wins!

