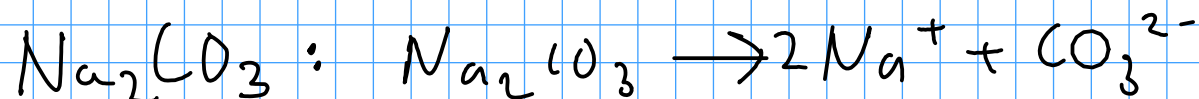


SALTS

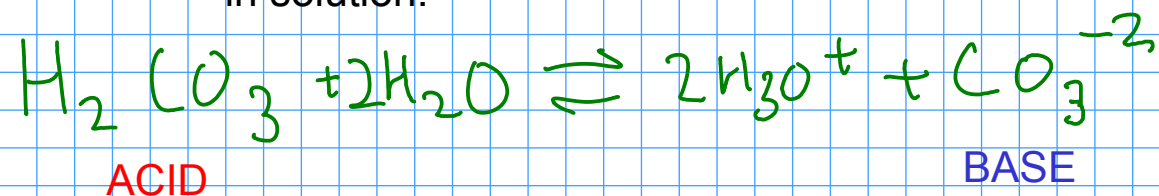
- Compounds that result from the reaction of an acid and a base.
- Salts are strong electrolytes (completely dissociate in water) IF SOLUBLE (not all salts dissolve appreciably).
- Most ionic compounds are considered salts (they can be made by some reaction between the appropriate acid and base)
- Salts have acidic and basic properties! The ions that form when salts are dissolved can be acidic, basic, or neutral.
 - Salts made from WEAK ACIDS tend to form BASIC solutions
 - Salts made from WEAK BASES tend to form ACIDIC solutions



Do any of these ions have acidic or basic properties?

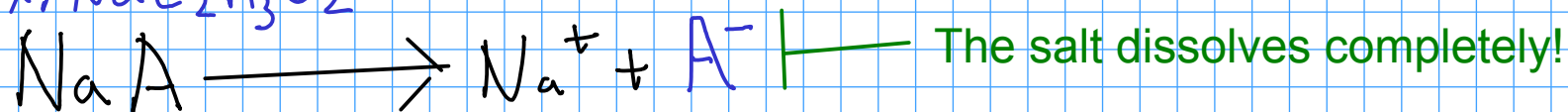
Na^+ : neutral. Not a proton donor or a proton acceptor

CO_3^{2-} : BASIC, since it can accept protons to form the weak acid CARBONIC ACID in solution.

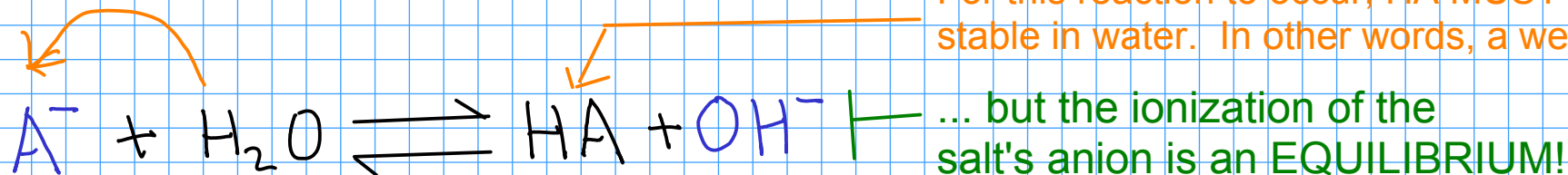


SALT OF A WEAK ACID

ex: $\text{NaC}_2\text{H}_3\text{O}_2$



For this reaction to occur, HA MUST be stable in water. In other words, a weak acid.



The anion is a BASE. It can accept a proton from water to form the weak (therefore stable as a molecule!) acid HA

$$K_b = \frac{[\text{HA}][\text{OH}^-]}{[\text{A}^-]} \quad \left| \text{--- This is the base ionization constant for } \bar{\text{A}} \right.$$

Since $\bar{\text{A}}$ and HA are a conjugate pair, the ionization constants are related!

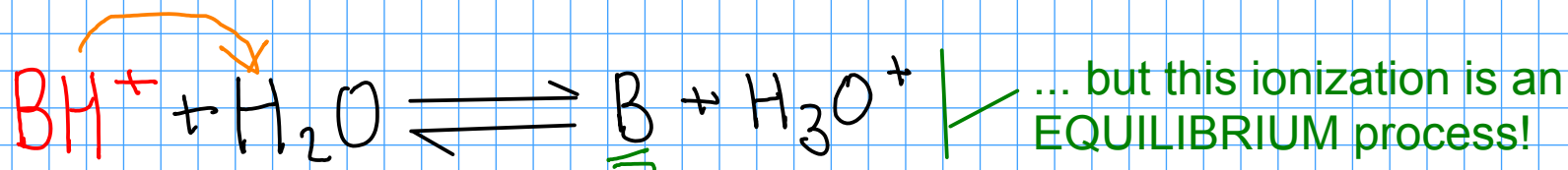
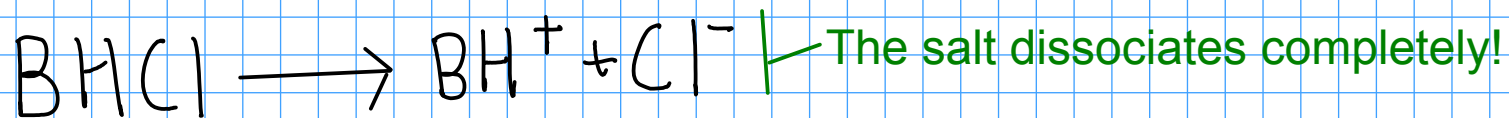
$$K_w = (K_{a,\text{HA}})(K_{b,\bar{\text{A}}}) \quad \left| \text{---} \right.$$

1.0×10^{-14}

You will generally not find both the K_a AND K_b for a conjugate pair in the literature, since one can be easily converted to the other!

ex: NH_4Cl

SALT OF A WEAK BASE



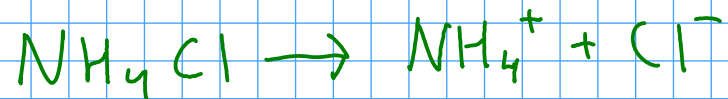
$$K_a = \frac{[\text{B}][\text{H}_3\text{O}^+]}{[\text{BH}^+]} \quad \left| \text{Acid ionization constant for } \text{BH}^+ \right.$$

$$K_w = (K_{a, \text{BH}^+})(K_{b, \text{B}})$$

1.0×10^{-14}

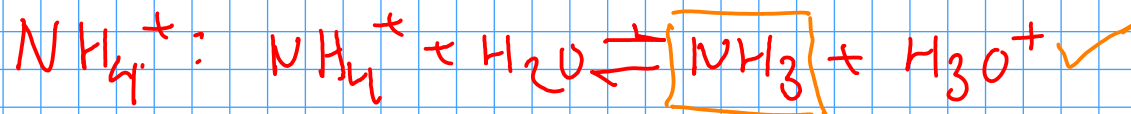
Find the pH for salt solutions just like you would find pH for any other weak acid or weak base solutions. Only trick is to find out whether the salt is actually acidic or basic!

0.100 M NH_4Cl ... Find the pH of the solution



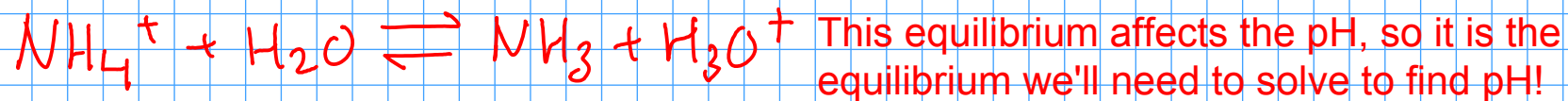
Acidic, basic, or neutral salt?

This is the WEAK BASE ammonia. Stable
✓ in water.



This is a STRONG ACID, which does not
exist as a stable molecule in water.

The conjugate of a strong acid or
base is NEUTRAL - does not
affect pH!





$$K_a = \frac{[\text{NH}_3][\text{H}_3\text{O}^+]}{[\text{NH}_4^+]} = 5.56 \times 10^{-10}$$

Where do we get this K_a ?

$$K_{b, \text{NH}_3} = 1.8 \times 10^{-5}$$

$$K_a \times K_b = 1.0 \times 10^{-14}$$

| | initial | Δ | equilibrium |
|--------------------------|---------|----------|-------------|
| $[\text{NH}_3]$ | 0 | +X | X |
| $[\text{H}_3\text{O}^+]$ | 0 | +X | X |
| $[\text{NH}_4^+]$ | .100 | -X | .100 - X |

Define "x" to be the amount of ammonium ion that reacts!

$$\frac{x^2}{.100 - x} = 5.56 \times 10^{-10}$$

$$x \ll .100$$

$$\frac{x^2}{.100} = 5.56 \times 10^{-10}$$

$$x = 7.45 \times 10^{-6}$$

$$7.45 \times 10^{-6} = [\text{H}_3\text{O}^+]$$

Compare to:

pH = 1.00 for 0.100 M strong acid

pH = 2.16 for 0.100 M nitrous acid

$$5.13 = \text{pH}$$