Bases

Strong bases are substances that completely dissociate, as with acids doing strong base calculation are trivial. Weak bases because they are equilibrium conditions are a different story.

As with acids we define a standard form of the base reacting with water to produce hydroxide and use that equilibrium to measure base strength.

$$B_{(aq)} + H_2O_{(l)} \iff BH^+{}_{(aq)} + OH^-{}_{(aq)} \qquad K_b = \frac{[BH^+][OH^-]}{[B]}$$

Calculate the pH for a 15.0M solution of ammonia(Kb=1.8e-5).

$$NH_{3(aq)} + H_2O_{(l)} \iff NH_4^+{}_{(aq)} + OH^-{}_{(aq)}$$

$$K_b = 1.8 \cdot 10^{-5} = \frac{[NH_4^+][OH^-]}{[NH_3]} = \frac{(x)(x)}{15.0 - x} \approx \frac{x^2}{15.0} \qquad x \approx 1.6 \cdot 10^{-2} = [OH^-]$$

$$pOH = 1.80 \qquad pH = 14 - pOH = 12.2$$

Acid Base Properties of Salts

Salts are the simply another name for ionic compounds. Since many salts are the by conjugates of acids and bases they may have an impact on the pH of a solution.

There are three cases for salts:

Salts that are the conjugates of strong acids and strong bases have no effect on the pH of a solution.	NaCl
Salts that are the conjugates of a weak acid and a strong base will produce basic solutions.	NaF
Salts that are the conjugates of a strong acid and a weak base will produce acidic solutions.	NH_4Cl

We can use appropriate Ka or Kb values and ICE diagrams to calculate the pH of each solution.

K_a, K_b, and K_w

We need to be able to find K_a from K_b or vice versa. To do that we need to see how they are related.

$$K_a = \frac{[H^+][A^-]}{[HA]} \qquad K_b = \frac{[HA][OH^-]}{[A^-]}$$

$$K_a \cdot K_b = \frac{[H^+][A^-]}{[HA]} \cdot \frac{[HA][OH^-]}{[A^-]}$$

$$K_a \cdot K_b = [H^+][OH^-] = K_w$$

Ex: