

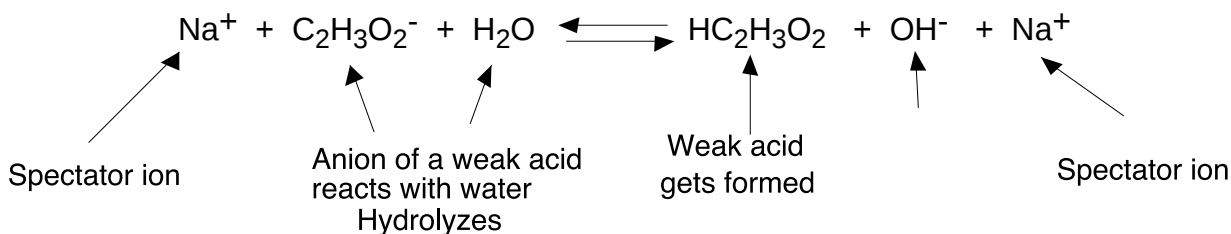
The Common Ion Effect

The common ion effect is just that for weak acids and bases you have to keep track if there is another source (some salt) of the acid-anion or the base's conjugate acid. Like if there was sodium acetate in a solution that you are adding acetic acid to. Whatever the case just be careful to use the total concentration for the ions (that from the acid/base and that from the salt) in your K_a and K_b . Common ions change how much acid will dissociate and thus how much H^+ or OH^- is formed and thus the solution pH.

Salt Solutions

Now there is another way that solutions can become acidic or basic. By another way, I mean by not just dumping in an acid or a base. It comes from the equilibrium of weak acids and bases. If you put a salt into H_2O and it breaks up, the ions of the salt can react with H_2O to form a weak acid or a weak base. The tricky part to keep track of here is that if you put in an ion that forms a weak acid the solution actually becomes basic:

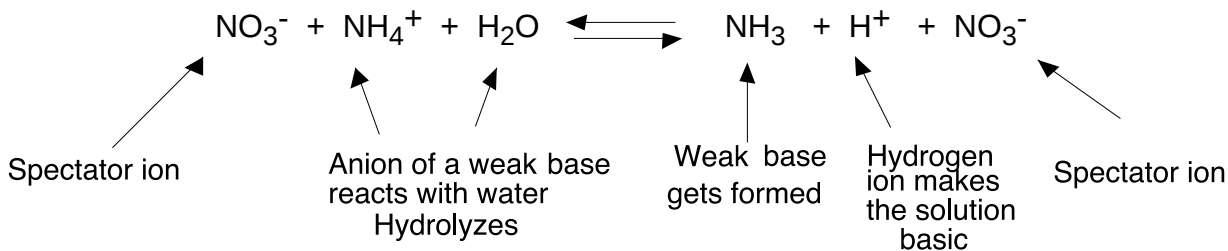
For example: Say we drop some sodium acetate, $NaC_2H_3O_2$, into water



So if you put a salt that has **the anion of a weak acid** and **the cation of a strong base** into solution you **form the weak acid and the solution is basic**.

Similarly, if you put in a salt that has a **cation from a weak base** and an **anion from a strong acid** you **form the weak base and the solution is acidic**.

For example: Say we drop some ammonium nitrate into water



Strictly speaking H^+ should always be written as H_3O^+ that's supposedly how it exists in water. But it's a pain in the butt to write out so I as well as many others still write H^+ and know that it's really H_3O^+ .

- Sometimes you can put in a salt that forms both a weak acid and a weak base (NH_4CN) in this case the weakest acid/base formed (smallest K_a or K_b) wins out and the solution will be acidic or basic accordingly.
- If the salt ions correspond to strong acids/bases then nothing hydrolyzes and the solution pH remains the same. That's like adding table salt to water. You aren't going to form any HCl or $NaOH$.

Student Packet: 6.5: Common Ion Effect: AssessMe questions

- 1) What will be the effect of adding a solution of NaCl to a saturated solution of CsCl?
- A) No effect.
B) The solubility of CsCl will be increased.
C) The solubility of CsCl will be decreased.
D) The NaCl will not dissolve.
E) I'm clueless
- 2) Which salt solution will exhibit the largest common ion effect upon addition of a NaCl solution?
- A) NaCl B) CsCl C) MgCl₂ D) NaClO₄ E) I'm clueless
- 3) The solubility product of CaF₂ is 4.3×10^{-11} . What is the molar solubility of CaF₂ in a 0.050 M solution of Ca(NO₃)₂?
- A) 2.2×10^{-4} M B) 1.0×10^{-5} M
C) 1.5×10^{-5} M D) 8.4×10^{-10} M E) I'm clueless
- 4) Silver oxalate Ag₂(C₂O₄) is dissolved in pure water. The concentration of Ag⁺ ions in a saturated solution is 2.2×10^{-4} M. What is the K_{sp} of Ag₂(C₂O₄)?
- A) 5.3×10^{-12} B) 1.1×10^{-12}
C) 5.0×10^{-8} D) 2.4×10^{-8} E) I'm clueless
- 5) A 0.30 M solution of a weak acid (HA) has an [H⁺] of 1.66×10^{-4} M. What is the K_a of this weak acid?
- A) 4.8×10^1 B) 5.5×10^{-4} C) 1.2×10^8 D) 9.2×10^{-8} E) I'm clueless
- 6) An aqueous solution of which of the following compounds will turn blue litmus red?
- A) K₂CO₃ B) NH₄Cl C) NaOH D) NaCl E) I'm clueless

Student Packet: 6.5: Common Ion Effect: ShowMe questions

- 1) For the fluoride ion F^- , $K_b = 1.4 \times 10^{-11}$
- What is the K_a of HF?
 - What is the pH of 1.0 L of a 0.300 M solution of HF?
 - What is the pH of the solution from part (b) if 0.10 mol NaF is added? (assume no volume change)
- 2) Classify each of the following as either an acid, base, acidic salt, basic salt, or neutral salt:
- $NaNO_2$
 - H_3PO_4
 - CH_3NH_2
 - NH_4Br
 - SrF_2
- 3) Determine the pH of a solution in which 1.00 mol H_2CO_3 ($K_a = 4.2 \times 10^{-7}$) and 1.00 mole $NaHCO_3$ are dissolved in enough water to form 1.0 L solution.
- 4) If 40.0 mL of 1.00 M CH_3COOH are added to 50.0 mL of 2.25 M CH_3COONa , what will be the final concentration of Na^+ , acetate ion, H^+ , CH_3COOH , and OH^- in the solution? ($K_a = 1.8 \times 10^{-5}$)

Student Packet: 6.5: Common Ion Effect: TestMe questions

- 1) What is the pH of a solution made by dissolving 3.0 g of NaCH_3COO into 200.0 mL of water?
 K_a of $\text{CH}_3\text{COOH} = 1.8 \times 10^{-5}$
- A) 4.5 B) 9.5 C) 2.2 D) 11.8 E) None of the above
- 2) What is the pH of a 400.0 mL solution of 0.10 M HClO_3 ($K_a = 1.0 \times 10^{-2}$) to which 50.0 g of NaClO_3 is added?
- A) 11.3 B) 10.9 C) 4.2 D) 3.07 E) 2.67
- 3) The acid HX has an ionization constant of 1×10^{-4} . A solution is 0.1 M in HX and 1 M in the salt NaX. What is a close approximation of the hydrogen ion concentration?
- A) 1×10^{-3} M
B) 2×10^{-3} M
C) 1×10^{-5} M
D) 3×10^{-5} M
E) 1×10^{-8} M
- 4) What is the acetate ion concentration and pH of a solution that is 0.070 M in acetic acid ($K_a = 1.8 \times 10^{-5}$) and 0.090 M in HCl?
- A) $[\text{CH}_3\text{COO}^-] = 2.3 \times 10^{-5}$, pH = 1.15
B) $[\text{CH}_3\text{COO}^-] = 1.4 \times 10^{-5}$, pH = 1.15
C) $[\text{CH}_3\text{COO}^-] = 1.4 \times 10^{-5}$, pH = 1.05
D) $[\text{CH}_3\text{COO}^-] = 2.7 \times 10^{-5}$, pH = 2.95
E) $[\text{CH}_3\text{COO}^-] = 2.3 \times 10^{-5}$, pH = 2.95
- 5) What is the pH of a 500 mL solution containing 0.20 mol NH_2CH_3 ($K_b = 4.4 \times 10^{-4}$), 0.10 mol $\text{NH}_3\text{CH}_3\text{Cl}$, and 0.050 mol NaOH?
- A) 2.66 B) 4.06 C) 9.94 D) 11.35 E) 11.57