

# AP CHEMISTRY CHEAT SHEET

## Unit 8 : ACIDS & BASES

### Quick Overview

- **Focus:** acid–base definitions, pH and pOH,  $K_a$  and  $K_b$ , buffers, titrations, and equilibrium reasoning.
- **Exam Lens:** identify acid/base type → calculate pH → compare strength → justify equilibrium shifts.

### What Is an Acid or Base

#### Arrhenius:

- Acid produces  $H^+$  in water
- Base produces  $OH^-$  in water

#### Brønsted–Lowry:

- Acid = proton donor
- Base = proton acceptor

#### Conjugate pairs:

- Acid → conjugate base
- Base → conjugate acid

**Key rule:** Stronger acid → weaker conjugate base.

### Strong vs Weak Acids and Bases

#### Strong acids (memorize):

HCl, HBr, HI,  $HNO_3$ ,  $H_2SO_4$ ,  $HClO_4$

#### Strong bases:

Group 1 hydroxides,  $Ca(OH)_2$ ,  $Sr(OH)_2$ ,  $Ba(OH)_2$

- Strong acids/bases fully dissociate.
- Weak acids/bases partially dissociate and establish equilibrium.

### pH, pOH, and $K_w$

$$pH = -\log[H^+]$$

$$pOH = -\log[OH^-]$$

$$K_w = [H^+][OH^-] = 1.0 \times 10^{-14}$$

$$pH + pOH = 14$$

- $pH < 7$  → acidic
- $pH = 7$  → neutral
- $pH > 7$  → basic

### Acid and Base Strength

#### Mini formula box

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

- Larger  $K_a$  or  $K_b$  → stronger acid or base.
- $K_a \times K_b = K_w$  for conjugate pairs.

### pH of Strong Acids and Bases

- Strong acids:  $[H^+] =$  acid concentration.
- Strong bases:  $[OH^-] =$  base concentration  $\times$  number of  $OH^-$ .

Convert to pH or pOH using logarithms.

### pH of Weak Acids and Bases

Use ICE tables.

#### For weak acids:



- Assume initial  $[H^+] \approx 0$ .
- Use  $K_a$  to solve for  $[H^+]$ .
- If  $K_a$  is very small,  $x$  is often negligible (justify).

### Buffers

A buffer resists pH change when small amounts of acid or base are added.

Components:

- Weak acid + conjugate base
- Weak base + conjugate acid

#### Mini formula box

$$\text{Henderson–Hasselbalch:}$$
$$pH = pK_a + \log\left(\frac{[A^-]}{[HA]}\right)$$

### Titration

Used to determine unknown concentration.

#### Key points:

- **Equivalence point:** moles acid = moles base (stoichiometric).
- **Endpoint:** indicator color change.
- Strong acid–strong base →  $pH = 7$  at equivalence.
- Weak acid–strong base →  $pH > 7$  at equivalence.

Use mole ratios, not just  $M_1V_1 = M_2V_2$  unless coefficients are 1:1.

### Acid–Base Equilibria & $K$

- Weak acids and bases establish equilibrium.
- ICE tables commonly required.
- Larger  $K_a$  → equilibrium lies further toward products.

### Polyprotic Acids

- Donate more than one proton ( $H_2SO_4$ ,  $H_3PO_4$ ).
- Each dissociation has its own  $K_a$ .
- First dissociation dominates pH.

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