

Crack the DAT

Crack Notes [General Chem 6] Acids & Bases

Definitions

Arrhenius acid: H^+ donor

Arrhenius base: OH^- donor

Bronsted-Lowry acid: H^+ donor

Bronsted-Lowry base: H^+ acceptor

Lewis acid: electron pair acceptor

Lewis base: electron pair donor

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

Conjugate acid: a base that has lost an OH^- or gained an H^+

Conjugate base: an acid that has gained an OH^- or lost an H^+

Weak acids have strong conjugate bases, strong acids have weak conjugate bases

Amphoteric: a substance that can act both as an acid and a base i.e. water

Polyprotic: an acid that can donate more than one proton

Diprotic: an acid that can donate two protons

Acid Strength

Strong acid: one that completely dissociates in water

Weak acid: one that doesn't completely dissociate in water

Stronger acids can stabilize a negative charge better: larger molecule or more oxygens

Strong Acids

HI, HBr, **HCl**, **HNO₃**, HClO₄, HClO₃, **H₂SO₄**

Strong Bases

NaOH, **KOH**, NH_2^- , H^- , $Ca(OH)_2$, Na₂O, CaO

Equilibrium Constant

$K_w = [H^+][OH^-] = 10^{-14}$ for reaction $H_2O + H_2O \rightarrow H_3O^+ + OH^-$

$pH + pOH = pK_w = 14$

$K_a = \frac{[H^+][A^-]}{[HA]}$ for reaction $HA + OH^- \rightarrow A^- + H_2O$

$K_b = \frac{[OH^-][HA]}{[A^-]}$ for reaction $A^- + H_2O \rightarrow HA + OH^-$

$K_a K_b = K_w$, $pK_a + pK_b = pK_w = 14$

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How to Find pH?

For weak acids, there's a K_a

If you start out with n molar acid, you can write the equilibrium:

$$K_a = \frac{[H^+][A^-]}{[HA]} = \frac{[x][x]}{[n-x]} \approx \frac{[x][x]}{[n]}, \text{ then solve for } x$$

If you have salts, they can change the pH by the common ion effect.

Titration

Mixing an acid and a base drop by drop

Equivalence point: equal concentrations of acid, base = usually vertical

Half-equivalence point: half of acid neutralized by base (or vice versa) = usually horizontal

Buffer point: at half equivalence point, changes in added base/acid doesn't change pH

Titration curves:

Strong acid + strong base: one equivalence point usually around pH 7

Weak acid + strong base: half equivalence point (buffer), then equivalence point above pH 7

Henderson-Hasselbach Equation: $pH = pK_a + \log \frac{[A^-]}{[HA]}$

At the half equivalence point, $pH = pK_a$

Indicators

Change color at a specific pH called the *end point*

Polyprotic Titration

Half equivalence point #1 -> Equivalence point #1 -> HEP #2 -> EP #2 etc.