Charge Balance -The sum of positive charges equals the sum of negative charges in solution (Electroneutrality).

The right-hand side of the equation should be roughly equal to the left-hand side.

Protons and hydroxide ions are always present due to the dissociation of water:

The concentration of *either* protons or hydroxide ions can usually be neglected because their concentrations are small relative to the other components of the charge balance.

Ex.1. In a H_2S solution, [H+] is two times [S-].

False: $H_2S \longleftrightarrow HS^- + H^+$

$HS^- \longleftrightarrow S^{2-} + H^+$

$H_2O \longleftrightarrow H^+ + OH^-$

Answer: $[H+] = 2[S^{2-}] + [HS^-] + [OH-]$

Note: Singly charged species - charge conc. is identical to conc. of the species.

But, S^{2-} charge conc. = twice that of the species, hence we must multiply the S^{2-} conc. by 2.

Mass Balance-based on the law of mass conservation and states that the # of atoms of an element remains constant in normal chemical reactions (no atoms can be created or destroyed).

Ex.2. Write the equations of mass balance for a 1.00 x 10^{-5} M $[Ag(NH_3)_2]Cl$.

Equilibria:

$$[Ag(NH_3)_2]Cl \longrightarrow [Ag(NH_3)_2]^+ + Cl^-$$
$$[Ag(NH_3)_2]^+ \longleftrightarrow [Ag(NH_3)]^+ + NH_3$$
$$[Ag(NH_3)]^+ \longleftrightarrow Ag^+ + NH_3$$
$$NH_3 + H^+ \text{ (from } H_2O) \longleftrightarrow NH_4^+$$

Cl- conc. = to the conc. of the salt that is dissociated

$$[Cl-] = 1.00 \text{ x } 10^{-5} \text{ M}$$

Ag+ species = to the conc. of Ag+ in the original salt

$$[Ag+] + [Ag(NH_3)]^+ + [Ag(NH_3)_2]^+ = 1.00 \text{ x } 10^{-5} \text{ M}$$

We have the following N-containing species:

$$NH_4^+, NH_3, [Ag(NH_3)]^+, [Ag(NH_3)_2]^+$$

Note: The conc. of N from the last species is twice the conc. of $[Ag(NH_3)_2]^+$

The total conc. of N is twice the concentration of the original salt, since there are two NH_3 per molecule. Hence:

$$[NH_4^+] + [NH_3] + [Ag(NH_3)]^+ + 2[Ag(NH_3)_2]^+ = 2.00 \text{ x } 10^{-5}$$