

Rules for Balancing REDOX Equations: (Half-Reaction Method)

Acidic or Neutral Solution

1. Split into two half reactions (reduction and oxidation half-reactions).
2. For each half-reaction:
 - a. Balance all elements except hydrogen and oxygen.
 - b. Balance oxygen by adding water, $\text{H}_2\text{O}(\text{l})$.
 - c. Balance hydrogen by adding $\text{H}^+(\text{aq})$ ion.
 - d. Balance charge by adding electrons.
3. If required, multiply each balanced half-reaction by the smallest whole number necessary to equalize the number of electrons in the two half-reactions.
4. Sum the two half-reactions to obtain the overall equation. If possible, simplify the overall equation by canceling like species.
5. Check that the elements and charges balance on both sides of the equation.

Basic Solution

1. Complete steps 1-5 described above for an acidic solution.
2. Add one $\text{OH}^-(\text{aq})$ ion to both sides of the overall equation for every $\text{H}^+(\text{aq})$ ion present. The $\text{H}^+(\text{aq})$ ions on one side combine with the added $\text{OH}^-(\text{aq})$ ions to form $\text{H}_2\text{O}(\text{l})$, and $\text{OH}^-(\text{aq})$ ions appear on the other side of the equation.



3. If possible, simplify the resulting overall equation by canceling like species.
4. Check that the elements and charges balance on both sides of the equation.

Notes on Total and Net Ionic Equations

In describing reactions that occur in solution, it is often desirable to write the equation for the reaction in ionic form, indicating the ionic species that actually exist in solution.

For example, if we were describing the reaction of a solution of BaCl_2 with a solution of Na_2SO_4 to form the insoluble solid BaSO_4 we would write



In writing a total ionic equation for reactions in water:

1. We indicate all soluble ionic materials as ions, followed by (aq).
2. All substances that react with water to form ions are written as ions followed by (aq).
3. All insoluble ionic solids are written with (s) following their formula.
4. All soluble unionized species are written with their molecular formula followed by (aq).
5. In the above equation, we note that the sodium and chloride ions are unchanged and are present on both sides of the equation. Since they are not undergoing chemical reaction, they can be referred to as spectator ions. If we subtract the spectator ions from each side of the equation, we then have a net ionic equation. The net ionic equation for the above reaction is:



The net ionic equation is a statement of the chemistry that occurred, namely, aqueous barium 2+ ion reacted with aqueous sulfate ion to form solid barium sulfate.

Net ionic equations may also be written for replacement reactions.