

Balancing Half-Reactions : Notes/W.S. 24

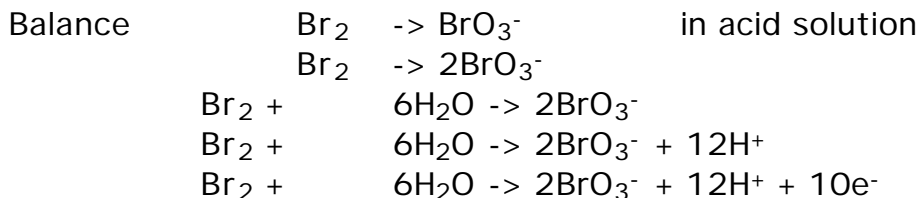
Some simpler half-reactions may be balanced by inspection.

For half-reactions taking place in an acidic solution, follow the four steps given below.

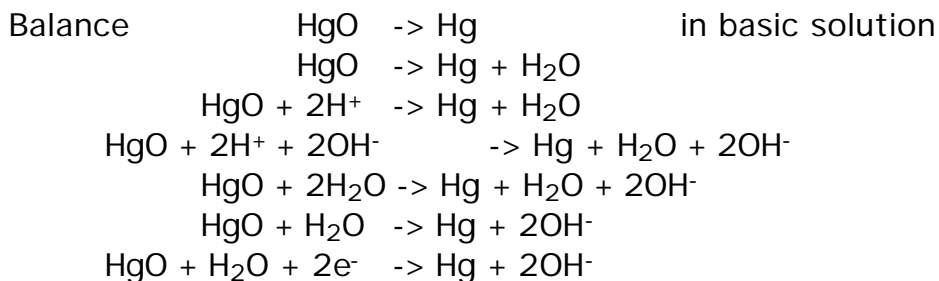
- 1) Balance main atoms (other than O and H).
- 2) Balance O atoms by adding H₂O molecules to one side.
- 3) Balance H atoms by adding H⁺ ions to one side.
- 4) Balance charges by adding electrons to one side.

For basic solutions, carry out the first three steps, then eliminate the H⁺ ions by adding OH⁻ ions to both sides. Then balance charges.

Examples:



Br is oxidized



Hg is reduced

Questions:

- 1) Balance the following half-reactions. State whether each is an oxidation or a reduction half-reaction.

- a) $\text{Ag}^+ \rightarrow \text{Ag}$
- b) $\text{Pb} \rightarrow \text{Pb}^{2+}$
- c) $\text{I}_2 \rightarrow \text{I}^-$
- d) $\text{SO}_4^{2-} \rightarrow \text{S}_2\text{O}_8^{2-}$
- e) $\text{S} \rightarrow \text{H}_2\text{S}$ acidic
- f) $\text{HClO}_2 \rightarrow \text{Cl}^-$ acidic
- g) $\text{N}_2\text{O}_4 \rightarrow \text{NO}_3^-$ basic
- h) $\text{S} \rightarrow \text{H}_2\text{SO}_3$ acidic
- i) $\text{MnO}_4^- \rightarrow \text{Mn}^{2+}$ acidic
- j) $\text{AgO} \rightarrow \text{Ag}_2\text{O}$ basic

Answers: 1)a) $\text{Ag}^+ + \text{e}^- \rightarrow \text{Ag}$, reduction, b) $\text{Pb} \rightarrow \text{Pb}^{2+} + 2\text{e}^-$, oxidation, c) $\text{I}_2 + 2\text{e}^- \rightarrow 2\text{I}^-$, reduction, d) $2\text{SO}_4^{2-} \rightarrow \text{S}_2\text{O}_8^{2-} + 2\text{e}^-$, oxidation, e) $\text{S} +$

$2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2\text{S}$, reduction, f) $\text{HClO}_2 + 3\text{H}^+ + 4\text{e}^- \rightarrow \text{Cl}^- + 2\text{H}_2\text{O}$,
reduction, g) $\text{N}_2\text{O}_4 + 4\text{OH}^- \rightarrow 2\text{NO}_3^- + 2\text{H}_2\text{O} + 2\text{e}^-$, oxidation, h) $\text{S} + 3\text{H}_2\text{O}$
 $\rightarrow \text{H}_2\text{SO}_3 + 4\text{H}^+ + 4\text{e}^-$, oxidation, i) $\text{MnO}_4^- + 8\text{H}^+ + 5\text{e}^- \rightarrow \text{Mn}^{2+} + 4\text{H}_2\text{O}$,
reduction, j) $2\text{AgO} + \text{H}_2\text{O} + 2\text{e}^- \rightarrow \text{Ag}_2\text{O} + 2\text{OH}^-$, reduction.