

Balancing Redox Equations using half equations

Download slides at ChemistryTuition.Net

- 1. Ensure both equations have the same number of electrons.
- 2. Check which equation will be reversed
- 3. Combine the equations
- 4. Cancel species that appear on both sides.

$$Fe^{3+}_{(aq)} + e^{-} \rightarrow Fe^{2+}_{(aq)}$$
 [1]

$$MnO_{4 (aq)}^{-} + 8H_{(aq)}^{+} + 5e^{-} \rightarrow Mn^{2+}_{(aq)} + 4H_{2}O_{(I)}$$
 [2]

- 1. Ensure both equations have the same number of electrons.
- 2. Check which equation will be reversed
- 3. Combine the equations
- 4. Cancel species that appear on both sides.

$$Fe^{3+}_{(aq)} + e^{-} \rightarrow Fe^{2+}_{(aq)}$$
 [1] x 5

$$MnO_{4(aq)} + 8H_{(aq)}^{+} + 5e^{-} \rightarrow Mn^{2+}_{(aq)} + 4H_{2}O_{(l)}$$
 [2]

- Ensure both equations have the same number of electrons
- 2. Check which equation will be reversed
- 3. Combine the equations
- 4. Cancel species that appear on both sides.

$$5 \text{Fe}^{3+}_{(aq)} + 5 \text{e}^{-} \rightarrow 5 \text{Fe}^{2+}_{(aq)}$$
 [1]

$$MnO_{4 (aq)}^{-} + 8H_{(aq)}^{+} + 5e^{-} \rightarrow Mn^{2+}_{(aq)} + 4H_{2}O_{(I)}$$
 [2]

- 1. Ensure both equations have the same number of electrons.
- 2. Check which equation will be reversed
- 3. Combine the equations
- 4. Cancel species that appear on both sides.

$$5Fe^{3+}_{(aq)} + 5e^{-} \rightarrow 5Fe^{2+}_{(aq)}$$
 [1]

$$MnO_{4(aq)} + 8H_{(aq)}^{+} + 5e^{-} \rightarrow Mn^{2+}_{(aq)} + 4H_{2}O_{(l)}$$
 [2]

- 1. Ensure both equations have the same number of electrons.
- 2. Check which equation will be reversed
- 3. Combine the equations
- 4. Cancel species that appear on both sides.

$$5Fe^{3+}_{(aq)} + 5e^{-} \rightarrow 5Fe^{2+}_{(aq)}$$
 [1]

$$MnO_{4 (aq)} + 8H_{(aq)}^{+} + 5e^{-} \rightarrow Mn^{2+}_{(aq)} + 4H_{2}O_{(l)}$$
 [2]

- 1. Ensure both equations have the same number of electrons.
- 2. Check which equation will be reversed
- 3. Combine the equations
- 4. Cancel species that appear on both sides.

$$5Fe^{2+}_{(aq)} \rightarrow 5Fe^{3+}_{(aq)} + 5e^{-}$$
 [1]

$$MnO_{4 (aq)}^{-} + 8H_{(aq)}^{+} + 5e^{-} \rightarrow Mn^{2+}_{(aq)} + 4H_{2}O_{(I)}$$
 [2]

$$5Fe^{2+}_{(aq)}MnO_{4(aq)}^{-} + 8H^{+}_{(aq)} \rightarrow 5Fe^{3+}_{(aq)} + Mn^{2+}_{(aq)} + 4H_2O_{(I)}$$

- 1. Ensure both equations have the same number of electrons.
- 2. Check which equation will be reversed
- 3. Combine the equations
- 4. Cancel species that appear on both sides.

$$5Fe^{2+}_{(aq)} \rightarrow 5Fe^{3+}_{(aq)} + 5e^{-}$$
 [1]

$$MnO_{4(aq)}^{-} + 8H_{(aq)}^{+} + 5e^{-} \rightarrow Mn^{2+}_{(aq)} + 4H_{2}O_{(I)}$$
 [2]

$$5Fe^{2+}_{(aq)}MnO_{4(aq)}^{-} + 8H^{+}_{(aq)} \rightarrow 5Fe^{3+}_{(aq)} + Mn^{2+}_{(aq)} + 4H_2O_{(l)}$$

- 1. Ensure both equations have the same number of electrons.
- 2. Check which equation will be reversed
- 3. Combine the equations
- 4. Cancel species that appear on both sides.

$$MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O$$
 [3]

$$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$$
 [4]

- 1. Ensure both equations have the same number of electrons.
- 2. Check which equation will be reversed
- 3. Combine the equations
- 4. Cancel species that appear on both sides.

$$MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O$$
 [3] x 6
 $Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$ [4] x 5

- 1. Ensure both equations have the same number of electrons.
- 2. Check which equation will be reversed
- 3. Combine the equations
- 4. Cancel species that appear on both sides.

$$6MnO_4^- + 48H^+ + 30e^- \rightarrow 6Mn^{2+} + 24H_2O$$
 [3]

$$5Cr_2O_7^{2-} + 70H^+ + 30e^- \rightarrow 10Cr^{3+} + 35H_2O$$
 [4]

- 1. Ensure both equations have the same number of electrons.
- 2. Check which equation will be reversed
- 3. Combine the equations
- 4. Cancel species that appear on both sides.

Example 2 – Construct the equation for MnO₄- reacting with Cr³⁺

[3]

$$6MnO_4^- + 48H^+ + 30e^- \rightarrow 6Mn^{2+} + 24H_2O$$

$$5Cr_2O_7^{2-} + 70H^+ + 30e^- \rightarrow 10Cr^{3+} + 35H_2O$$
 [4]

- 1. Ensure both equations have the same number of electrons.
- 2. Check which equation will be reversed
- 3. Combine the equations
- 4. Cancel species that appear on both sides.

$$6MnO_4^- + 48H^+ + 30e^- \rightarrow 6Mn^{2+} + 24H_2O$$
 [3]

$$10Cr^{3+} + 35H_2O \rightarrow 5Cr_2O_7^{2-} + 70H^+ + 30e^-$$
 [4]

- 1. Ensure both equations have the same number of electrons.
- 2. Check which equation will be reversed
- 3. Combine the equations
- 4. Cancel species that appear on both sides.

Example 2 – Construct the equation for MnO₄- reacting with Cr³⁺

$$6MnO_4^- + 48H^+ + 30e^- \rightarrow 6Mn^{2+} + 24H_2O$$
 [3]
 $10Cr^{3+} + 35H_2O \rightarrow 5Cr_2O_7^{2-} + 70H^+ + 30e^-$ [4]

 $6MnO_4^- + 48H^+ + 10Cr^{3+} + 35H_2O \rightarrow 6Mn^{2+} + 24H_2O + 5Cr_2O_7^{2-} + 70H^+$

- 1. Ensure both equations have the same number of electrons.
- 2. Check which equation will be reversed
- 3. Combine the equations
- 4. Cancel species that appear on both sides.

Example 2 – Construct the equation for MnO₄- reacting with Cr³⁺

$$6MnO_4^- + 48H^+ + 30e^- \rightarrow 6Mn^{2+} + 24H_2O$$
 [3]
 $5Cr^{3+} + 35H_2O \rightarrow 5Cr_2O_7^{2-} + 70H^+ + 30e^-$ [4]

 $6MnO_4^- + 48H^+ + 10Cr^{3+} + 35H_2O \rightarrow 6Mn^{2+} + 24H_2O + 5Cr_2O_7^{2-} + 70H^+$

- 1. Ensure both equations have the same number of electrons.
- 2. Check which equation will be reversed
- 3. Combine the equations
- 4. Cancel species that appear on both sides.

$$6MnO_4^- + 48H^+ + 30e^- \rightarrow 6Mn^{2+} + 24H_2O$$
 [3]

$$5Cr^{3+} + 35H_2O \rightarrow 5Cr_2O_7^{2-} + 70H^+ + 30e^-$$
 [4]

6MnO₄ ⁻
$$+$$
 48H⁺ + 10Cr³⁺ + 35H₂O \rightarrow 6Mn²⁺ + 24H₂O + 5Cr₂O₇²⁻ + 70H⁺

- 1. Ensure both equations have the same number of electrons.
- 2. Check which equation will be reversed
- 3. Combine the equations
- 4. Cancel species that appear on both sides.

$$6MnO_4^- + 48H^+ + 30e^- \rightarrow 6Mn^{2+} + 24H_2O$$
 [3]
 $5Cr^{3+} + 35H_2O \rightarrow 5Cr_2O_7^{2-} + 70H^+ + 30e^-$ [4]

$$6MnO_4^- + 4871^+ + 10Cr^{3+} + 35H_2O \rightarrow 6Mn^{2+} + 24H_2O + 5Cr_2O_7^{2-} + 22H^+$$

- 1. Ensure both equations have the same number of electrons.
- 2. Check which equation will be reversed
- 3. Combine the equations
- 4. Cancel species that appear on both sides.

$$6MnO_4^- + 48H^+ + 30e^- \rightarrow 6Mn^{2+} + 24H_2O$$
 [3]

$$5Cr^{3+} + 35H_2O \rightarrow 5Cr_2O_7^{2-} + 70H^+ + 30e^-$$
 [4]

$$6MnO_4^- + 10Cr^{3+} + 35H_2O \rightarrow 6Mn^{2+} + 24H_2O + 5Cr_2O_7^{2-} + 22H^+$$

- 1. Ensure both equations have the same number of electrons.
- 2. Check which equation will be reversed
- 3. Combine the equations
- 4. Cancel species that appear on both sides.

$$6MnO_4^- + 48H^+ + 30e^- \rightarrow 6Mn^{2+} + 24H_2O$$
 [3]
 $10Cr^{3+} + 35H_2O \rightarrow 5Cr_2O_7^{2-} + 70H^+ + 30e^-$ [4]

$$6MnO_4^- + 10Cr^{3+} + 11H_2O \rightarrow 6Mn^{2+} + 24H_2O - 5Cr_2O_7^{2-} + 22H^+$$

- 1. Ensure both equations have the same number of electrons.
- 2. Check which equation will be reversed
- 3. Combine the equations
- 4. Cancel species that appear on both sides.

Example 2 – Construct the equation for MnO₄- reacting with Cr³⁺

$$6MnO_4^- + 48H^+ + 30e^- \rightarrow 6Mn^{2+} + 24H_2O$$
 [3]
 $10Cr^{3+} + 35H_2O \rightarrow 5Cr_2O_7^{2-} + 70H^+ + 30e^-$ [4]

 $6MnO_4^{-} + 10Cr^{3+} + 11H_2O \rightarrow 6Mn^{2+} + 5Cr_2O_7^{2-} + 22H^2$

Online Teaching and Learning Resources for Chemistry Students

ChemistryTuition.Net

