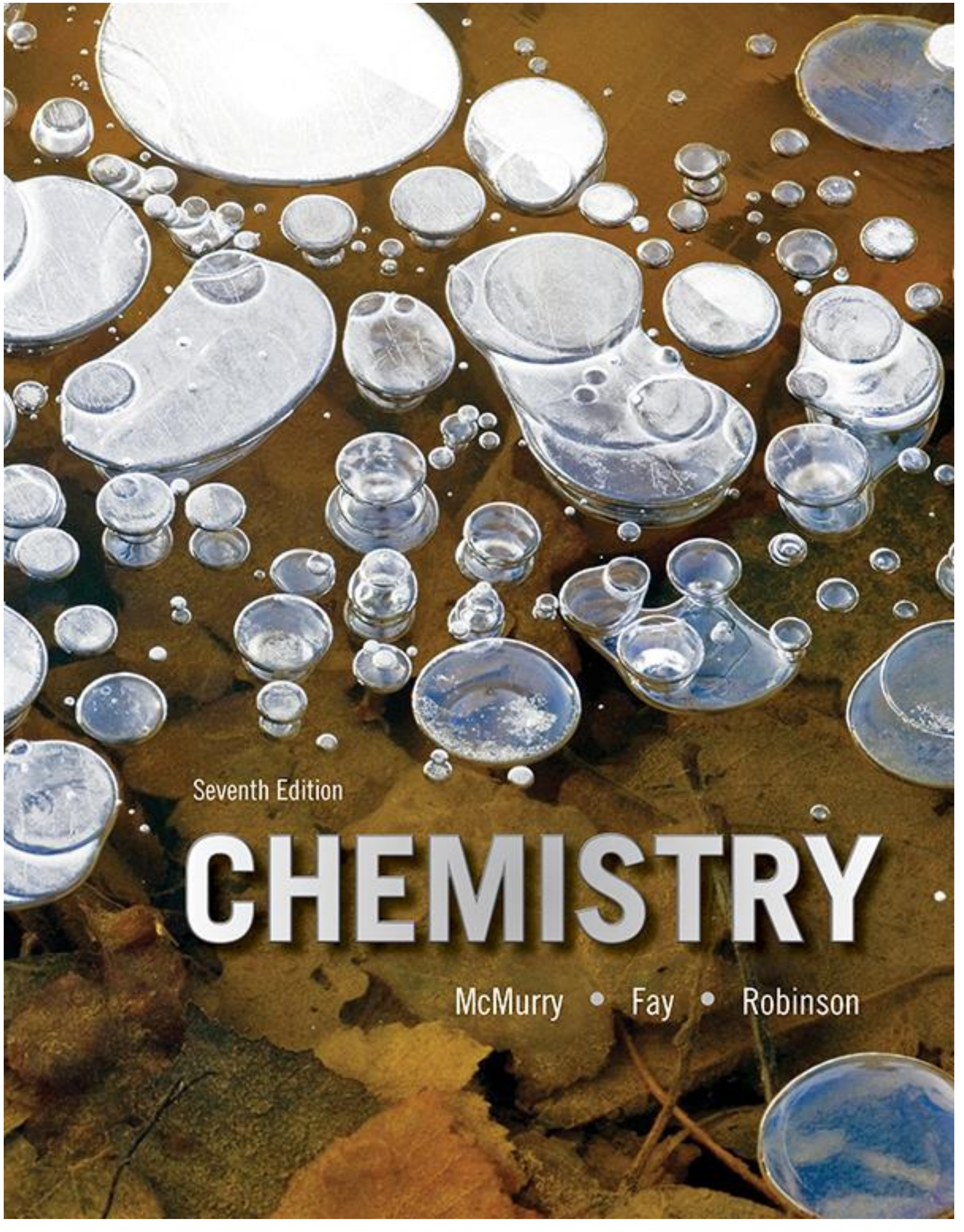

Lecture Presentation

Chapter 18

Electrochemistry

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Balancing Redox Reactions by the Half-Reaction Method (in acidic solution)

Step 1. Write the unbalanced net ionic equation.

Step 2. Decide which atoms are oxidized and which are reduced, and write the two unbalanced half-reactions.

Step 3. Balance both half-reactions for all atoms except O and H.

Step 4. Balance each half-reaction for O by adding water to the side with less O, and balance for H by adding H^+ to the side with less H.

Step 5. Balance each half-reaction for charge by adding electrons to the side with greater positive charge, and then multiply by suitable factors to make the electron count the same in both half-reactions.

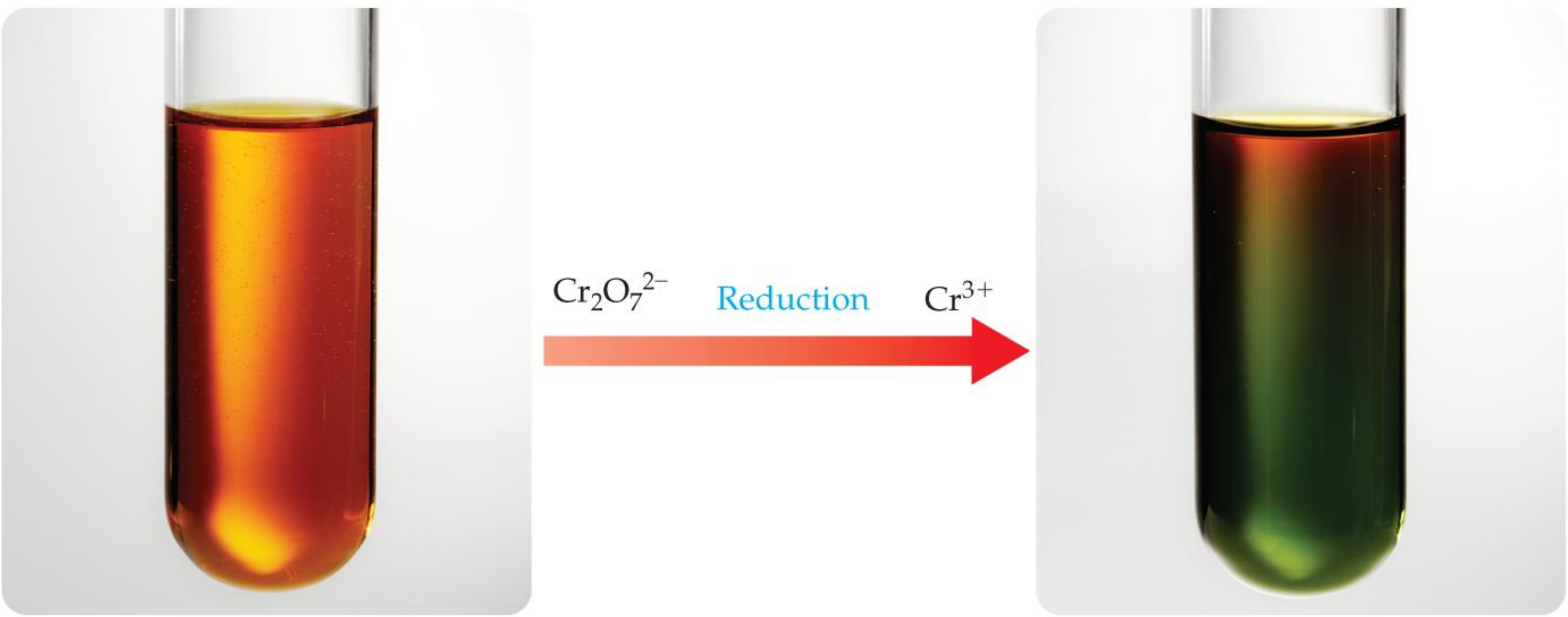
Step 6. Add the two balanced half-reactions together, and cancel electrons and other species that appear on both sides of the equation.

Check your answer by making sure the equation is balanced both for atoms and for charge.

Balancing Redox Reactions by the Half-Reaction Method

Balance the following net ionic equation in acidic solution:

$$Cr_2O_7^{2-}(aq) + Cl^-(aq) \longrightarrow Cr^{3+}(aq) + Cl_2(aq)$$



Balancing Redox Reactions: The Half-Reaction Method

- Write the two unbalanced half-reactions.

$$Cr_2O_7^{2-}(aq) \longrightarrow Cr^{3+}(aq)$$

$$Cl^{-}(aq) \longrightarrow Cl_2(aq)$$

Balancing Redox Reactions: The Half-Reaction Method

- Balance both half-reactions for all atoms except O and H.

$$Cr_2O_7^{2-}(aq) \longrightarrow 2\ Cr^{3+}(aq)$$

$$2\ Cl^{-}(aq) \longrightarrow Cl_2(aq)$$

Balancing Redox Reactions: The Half-Reaction Method

- Balance each half-reaction for O by adding H_2O, and then balance for H by adding H^+.

$$14\ H^+(aq) + Cr_2O_7^{2-}(aq) \longrightarrow 2\ Cr^{3+}(aq) + 7\ H_2O(l)$$

$$2\ Cl^-(aq) \longrightarrow Cl_2(aq)$$

End A sect
4/20/20
Monday

Balancing Redox Reactions: The Half-Reaction Method

- Balance each half-reaction for charge by adding electrons to the side with greater positive charge.

reduction: $6\ e^- + 14\ H^+(aq) + Cr_2O_7^{2-}(aq) \longrightarrow 2\ Cr^{3+}(aq) + 7\ H_2O(l)$

oxidation: $2\ Cl^-(aq) \longrightarrow Cl_2(aq) + 2\ e^-$

Balancing Redox Reactions: The Half-Reaction Method

- Multiply each half-reaction by a factor to make the electron count the same in both half-reactions.

reduction: $6\ e^- + 14\ H^+(aq) + Cr_2O_7^{2-}(aq) \longrightarrow 2\ Cr^{3+}(aq) + 7\ H_2O(l)$

oxidation: $3\left[2\ Cl^-(aq) \longrightarrow Cl_2(aq) + 2\ e^-\right]$

Balancing Redox Reactions: The Half-Reaction Method

- Add the two balanced half-reactions together and cancel species that appear on both sides of the equation.

reduction: $6\ e^- + 14\ H^+(aq) + Cr_2O_7^{2-}(aq) \longrightarrow 2\ Cr^{3+}(aq) + 7\ H_2O(l)$

oxidation: $6\ Cl^-(aq) \longrightarrow 3\ Cl_2(aq) + 6\ e^-$

$$\boxed{14\ H^+(aq) + Cr_2O_7^{2-}(aq) + 6\ Cl^-(aq) \longrightarrow 2\ Cr^{3+}(aq) + 7\ H_2O(l) + 3\ Cl_2(aq)}$$

HW 18.1: Balancing Redox Reactions: The Half-Reaction Method

$$Zn(s) + Cu^{2+}(aq) \longrightarrow Zn^{2+}(aq) + Cu(s)$$

(a) Oxidation half-reaction: ____________________

(b) Reduction half-reaction: ______________________

18.1: Balancing Redox Reactions: The Half-Reaction Method

End 4/21/20
Tues, C section

$$\overbrace{Zn(s) + Cu^{2+}(aq) \longrightarrow Zn^{2+}}^{-2\,e}(aq) + Cu(s)$$

$$Zn(s) + \underbrace{Cu^{2+}(aq) \longrightarrow Zn^{2+}(aq) + Cu(s)}_{+2\,e}$$

(a) Oxidation half-reaction: ______________________

(b) Reduction half-reaction: ______________________

18.1: Balancing Redox Reactions: The Half-Reaction Method

$$\overbrace{Zn(s) + Cu^{2+}}^{-\,2\,e}(aq) \longrightarrow Zn^{2+}(aq) + Cu(s)$$

(a) Oxidation half-reaction: $Zn(s) \longrightarrow Zn^{2+}(aq) + 2\,e^{-}$

(b) Reduction half-reaction: $Cu^{2+}(aq) + 2\,e^{-} \longrightarrow Cu(s)$

Balanced redox reaction:

$$Zn(s) + Cu^{2+}(aq) \longrightarrow Zn^{2+}(aq) + Cu(s)$$

HW 18.2: Balancing Redox Reactions: The Half-Reaction Method (acidic solution)

$$\overset{+5}{NO_3^-}(aq) + Cu(s) \longrightarrow \overset{+2}{NO}(g) + Cu^{+2}(aq)$$

(a) Oxidation half-reaction: ____________________________

(b) Reduction half-reaction: ____________________________

(c) Balanced redox reaction:

___ NO_3^- (aq) + 8 H^+ + 3 Cu (*s*) → 2 NO(*g*) + 3 Cu^{+2}(*aq*) + ___ H_2O (l)

End 4/22 Wed
A,C section

HW 18.2: Balancing Redox Reactions: The Half-Reaction Method (acidic solution)

+3 e

+2

NO_3^- (aq) + Cu (*s*) ⟶ NO(*g*) + Cu^{+2}(*aq*)

+5

- 2 e

(a) Oxidation half-reaction: ____________________________

(b) Reduction half-reaction: ____________________________

(c) Balanced redox reaction:

___ NO_3^- (aq) + 8 H^+ + 3 Cu (*s*) → 2 NO(*g*) + 3 Cu^{+2}(*aq*) + ___ H_2O (l)

HW 18.2: Balancing Redox Reactions: The Half-Reaction Method (acidic solution)

+3 e

+2

$NO_3^-\,(aq) + Cu\,(s) \longrightarrow NO(g) + Cu^{+2}(aq)$

+5

- 2 e

(a) Oxidation half-reaction: $Cu(s) \longrightarrow Cu^{2+}(aq) + 2e^-$

(b) Reduction half-reaction: $NO_3^-(aq) + 3\,e^- \longrightarrow NO(g)$

(c) Balanced redox reaction:

$$2\,NO_3^-\,(aq) + 8\,H^+ + 3\,Cu\,(s) \rightarrow 2\,NO(g) + 3\,Cu^{+2}(aq) + 4\,H_2O\,(l)$$

End Final Exam