April 8, 2002

≻This Week: Demo a day!

▶ Redox: Readings and Assigned Problems

(with solutions) are now online!

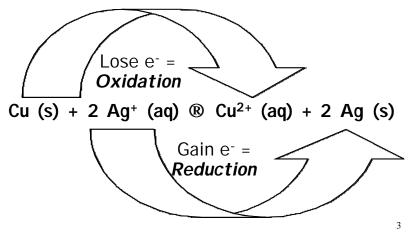
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Oxidation-Reduction Chemistry

Chem 36 Spring 2002

Definitions

■ Redox reactions involve *electron transfer*:



Half-Reactions

> Consider each process indivually:

Oxidation Cu (s)
$$\rightarrow$$
 Cu²⁺ (aq) + 2 e⁻

Reduction [Ag⁺ + e⁻
$$\rightarrow$$
 Ag (s)] x 2

Overall:
$$Cu$$
 (s) + $2Ag^+$ (aq) $\rightarrow Cu^{2+}$ (aq) + $2Ag$ (s)

Oxidized (reducing agent)

Reduced (oxidizing agent)

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Balancing Redox Reactions

The Half-Reaction Method

Three Steps:

- 1. Determine *net ionic equations* for both half-reactions
- 2. Balance half-reactions with respect to mass and charge
- 3. Combine so as that electrons cancel

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Example

$$SO_3^{2-} + H^+ + MnO_4^- \rightarrow SO_4^{2-} + Mn^{2+} + H_2O$$

1. Write Skeleton Half-Reactions

Oxidation
$$SO_3^{2-} \rightarrow SO_4^{2-}$$

Reduction
$$MnO_4^- \rightarrow Mn^{2+}$$

2. Mass Balance

$$SO_3^{2-} + H_2O \rightarrow SO_4^{2-} + 2H^+$$

$$MnO_4^- + 8H^+ \rightarrow Mn^{2+} + 4H_2O$$

- •Add H₂O to side needing oxygen
- •Add H⁺ to balance hydrogen

Example: Continued

3. Charge Balance (use electrons)

$$SO_3^{2-} + H_2O \rightarrow SO_4^{2-} + 2H^+ + 2e^-$$

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

4. Combine!

$$[SO_3^{2-} + H_2O \rightarrow SO_4^{2-} + 2H^+ + 2e^-] \times 5$$

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

$$5SO_3^{2^-} + 5H_2O + 2MnO_4^- + 16H^+ + 10e^- \rightarrow$$

 $5SO_4^{2^-} + 10H^+ + 10e^- + 2Mn^{2^+} + 8H_2O$