

# **Electrochemistry**

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**All electrochemical processes involve the transfer of electrons from one substance to another and are therefore redox reactions.**

**use spontaneous chemical reactions to generate electric current**

**use electrical current to drive chemical reactions that would otherwise be nonspontaneous**

# **Redox Reactions**

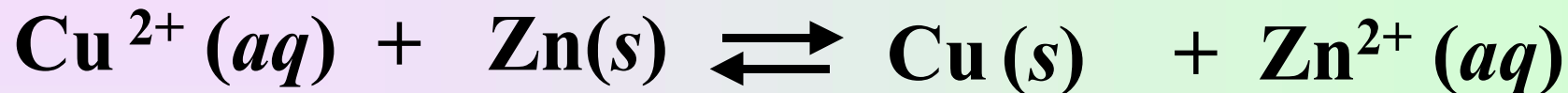
**key terms:**

**oxidizing agent**

**reducing agent**

**oxidation number**

## Consider the oxidation-reduction reaction



**$\text{Cu}^{2+}$  gains 2 electrons**

**oxidation number decreases;**

**is reduced**

**is the oxidizing agent**

**$\text{Zn}^0$  loses 2 electrons**

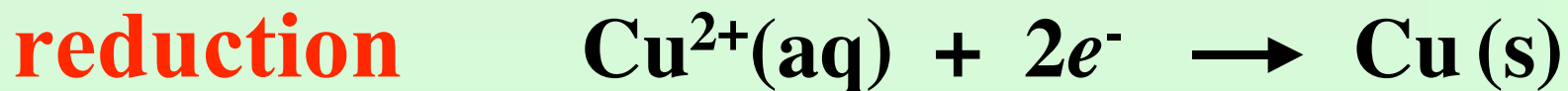
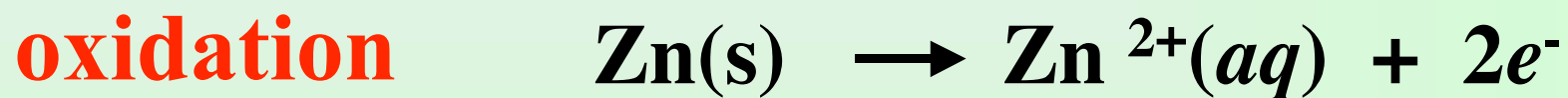
**oxidation number increases;**

**is oxidized**

**is the reducing agent**

# oxidation-reduction reactions

In studying a redox reaction we often think of it as two half reactions.



# **Balancing Oxidation-Reduction Equations**

## **Half-Reaction Method**

## **Half-Reaction Method in Acid**

- 1. Write the unbalanced equation in ionic form.**
- 2. Separate the equation into two half-reactions.**
- 3. Balance each half reaction (except for O and H).**
- 4. In acid solution, balance O by adding  $\text{H}_2\text{O}$  and H by adding  $\text{H}^+$**
- 5. Balance the charges by adding electrons.**
- 6. Add the half reactions**
- 7. Check to make sure atoms and charges are balanced**

# Example

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**Balance the following equation for the reaction in acid solution. \***

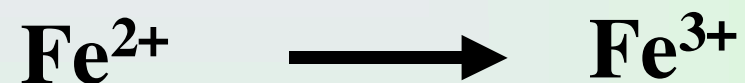


**\*All species are (aq)**

**1. Write the unbalanced equation in ionic form.**

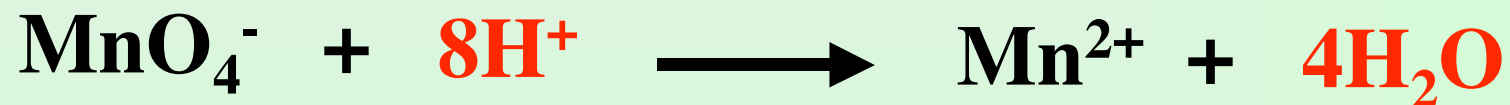
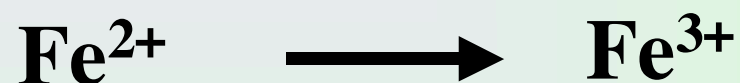


**2. Separate the equation into two half-reactions**



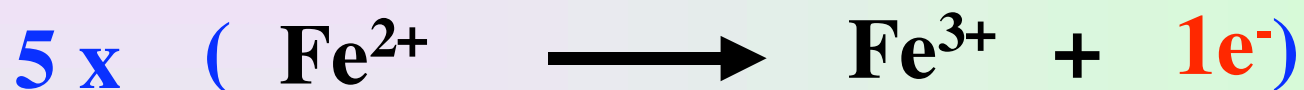
**3. Balance each half reaction (except for O and H).**

**4. In acid solution, balance O by adding H<sub>2</sub>O and H by adding H<sup>+</sup>**

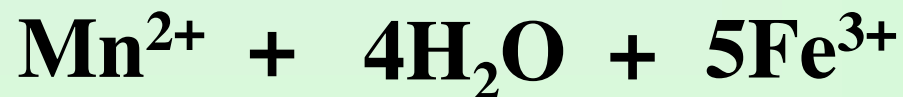
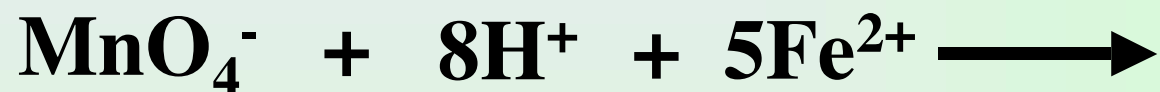


## 5. Balance the charges by adding electrons.

You need the same number of electrons on both sides of the equation.



## 6. Add the half reactions



**This is the balanced equation**

## Half-Reaction Method in Base

1. Use the half-reaction method as specified for acidic solutions to obtain the final balanced equation *as if  $H^+$  ions were present*.
2. Add the number of  $OH^-$  ions to both sides of the equation to turn the remaining  $H^+$  ions to  $H_2O$
3. Eliminate waters that appear on both sides of the equation.

# Example

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**Balance the following equation for the reaction in basic solution. \***

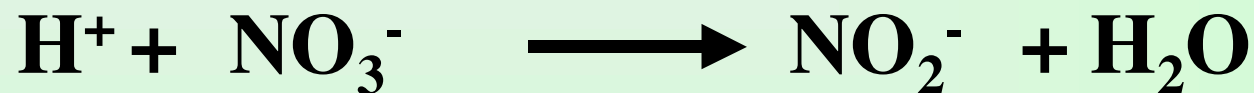


**\*All species are (aq)**

# Example

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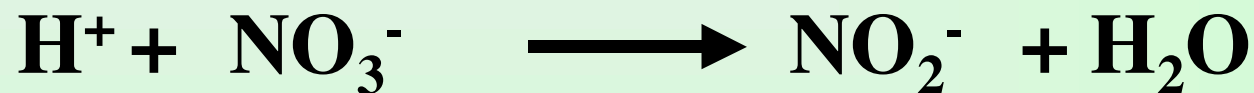
Balance the following equation for the reaction in basic solution. \*



# Example

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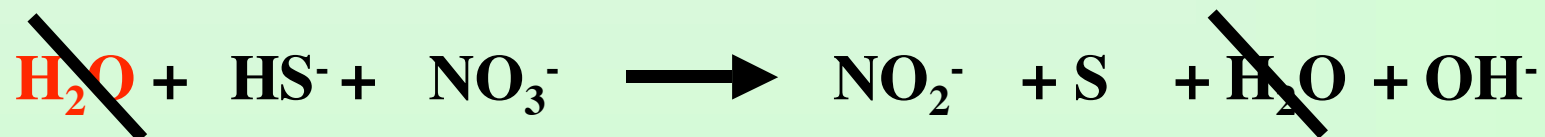
Balance the following equation for the reaction in basic solution. \*



# Example

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Balance the following equation for the reaction in basic solution. \*



# Example

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**Balance the following equation for the reaction in basic solution. \***

