

# Chapter 6

## Introduction

- **Electrochemistry** is the study of electrical energy and chemical energy.
- Some chemical reactions produce electricity or electricity causes the reactions take place.
- In 1771 Luigi Galvani, Italian anatomist, discovered a new form of electricity could be produced by living tissue.
- In 1800's Italian physicist Alessandro Volta built a battery.

# Oxidation-Reduction Reactions

- Electron transfer reactions are called **oxidation-reduction** or **redox** reactions.

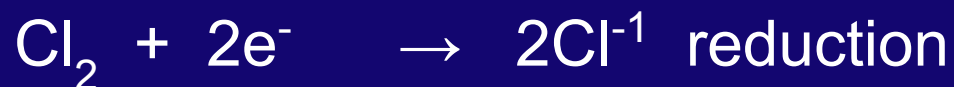
Charges of elements are zero.

Sum of charges of elements in a compound is equal to zero.

- **Oxidation** is loss of electrons. ( losing e )
- **Reduction** is gain of electrons. ( taking e )
- **Oxidizing agent** is Oxidizes other element. (take electron)
- **Reducing agent** is Reduces other element.(loses electron)

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### 1. Oxidation-Reduction Reactions



Here, Na is reducing agent, while  $\text{Cl}_2$  is oxidizing agent.

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# 1. Oxidation-Reduction Reactions

### *Example 1*

Mg and O<sub>2</sub> react to form MgO. What are the oxidizing and reducing agents?

### *Solution*



Mg undergoes oxidation process, it is called reducing agent.

O<sub>2</sub> undergoes reduction process, it is called oxidizing agent.

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## 1. Oxidation-Reduction Reactions

### 1. Oxidation States

- Oxidation states of the elements must be known to balance redox reactions.
- Oxidation states of elements in most stable form is zero, like Fe, Cu, Ag, O<sub>2</sub>, H<sub>2</sub>, P, S, P<sub>4</sub>...etc
- Group IA have +1, and Group IIA have +2 and Group IIIA have +3, Halogens have -1 oxidation states.
- Hydrogen in metal hydrates has -1 oxidation state.
- Sum of the oxidation states in compounds is zero, in ions is equal to charge of ion.

# Chapter 6 1. Oxidation-Reduction Reactions

## Example 2

Find the oxidation state of metals in the following species.

- A. FeO    B.  $\text{KMnO}_4$     C.  $\text{Na}_2\text{Cr}_2\text{O}_7$     D. HgOH

## Solution

A.  $x + -2 = 0 \rightarrow x = +2$

B.  $+1 + x + 4(-2) = 0 \rightarrow x = +7$

C.  $2(+1) + 2x + 7(-2) = 0 \rightarrow x = +6$

D.  $x + (-2) + 1 = 0 \rightarrow x = +1$

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## 1. Oxidation-Reduction Reactions

### Example 3

Find the oxidation state of indicated atoms in the following species.



### Solution

A.  $x + 4(-2) = -3 \rightarrow x = +5$

B.  $x + 3(-2) = -2 \rightarrow x = +4$

C.  $2(+1) + x + 4(-2) = 0 \rightarrow x = +6$

D.  $x + 4(+1) = +1 \rightarrow x = -3$