

# CHAPTERS 21 AND 22 NOTES

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## CONTENTS

21. Electric Charge and Electric Field	1
21.1 Electric Charge	1
21.1.1 Electric Charge and the Structure of Matter	1
21.1.2 Electric Charge is Conserved	2
21.2 Conductors, Insulators, and Induced Charges	2
21.2.1 Charging by Induction	2

## 21. ELECTRIC CHARGE AND ELECTRIC FIELD

Electromagnetic interactions involve particles that have electric charge, an attribute that is as fundamental as mass. Just as objects with mass are accelerated by gravitational forces, so electrically charged objects are accelerated by electric forces.

### 21.1 Electric Charge.

**Definition 1. Electric Charge:** is the state of having more or less than a natural amount of electrons. *Positive* if less or *Negative* if more.

**Remark.** Two positive charges or two negative charges repel each other. A positive charge and a negative charge attract each other.

**Definition 2. Electrostatics:** the interactions between electric charges that are at rest (or nearly so).

#### 21.1.1 Electric Charge and the Structure of Matter.

**Definition 3. Parts of Atom:** Positive Protons, negative Electrons and Neutral Neutrons. Protons and Neutrons are held by *Strong Nuclear Force* to form the Nucleus and are themselves comprised of *Quarks*. The Majority of Atom is the *Electron Cloud*

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**Definition 4. Ionization:** Normally positive charge and negative charge cancel out, but through an addition or loss of an electron the atom becomes ionized, becoming either a *positive* or *negative* ion

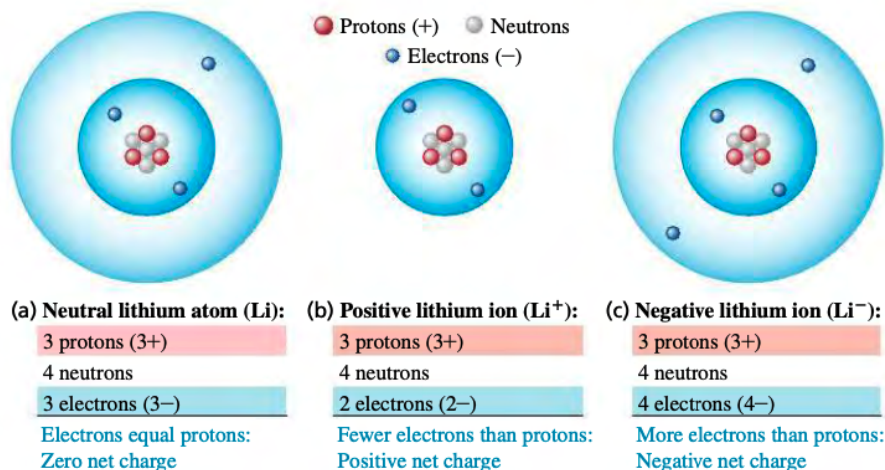


FIGURE 1. Atomic Structure and Ionization

### 21.1.2 Electric Charge is Conserved.

**Theorem 1.** Principle of conservation of charge: The algebraic sum of all the electric charges in any closed system is constant. In any charging process, charge is not created or destroyed; it is merely transferred from one body to another.

**Theorem 2.** Quantized Nature of Charge: The magnitude of charge of the electron or proton is a natural unit of charge.

## 21.2 Conductors, Insulators, and Induced Charges.

**Definition 5. Conductivity and Insulation:** *Conductors* are materials that transfer electrons well, such as copper and other metals. The opposite are *Insulators* which are poor and transferring charge, these are often nonmetals. Some materials called *semiconductors* are intermediate in their properties between good conductors and good insulators.

### 21.2.1 Charging by Induction.

**Definition 6. Induction:** a method used to charge an object without actually touching the object to any other charged object. This is done by rearranging electrons already present in object

**Definition 7. Polarization:** The slight shifting of charge within the molecules of the neutral insulator when placed near a charge object. This is what causes charge by Induction

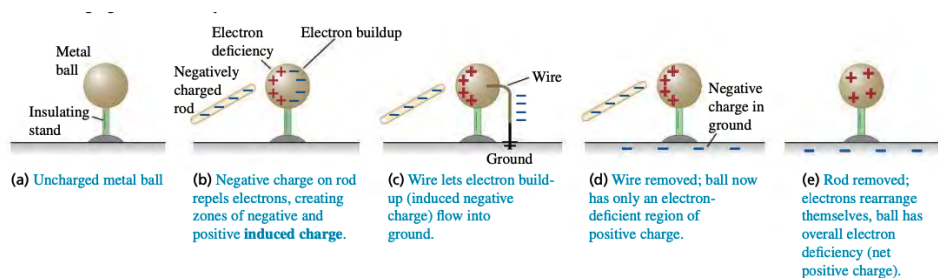


FIGURE 2. Charge by Induction