Basic Electricity

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INTRODUCTION

Today's automobiles are becoming even more dependent on electrical and electronic technology to manage systems that control power train, passenger compartment, and safety devices. Because of this, it is very important that automotive technicians have a good understanding of how electricity works, both in theory and practical application.

KIA Motors Technical Service Training Department is aware of the daily challenge technicians face when diagnosing a vehicle with electrical or electronic problems. We also understand the specialized knowledge required to effectively isolate, troubleshoot and repair electrical problems which may occur in a vehicle.

In consideration of this, we have developed this new course titled, **"Basic Electrical Training"** as part of our training program. This course is designed to be instructed in two segments; first a "refresher" reviewing basic electrical principles (such as circuit types, Ohm's Law, and schematic diagram reading); and second (and most important), learning how to apply the theory to diagnose actual on-vehicle circuitry.

Through carefully prepared worksheets, students will learn how to pinpoint circuit locations, conduct measurements, and determine how voltage, current or resistance values contribute toward determining the necessary repair.

This course has been design to be instructed mainly in a workshop environment with the intent of demonstrating the practical "on-vehicle" application of the course content. It is our hope that use of this training technique will optimize the individual learning experience and technicians will relate the knowledge gained directly to vehicle repairs at the dealership.

We at **KIA motors** hope that the information received during this course improves technician's knowledge of electricity and electronics. We also encourage that the procedures shown become part of each technician's regular diagnostic routine and are applied whenever possible to help ensure customers receive the best possible service.

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1. Electricity General

1.1 Fundamental

Everything in the universe is made up of matter.
Matter can be defined as anything that occupies space or has mass.
Matter can be found in the form of solids, liquids, and gases. However, these states are subject to relative temperature. Water is usually found in liquid form. Yet water can be readily changed to solid or a vapor form by changing its temperature. Matter can also be described by color, taste, and aridness, but these are only observable characteristics. They may not truly identify a substance.
To truly identify a substance, the substance must be broken down into its smallest parts. The substance must be described in term of its atomic structure. Only then can it truly be defined and it's behavioral characteristic identified.

A **substance** has been broken down to its purest form when breaking it down further it down further will change its atomic characteristics. This form is called an **element**. There are over 100 elements. Most of these elements occur naturally in our universe. Some of the elements do not occur naturally, but have been created in laboratories. Some common examples of naturally occurring elements are iron, copper, gold, aluminum, carbon, and oxygen.

If two or more of these elements are mixed together, a compound is created. A compound can be reduced to its individual elements.

An element can be reduced to its atomic structure

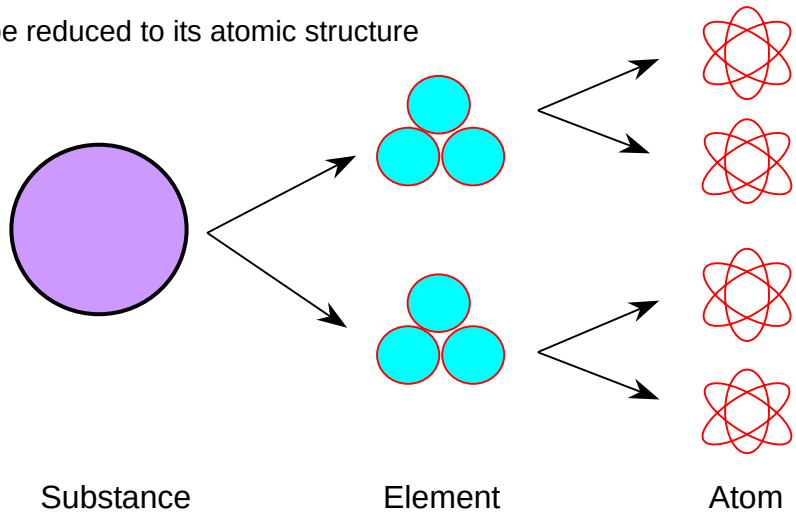


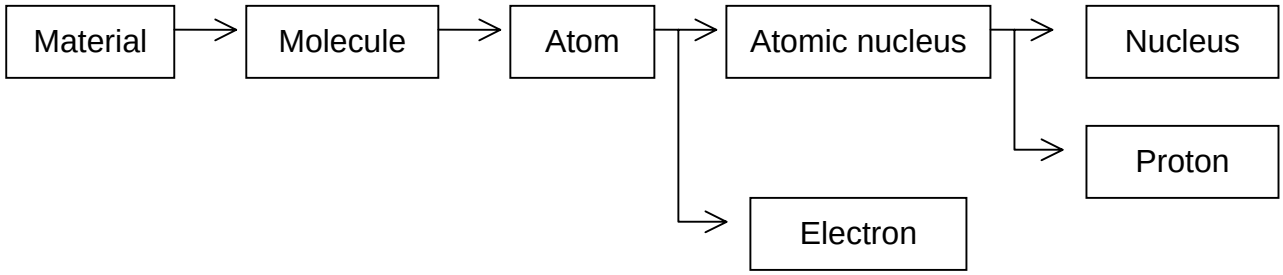
Figure 1-1

1.2 Occurrence of electricity

1.2.1 what is electricity?

First, need to understand about structure of material before understand electricity.

Structure of material is composed as following.



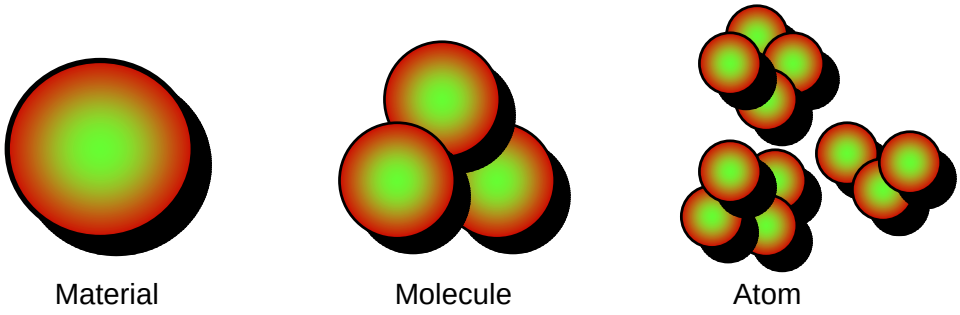
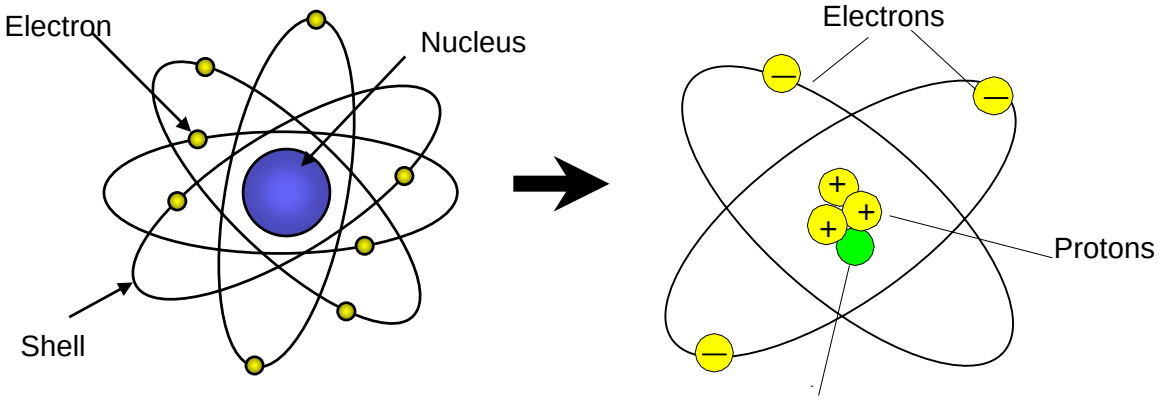


Figure 1-2 Structure of material

Characteristic of molecule and atom

- Melecul : Atom has propensity of material being minimum unit that can no longer split.
- Atom : It is material that can no longer split. no nature of material .

Atom makes of following element again, and the structure is with figure.



Structure of Atom Detail structure of Atom

. **Figure 1-3 Structure of Atom**

Protons located in the nucleus of an atom, are the positive (+) charged particles.

Neutrons also in the nucleus, have no electric charge and are electrically neutral

Electrons are the particles that orbit the nucleus and have a negative (-) charge.

Electrons move or *flow* from atom to atom because it is possible for an atom to gain or lose electrons in certain circumstances.
Electrons that have been driven from an atom are called *free electrons.*

The loss of one electron means the atom has an extra proton, which results in a more positive charge than negative. Positively charged atoms attract free electrons to replace the ones that were lost.

If an atom gains an extra electron, it will have a more negative charge. The atom will repel other Negatively charged particles and will easily give up this extra electron if it is attracted away by a positively charged atom.

To understand this better, think of a line of cars in traffic on a highway. When one car turns off, an opening is available. When an opening is available, another car, wanting in, sees it and is attracted to it and fills it in.
This movement or flow of free electrons from one atom to another is *electrical current* or *electricity*.

1.2.2 Ionization

The number of electrons and protons that make a particular atom are usually equal in number.
This equal number creates a canceling effect between the negative and positive charge.
The atomic structure of each element can be described as having a fixed number of electrons in orbit.

Usually, an atom remains in its normal state unless energy is added by some exterior force such as heat, friction, or bombardment by other electrons. When energy is added to an atom, the atom becomes excited. If the exterior force is of sufficient strength, electrons in the atoms outer rings or orbits can leave their orbit. How tightly bound these outer electrons are to an atom depends on the element and the number of electrons in the outer orbit. If electrons leave the outer orbit, the atom becomes out of balance electrically.

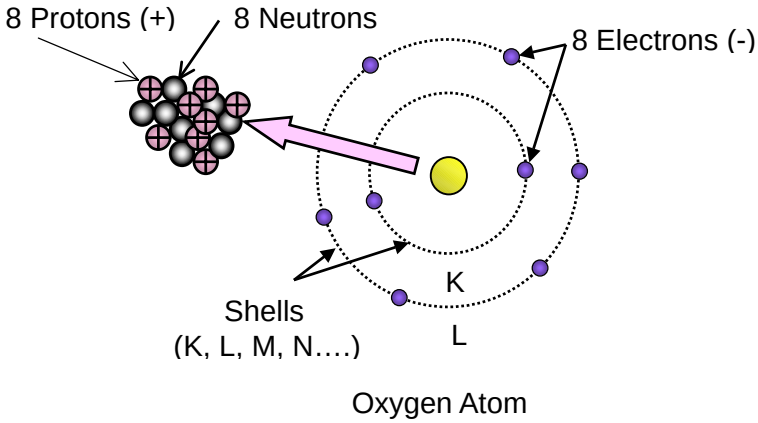
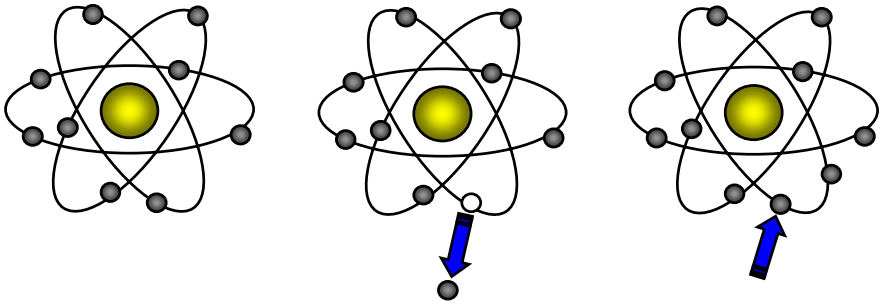


Figure 1.4 Atom ionization

When the electron leaves the outer orbit. The atom becomes ionized. An atom that loses an electron from its outer orbit has more protons. The atom becomes a **positive ion** and displays positive charged characteristics.

When an atom gains an extra electron, it becomes a **negative ion**. Negative ions display negatively charged characteristics.



Electrically Neutral | Positive Ion | Negative Ion

Figure 1-5 Atom ion

1.2.3 Electrostatic Field

The field or force surrounding a charged body is called the electrostatic field or dielectric field. The field can exhibit a positive or negative charge depending on a gain or loss of electrons. Two charged masses are shown in **Figure 1-6**. Lines represent the electrostatic fields of opposite polarity and the attractive force existing between the masses. In **Figure 1-7,** two charged masses are shown with like polarities. A repulsive force exists the charged masses due to the electrostatic fields. The field strongest very close to charged body. The field strength diminishes at a distance inversely proportional to the square of the distance.

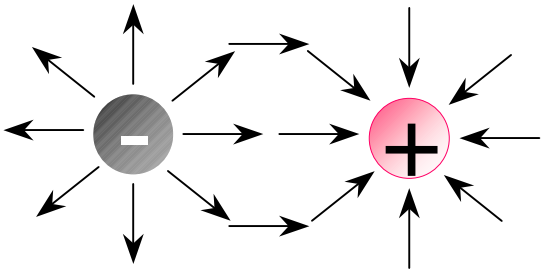


Figure 1-6

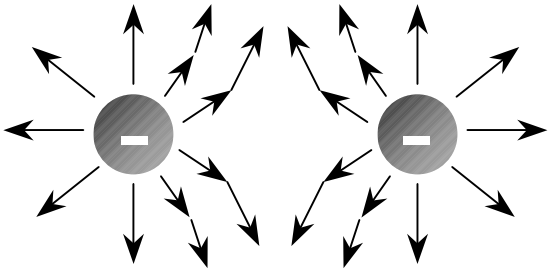


Figure 1-7

When two electrostatic fields are joined together, the electrons flow from the mass with an excess of electrons to the mass that has a need of electrons flow from the mass with excess of electrons**.**

Figure 1-8 illustrates this principle. The excess electrons flow from the body that is negatively charged to the positively charged body that has electron deficiency. This transfer of electrons can be accomplished by touching the two bodies together or by connecting them with a material that supports the flow of electrons between the two bodies. This connecting material is known as a conductor because it conducts electricity.