MODULE 03

FOR A CERTIFICATION

ELECTRICAL FUNDAMENTALS

Aviation Maintenance Technician Certification Series

COMPLIANT WITH EASA
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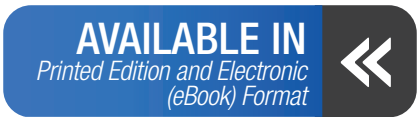

AVIATION MAINTENANCE TECHNICIAN CERTIFICATION SERIES

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WELCOME

The publishers of this Aviation Maintenance Technician Certification Series welcome you to the world of aviation maintenance. As you move towards EASA certification, you are required to gain suitable knowledge and experience in your chosen area. Qualification on basic subjects for each aircraft maintenance license category or subcategory is accomplished in accordance with the following matrix. Where applicable, subjects are indicated by an "X" in the column below the license heading.

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We wish you good luck and success in your studies and in your aviation career!

REVISION LOG

VERSION	EFFECTIVE DATE	DESCRIPTION OF CHANGE
001	2014 08	Module Creation and Release
002	2019 04	Fine tuned Sub-Module content sequence based on Appendix-A. Updated layout and styling.

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ELECTRICAL FUNDAMENTALS

ELECTRON THEORY

SUB-MODULE 01

PART-66 SYLLABUS **LEVELS**

	CERTIFICATION CATEGORY → A
Sub-Module 01 ELECTRON THEORY Knowledge Requirements	
3.1 - Electron Theory Structure and distribution of electrical charges within: atoms, molecules, ions, compounds; Molecular structure of conductors, semiconductors and insulators.	1

3.1 - ELECTRON THEORY

STRUCTURE AND DISTRIBUTION OF ELECTRICAL CHARGES WITHIN ATOMS, MOLECULES, IONS, AND COMPOUNDS

MATTER

Matter can be defined as anything that has mass and has volume and is the substance of which physical objects are composed. Essentially, it is anything that can be touched. Mass is the amount of matter in a given object. Typically, the more matter there is in an object the more mass it will have. Weight is an indirect method of determining mass but not the same. The difference between mass and weight is that weight is determined by how much something or the fixed mass is pulled by gravity. Categories of matter are ordered by molecular activity. The four categories or states are: solids, liquids, gases, and plasma. For the purposes of the aircraft technician, only solids, liquids, and gases are considered.

ELEMENTS

An element is a substance that cannot be reduced to a simpler form by chemical means. Iron, gold, silver, copper, and oxygen are examples of elements. Beyond this point of reduction, the element ceases to be what it is.

COMPOUNDS

A compound is a chemical combination of two or more elements. Water is one of the most common compounds and is made up of two hydrogen atoms and one oxygen atom.

MOLECULES

The smallest particle of matter that can exist and still retain its identity, such as water (H_2O), is called a molecule. A molecule of water is illustrated in ***Figure 1-1***. Substances composed of only one type of atom are called elements. But most substances occur in nature as compounds, that is, combinations of two or more types of atoms. It would no longer retain the characteristics of water if it were compounded of one atom of hydrogen and two atoms of oxygen. If a drop of water is divided in two and then divided again and again until it cannot be divided any longer, it will still be water.

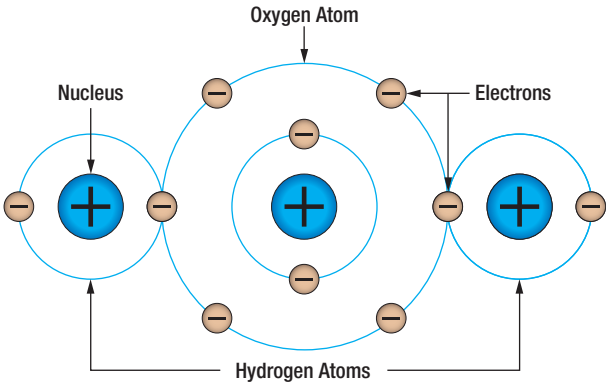

Figure 1-1. A water molecule.

ATOMS

The atom is considered to be the most basic building block of all matter. Atoms are composed of three subatomic particles. These three subatomic particles are: protons, neutrons, and electrons. These three particles will determine the properties of the specific atoms. Elements are substances composed of the same atoms with specific properties. Oxygen is an example of this.

The main property that defines each element is the number of neutrons, protons, and electrons. Hydrogen and helium are examples of elements. Both of these elements have neutrons, protons, and electrons but differ in the number of those items. This difference alone accounts for the variations in chemical and physical properties of these two different elements. There are over a 100 known elements in the periodic table (***Figure 1-2***), and they are categorized according to their properties on that table. The kinetic theory of matter also states that the particles that make up the matter are always moving. Thermal expansion is considered in the kinetic theory and explains why matter contracts when it is cool and expands when it is hot, with the exception of water/ice.

IONS

An ion is an atom or molecule that has a non-zero net electrical charge (its total number of electrons is not equal to its total number of protons). A cation is a positively charged ion, while an anion is negatively charged. Because of their opposite electric charges, cations and anions attract each other and readily form ionic compounds such as salts.

Periodic Table of Elements

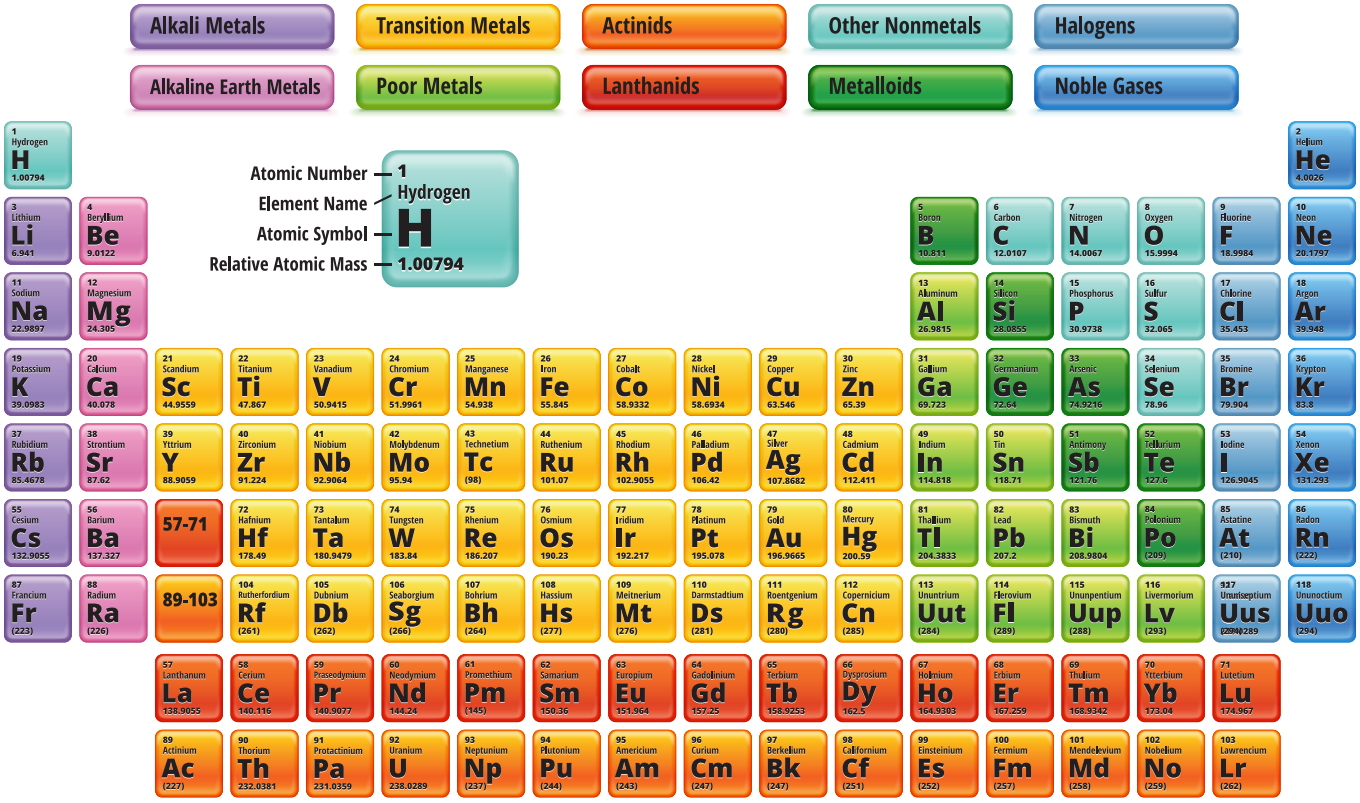

Figure 1-2. Periodic table of elements.

ELECTRONS, PROTONS, AND NEUTRONS

At the center of the atom is the nucleus, which contains the protons and neutrons. The protons are positively charged particles, and the neutrons are a neutrally charged particle. The neutron has approximately the same mass as the proton. The third particle of the atom is the electron that is a negatively charged particle with a very small mass compared to the proton. The proton's mass is approximately 1 837 times greater than the electron. Due to the proton and the neutron location in the central portion of the atom (nucleus) and the electron's position at the distant periphery of the atom, it is the electron that undergoes the change during chemical reactions. Since a neutron weighs approximately 1 845 times as much as an electron, the number of protons and neutrons in its nucleus determines the overall weight of an atom.

The weight of an electron is not considered in determining the weight of an atom. Indeed, the nature of electricity cannot be defined clearly because it is not certain whether the electron is a negative charge with no mass (weight) or a particle of matter with a negative charge.

Hydrogen represents the simplest form of an atom, as shown in ***Figure 1-3***. At the nucleus of the hydrogen atom is one proton and at the outer shell is one orbiting electron. At a more complex level is the oxygen atom, as shown in ***Figure 1-4***, which has eight electrons in two shells orbiting the nucleus with eight protons and eight neutrons. When the total positive charge of the protons in the nucleus equals the total negative charge of the electrons in orbit around the nucleus, the atom is said to have a neutral charge.

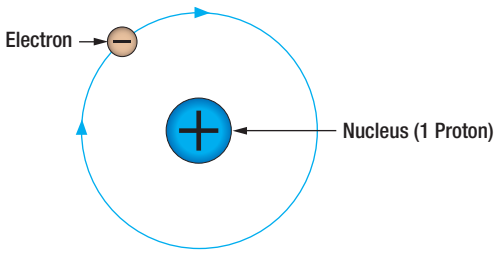

Figure 1-3. Hydrogen atom.