

EXPLORING ATOMS

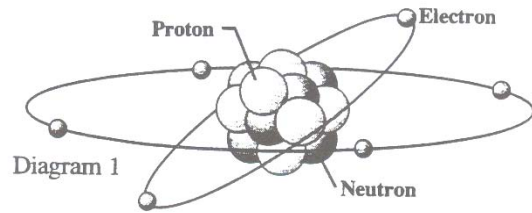
Introduction

Atoms

All physical entities are made of matter. Matter is anything which has mass and takes up space. There are three common states of matter – solid, liquid, and gas – on earth. A rare fourth form of matter here on earth, plasma, is actually the most abundant form of matter in the universe; it makes up the sun and other stars. A solid will have a definite fixed shape and volume. A liquid will have a definite volume, but will take the shape of its container. A gas has no fixed shape or volume.

Although the old Bohr model of the atom pictured below is extremely simplistic, and does not truly portray the appearance of an atom, it can serve as a starting point for the study of atoms.

An atom consists of neutrons and protons in a central nucleus being orbited by electrons. Neutrons have no charge and have a mass of approximately 1. Protons are positively charged and have a mass of approximately 1. Electrons orbiting around the nucleus have a charge of -1 and a mass only $1/1860$ that of a proton or neutron. (Diagram 1)



More than 99.9% of an atom's mass is centered in the nucleus. Atoms are mostly composed of empty space. In an atomic nucleus were enlarged to the size of a golf ball, the nearest electrons would be orbiting a kilometer away.

Electrons are located in discrete shells called orbitals. The first orbital away from the nucleus can hold 2 electrons, the next 8 electrons, and the next 8 or 18 electrons.

Questions

1. What is matter? _____

2. List and define the three common states of matter.
 - a. _____
 - b. _____
 - c. _____
3. Draw and label an atom. (Use words: Nucleus, neutrons, protons, electrons, orbital)

4. Where is most of an atom's mass located? _____

Elements

Elements are substances which cannot be broken down into simpler parts. An element contains only one type of atom. There are 90 naturally occurring elements; this means they have been made by the fusion process in a star. Twenty five of the elements are found in living things, but only four carbon, hydrogen, oxygen, and nitrogen – make up 96% of living tissue. Elements have been arranged by their characteristics into the Periodic Table of the Elements. The Periodic Table gives the atomic mass and atomic number of an element, and the number of protons, electrons, and neutrons of an element can be determined from the Table.

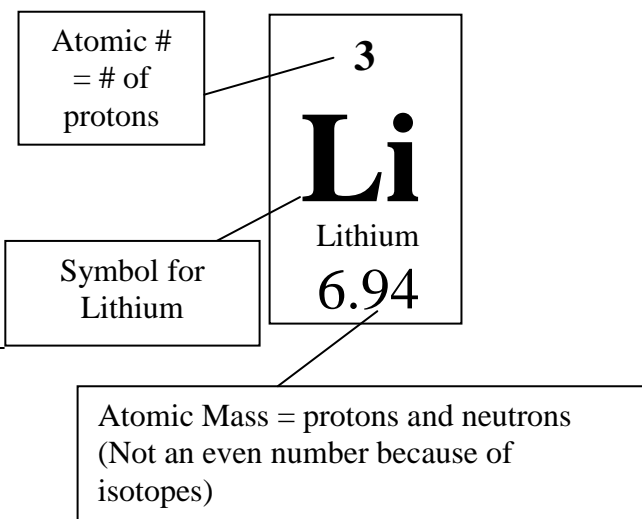
The atomic number is the number of protons in the nucleus. The atomic mass is the number of protons and neutrons added together. In an electrically neutral atom, the number of protons will equal the number of electrons, so the atomic number will also be an indication of the number of electrons. The number of neutrons can be determined by subtracting the atomic number (protons) from the atomic mass (protons + neutrons – rounded to the nearest whole number). Lithium (Diag. 2) has a rounded atomic mass (protons + neutrons) of 7 and an atomic number (protons) of 3. The number of electrons is equal to the number of protons = 3. The number of neutrons is calculated as $7 - 3 = 4$.

Diagram 2

5. What is an element? _____

6. Where are elements made? _____
7. How many elements are found in living things? _____
8. Which elements account for most of living tissue? _____

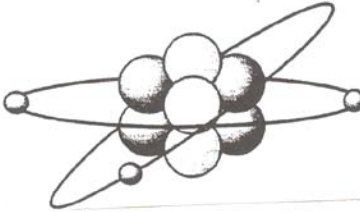
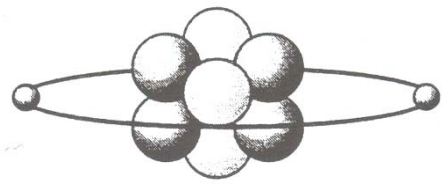
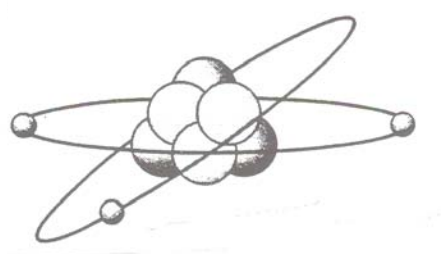
9. Where are elements organized? _____



Isotopes and Ions

When an element gains or loses a proton, a different element is formed. For example, if one proton is added to mercury, gold is formed. However, there are two ways atoms can change but still remain the same element. If an atom gains or loses electrons, it becomes an **ion**. If the atom loses electrons, it becomes positively charged. If it gains electrons, it becomes negatively charged. If an atom gains or loses neutrons, it becomes an **isotope**. While the charge on the atom does not change, the mass of the atom does change. Many isotopes such as ^{14}C are radioactive.

Diagram 3

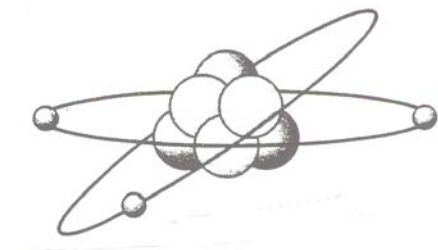
<p>Mass Protons = 3 <u>Neutrons = 3</u> Mass = 7</p> <p>Charge Protons = 3 <u>Electrons = -3</u> Charge = 0</p>  <p>Li Atom</p>	<p>Mass Protons = 3 <u>Neutrons = 4</u> Mass = 7</p> <p>Charge Protons = +3 <u>Electrons = -2</u> Charge = +1</p>  <p>Li Ion</p>	<p>Mass Protons = 3 <u>Neutrons = 3</u> Mass = 6</p> <p>Charge Protons = +3 <u>Electrons = -3</u> Charge = 0</p>  <p>Li Isotope</p>
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Questions:

- How is a different element formed?
- Diagram and describe how an ion is formed.
- Diagram and describe how an isotope is formed.
- Analyze the Li atoms on your Lab Data Sheet and determine whether they are ions or isotopes.

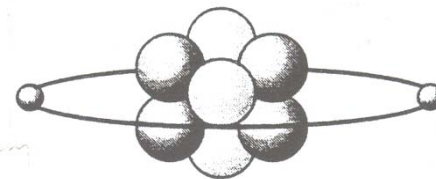
a. _____

b. _____



Mass
Protons = _____
Neutrons = _____
Mass = _____

Charge
Protons = _____
Electrons = _____
Charge = _____



Mass
Protons = _____
Neutrons = _____
Mass = _____

Charge
Protons = _____
Electrons = _____
Charge = _____

Activity - Using the Periodic Table

Element	Protons	Electrons	Neutrons
Hydrogen			
Gold			
Carbon			
Zinc			