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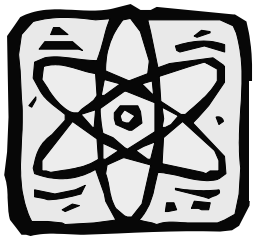

Chemistry Review

Atoms are very, very small particles of matter. Atoms that are identical to each other make up ***elements***. There are over 100 known elements. Oxygen, Hydrogen, and Carbon are examples of elements that are commonly found on Earth. The smallest part into which an element may be divided while keeping all of the characteristics of that element is an atom; an individual atom of any element has all the ***properties*** of that element.

For a long time, scientists believed that atoms were the smallest part of matter. Now that we have the technology to "split" an atom, we know that an atom is made up of smaller particles called ***protons***, ***neutron***, and ***electron***. These in turn are made up of even smaller particles with strange names like quark, meson, gluon, etc. We are going to concentrate on the protons, neutrons, and electrons.

Protons, neutrons, and electrons do *not* have the properties of the element. They do have characteristics of their own:

- ⇨ A proton has a positive electrical charge, it has a mass of 1 ***A***tomic ***M***ass ***U***nit (AMU), it is located in the nucleus, or center of the atom

- ⇨ An electron has a negative electrical charge, it has such a small mass, we can consider it to be 0, it is located around the outside of the nucleus in orbitals
- ⇨ A neutron has no electrical charge, it has a mass of 1 AMU, it is located in the nucleus of the atom

The number of protons an atom has determines most of the properties of the atom. Each different atom has a different number of protons. Atoms with the same number of protons are the same element, even if they have different numbers of electrons or neutrons.

Hydrogen is different from other atoms because Hydrogen usually does not have a neutron in its nucleus. The hydrogen atom is made of 1 proton and 1 electron, but no neutron.

The ***Periodic Table*** is a way of organizing atoms and elements. Each element is identified by a ***symbol***. The symbol for hydrogen is H, the symbol for oxygen is O, the symbol for carbon is C, and so on.

The columns that go up and down on the period table are called ***groups***. Groups are labeled with a Roman number at the top of each column. Elements in a group have similar structural properties. They usually have the same number of electrons in their last, or outer orbital.

The Periodic Table also shows the ***atomic number*** of the element. This is the number of protons (and usually electrons) in one atom of the element.

Elements are arranged from left to right and top to bottom in order of increasing mass. The table starts with Hydrogen, with an atomic number of 1 and a mass number of 1. The ***mass number*** is the sum of the protons and neutrons in the nucleus.

Only the lighter elements occur in living organisms. In general, organisms are made up of about 25 of the elements in the top four rows of the periodic table. Six of these elements are extremely important because they make up the four major groups of molecules found in living things: carbohydrates, lipids (fats), proteins, and nucleic acids. These elements are Carbon, Hydrogen, Nitrogen, Oxygen, Phosphorous, and Calcium. Living cells contain anywhere from 65 to 90% water by weight, so most of the body's mass is oxygen. Carbon takes second place. Together, the top six body elements - Oxygen, Carbon, Hydrogen, Nitrogen, Calcium, and Phosphorus – make up about 99% of the body's mass.

Element	*Composition by Weight (%)*
O	65
C	18
H	10
N	3
Ca	1.5
P	1.0
K	0.35
S	0.25
Na	0.15
Mg	0.05
Cu,Zn,Se,Mo,F,Cl,I,Mn,Co,Fe	0.70
Li,Sr,Al,Si,Pb,V,As,Br	traces

Use your periodic table to fill in this chart and answer the questions.

Symbol	*Atom*	*Atomic Number*	*Atomic Mass*	*Group*
C	Carbon			
H				
N				
O				
P				
Ca				

1. Which of the other five elements in this chart is most like Oxygen? Explain your answer ***using a complete sentence***.

   _____

   _____

2. Which of the other five elements in this chart is most like Nitrogen? Explain your answer ***using a complete sentence***.

   _____

   _____

There are over 12 million different substances on Earth. Each is made from the different combinations of just over 100 atoms.

Combinations of atoms are called molecules. A ***molecule*** is a part of matter that is made up of more than one atom. Molecules may contain one or more than one kind of atom. Molecules may be solids, liquids, or gases. ***Compounds*** are made up of two or more different kinds of atoms. Compounds are identified by ***formulas***; the symbols of the elements in that compound and the number of atoms of the element. $C_{20}H_{30}O$ is formula for vitamin A. One molecule of vitamin A has 20 atoms of Carbon, 30 atoms of Hydrogen and 1 atom Oxygen. Billions of the same kind of molecule together make a ***homogeneous*** substance. A homogeneous substance is one that is made up of the same kind of molecules or atoms.

Chemical changes occur because of atoms. A chemical change, or ***chemical reaction*** happens when atoms are combined, separate or

rearranged. Atoms are *not* created, destroyed, divided into parts, or converted into other kinds of atoms in chemical reactions. Living things are filled with continual chemical reactions. Digestion is a good example of a chemical reaction in living things.

The cells of living organisms are so small that we usually have to use microscopes to see them. Yet, even one single cell is made up of billions of atoms and molecules. We cannot see small molecules like water, but we can see very large molecules (called ***macromolecules***) like DNA with special microscopes like the electron or scanning tunnel microscope.

The macromolecules in living things use these elements:
Carbohydrates (sugar, starch, etc.) use carbon (C), hydrogen (H) and oxygen(O), almost equally, and are often abbreviated as "CHO's".

Proteins use carbon (C), hydrogen (H), oxygen (O), nitrogen (N), and sulphur (S) for their building blocks, and they are often "decorated" with phosporus (P). ***Fats*** are almost entirely carbon (C) and hydrogen (H) with very little oxygen (O). The "Phospho-lipids" that make up the cell walls also contain phosphorus (P) and usually some nitrogen (N). ***Nucleic Acids*** (DNA and RNA) are composed of carbon (C), hydrogen (H), oxygen (O), nitrogen (N), and phosphorus (P). Most of the body (over 80%) is salt water: sodium chloride (NaCl) and a little potassium chloride (KCl) dissolved in water (H_2O). ***Bone*** is made of calcium (Ca), phosphorus (P), oxygen (O), and hydrogen (H). The other elements are used by protein "enzymes" to run most of the body's chemical reactions: magnesium (Mg) and manganese (Mn) are important for making DNA; Iron (Fe) is needed to

carry oxygen in the blood and using it in the cell; many proteins need calcium (Ca) and zinc (Zn) to stay folded properly for them to work; and iodine (I) and the trace elements have more specific jobs in making hormones and coordinating other chemical reactions.

Answer the questions below ***using complete sentences***:

1. The formula for vitamin C is $C_6H_6O_6$. Name the elements and the number of atoms of each element in one molecule of vitamin C.

   _____

   _____

   _____

   _____

   _____

2. If there are only 100+ different elements, why are there over 12 million different substances?

   _____

   _____

   _____

   _____

   _____

   _____

3. Make a *bar graph* to show the *Mass Numbers* of the 10 most common elements in a living organism. Remember title & labels.