Review: Unit 2: Chemistry

Matter: Anything that takes up space and has mass.

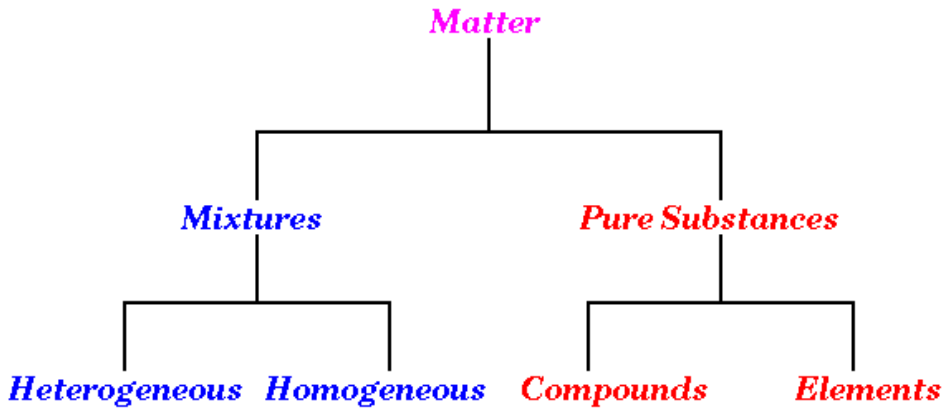
♦ States of matter

Solid- When matter is in this state, the particles do not have enough energy to move so they only vibrate at one spot. Particles are closely packed in an ordered array; and have very strong attractive forces.

Liquid- When matter is in this state, the particles have enough energy to move around.;they rotate, and take the shape of the container and have a definite volume.

Gas- When matter is in this state, the particles have enough energy to move around freely, the particles translate. Particles have very weak attractive forces of attraction, and they expand to fill the container.

♦ Classification of matter



♦ **Mixtures:**

Heterogeneous- A mixture that has more than 1 phase throughout, and is of non-uniform composition.

Homogenous- A mixture that has only 1 phase throughout and is of uniform composition.

♦ **Pure Substances:**

Elements- A substance that cannot be broken down by any chemical means into simpler substances. All the atom of the same element have same atomic number.

Compounds- Combination of 2 or more atoms bonded together by chemical means in such a way that the resultant compound has entirely different chemical properties from the elements it is made up of.

♦ Changes in matter

Physical Change- Change in matter, in which no new substance forms but the appearance, smell, taste might be changed. No new substance is formed, and the change is reversible.

Chemical Change- Change in matter, in which new substance forms which has entirely different properties from the starting substance; and the change is not reversible.

♦ Properties of matter

Physical Property- Any property that can be observed or measured such as taste, smell, colour, density.

Chemical Property-Any property that describes how a substance reacts with another substance when forming a new substance such as combustibility, rusting, respiration, and photosynthesis.

Physical properties can further be classified as:

Qualitative Property- Any characteristic that can only be described but not measured.

Quantitative Property- Any characteristic that can be measured numerically.

Density

Density- The amount of mass in a certain unit volume of a substance.

$$D = \frac{M}{V}$$

where M is mass and V is volume.

Example: A chunk of silver has a volume of 2.00 cm^3 and a mass of 21.0 g. Determine the density of the silver.

G- Mass of 21.0 g
Volume of 2.00 cm^3
R- Density
A- D = M/V
S- 21.0 g / 2.00 cm^3 = 10.5g/cm^3
S- Therefore, the density of the chunk of silver is 10.5 g/cm^3

Mixtures

A mixture is made up of two substances:

Solvent- A substance that dissolves a solute, and is usually present in large quantity. For example, the solvent in saltwater is water.

Solute- A substance that is dissolved by a solvent, usually present in smaller quantity. Salt would be the solute from the previous example.

***Alloy-** Homogenous mixture of one or more metals such as bronze or woods metal.

Mechanical Mixtures

There are three types of mechanical mixtures:

Mechanical Mixture- The different parts are big enough to see and they remain separated.

Suspension- Particles can be seen with low-power microscope or an unaided eye. Gravity separates the suspended particles according to their mass.

Colloid- In a suspension, if the particles are too light, gravity will not cause them to separate and the particles will stay suspended. This is called a Colloid.

***Emulsifying Agent-** Prevent suspension from separating such as soap.

Laws

Law of conservation of mass- In a chemical change, the total mass of new substance is always the same as the total mass of the original substances.

Law of definite proportions- All compounds are combined in fixed proportions.

Dalton's Atomic Theory

- All matter is made up of small particles called atoms.
- Atoms cannot be created, destroyed, or divided into smaller particles.
- All atoms of the same element are identical in mass and size, but they are different in mass and size from the atoms of another element.
- Compound are created when atoms of different elements link together in definite proportions.

Classification of Elements

Metals- Elements that can conduct heat and electricity, are malleable, ductile, and are usually silvery shiny solids of high melting points.

Non Metals- Elements that are poor conductors of heat and electricity, not ductile or malleable or shiny. Usually occur as liquids or gases or soft coloured waxy solids of low melting points

Metalloids- Elements that have properties between Metals and Non Metals.

Minerals

Metallurgy- The science and technology of retrieving metals from earth and making them as useful as possible.

Metallurgy includes three main steps

Extraction- Method in which a mineral is extracted from the earth in the form of ore

Mineral- Solid pure substance that occurs naturally in Earth's crust.

Ore- Impure form of mineral found in chunks or rocks.

Modification- Process in which the properties of pure metal is changed without a chemical change by using methods such as tempering.

Tempering- Changing the properties of metal by heating, beating and sudden cooling.

Alloying- Making an alloy by mixing metals together to make the product much more stronger.

The Periodic Table

Periodic Table- A table in which the elements are organized into rows and columns according to their atomic numbers and their patterns of similar properties.

Group- Name for each vertical column in the periodic table
Period- Name for each horizontal row of the periodic table.
Chemical Family- A group of elements with similar chemical properties..

In 1860s, a Russian chemist, Dimitri Mendeleev made cards for each element and set them in a particular order. He played around with the cards to find out a pattern. He arranged the elements in increasing mass. Keep in mind that he had many gaps in his periodic table since many of the elements were unknown at that time.

Characteristics of Some Groups.

Alkali metals- Located in Group 1, these metals are the most reactive metals. Their reactivity increases as up go down the group. They react with air and vigorously when exposed to water.

Halogens- Located in Group 17, these are the most reactive non-metals. Unlike Alkali metals, their reactivity decreases as you go down the group.

Alkali Earth metals- Located in Group 2, these metals are also reactive metals, and they are mainly obtained from Earth's crust.

Noble Gases- Located in group 18, they are the most unreactive gases compared to any element. They are also, sometimes called the "**Inert Gases**".

Probing the Atom

In 1821, Humphry Davy discovered that gases conduct electricity much better if trapped and the pressure is reduced.
Scientists followed up on his discovery and trapped air in a gas discharge tube made up of electrodes. By removing some air from the tube, they activated the power source and the gas began to glow.
Heinrich Geissler made a better gas discharge tube and observed that if the pressure is lowered too much, the end opposite to cathode begins to glow.

Anode- Positively charged electrode.
Cathode- Negatively charged cathode.
Cathode rays- Rays coming from the cathode and traveling to the anode.

Crooke conducted an experiment of Pin Wheel and discovered that cathode rays have a mass as well as charge.

Sub-atomic Particles- Proton and Neutron became known as subatomic particles.

Radioactivity- Discovered by Marie Curie, to describe the emission of rays by certain elements.

Rutherford discovered and named these particles which are emitted by radioactive substances:

Alpha- Negatively charged particles having a mass and having same charge as an electron.

Beta- Positively charged particles having mass and same charge as two protons.

Gamma- Energy particles having no mass and no charge.

After performing an experiment, Rutherford concluded that an atom must contain:

A Nucleus- a tiny core that is very small in volume, dense compared to rest of atom and has all the positive charge of an atom.

An electron Cloud- Very large in volume compared to the nucleus, and negatively charged.

Isotopes- Atoms of same element having same volume, same charge but more mass because of an excess of neutrons. The atoms of the element have the same atomic number but a different atomic mass; that is the atoms have the same number of protons and same number of electrons but a different number of neutrons.

Chemical Bonding

Stable Octet- An atom having all of its shells completed.

Ionic Compounds

When an ionic compound is formed, the electrons are transferred from one atom to another atom. For example, Sodium has only 1 electron in its outer shell, by giving that electron away, it can have a stable octet. Since fluorine needs an electron to have a stable octet, it receives the electron from sodium. Having 1 less electron in sodium, sodium becomes positively charged by one unit, whilst fluorine become negatively charged bu one unit because of the gain of an electron. Therefore, both of the oppositely charged sodium ion and the fluoride ion attract each other and form a new compound that is different from the atoms of sodium and fluorine. The ionic compound is called Sodium fluoride, formula NaCl.

Molecular Compound

Also called covalent compounds, these compounds are formed by sharing of electron. For example, oxygen, needs 2 electrons to fill its outer shell. Hydrogen needs 1. Since oxygen wants 2 more electrons, it gets two hydrogen atoms and share their electrons. That way, all the atoms have a stable octet; forming H— O— H, formula H_2O, named as dihydrogen monoxide.

Difference between ionic and covalent compounds

-Strength is almost the same in each bond type.

- In ionic bonding, electrons are transferred, in covalent electrons are shared.

– In ionic bonding, positive, (cation), and negative ions, (anion), are formed, in covalent, a molecular covalent compound is formed.

--In ionic compound, a giant crystalline lattice structure is formed, where each ion is attracted to many oppositely charged ions.

-In molecular compound, the bonding between individual molecules, (intra-molecular), is weak, but the covalent bonds within the atoms, (inter-molecular) which form the molecule are strong.