Chemistry Study sheet unit 3

Substance – Matter that has a uniform and unchanging compostion.

Physical property – A property that can be observed without changing the composition of the element or compound.

Because substances have an unchanging composition, they also have unchaniging physical properties such as density, color, odor, taste, hardness, melting point, boiling point etc.

Extensive properties are dependent on the amount of the substance present.

Intensive properties are independent of the amount of the substance present.

The ability for a substance to combine with other substances is called a chemical property.

States of matter –

Solid – a form of matter that has its own definite shape and volue.

Liquid – A form of matter that flows and has a constant volume and takes the shape of its container.

Gases – A form of matter that flows to conform the shape of the container and fills the entire volume of it.

Vapor – Refers to the gaseous state of a substance that is a solid or a liquid at room temp.

Physical Change - A change of a substance that does not influence its chemical composition.

As with other physical properties the state of matter depends on the temperature and pressure of the surroundings.

Chemical Change – A process that involves one or more substances changing into a new substance.

Law of conservation of mass – states that mass is neither created nor destroyed during a chemical reaction—it is conserved.

In equation form the law of conservation of mass looks like this

Massreactants = Massproducts

(The French scientist Antoine Lavoiser was the first one to use an analytical balance like the one shown above).

For equations that involve the law of conservation of mass involve the solving for known’s to produce an unknown. Its simple arithmetic. The mass sum of the compound is equal to the mass of the first compound + the mass of the second compound, nothing fancy.

Mixture – A mixture is a combination of two or more pure substances in which each pure substance retains its individual chemical characteristics.

Example of mixture – Sand and water.

Heterogeneous Mixture is a mixture that does not blend smoothly throughout and the individual substances remain distinct.

Homogeneous Mixture – this type of mixture has a constant composition throughout and is always in a single phase.

Homogeneous mixtures are also referred to as solutions.

Types of Solution Systems:

Gas-Gas

Gas-Liquid

Liquid-Gas

Liquid-Liquid

Solid-Liquid

Solid-Solid

It possible to separate mixtures by physical means and there are three processes by which we can go about doing this.

Filtration: A technique that uses a porous barrier to separate a solid from a liquid. The mixture is poured through a piece of filter paper that has been folded, the liquid passes through leaving the solids trapped in the filter paper.

Distillation – A separation technique that is based on the differences in boiling points of the substances involved. (In distillation a mixture is heated until the substance with the lowest boiling point boils to vapor that can then be condensed into a liquid and collected. )

Crystallization- A separation technique that results in the formation of pure solid particles of a substance from a solution containing a dissolved substance. ( When the solution contains as much dissolved substance as it can possibly hold, the addition of a tiny amount more often causes the dissolved substance to come out of a solution and collect as crystals on some available surface.

Crystallization produces highly pure solids.

Chromatography – A technique that separates the components of a mixture on the basis of the tendency of each to travel or be drawn across the surface of another material called stationary phase.

Element- a pure substance that cannot be separated into simpler substances by physical or chemical means.

91 elements occur naturally on earth.

Hydrogen makes up 75 percent of the mass in the universe. Oxygen and silicon comprise 75 percent of the earths crust.

Dimitri Mendeleev was accredited with creating the first periodic table in 1869. This would eventually evolve into the periodic table of elements that appear today. This table organizes elements into groups and periods.

Elements in the same group have similar chemical properties. The table was called periodic because the pattern of similar properties occurs as you move across the group.

Mendeleev original table could accommodate elements that were not yet known at the time.

Compound – A combination of two or more different elements that are combined chemically.

Today there are approximately 10 million known compounds.

Compounds can be broken down into simpler substances unlike elements. Separating a compound usually requires some amount of energy applied to it such as heat or electricity.

For example the process of separating water into hydrogen and oxygen requires electricity and is called electrolysis.

Law of definite proportions : This law states that regardless of the amount a compound is always composed of the same elements in the same proportions by mass.

Percent By Mass : The ratio of mass of each element to the total mass of the compound as a percentage:

This is calculated through the implementation of the formula

Percent by mass = (mass of element/mass of compound) × 100

Examples:

Compound: Sucrose, Element: Carbon

Carbon Mass = 8.44 g carbon

Sucrose Mass = 20.00 g sucrose

(8.44/20.00) × 100 = 42.20 percent carbon

This means that despite the amount of sucrose that you have, it will always be comprised of approximately 42 percent carbon.

Law of multiple proportions: When different compounds are formed by a combination of the same elements, different masses of one element combine with the same relative mass of other element in a ratio of small whole numbers. Ratios of the relative amounts of any items or substances.

Basically this means that the same elements can work to form completely knew compounds. Examples:

H20 Water and H202 Hydrogen Peroxide

In order to determine the “mass ratios” by dividing the percent mass of one substance in a compound by the other mass in the compound.

In doing this for both compounds, you can divide mass ratio 1 by mass ratio 2 and get a small ratio that expresses the comparison between the amount of one element to another fixed element in both compounds.

Ex.

Percent Cu: 64.20 ---- Compound 1

Percent Cl: 35.80 ---- Compound 1

Mass ratio of Cu/Cl : 1.793 g Cu/ 1g Cl

Percent Cu: 47.27 --- Compound 2

Percent Cl: 52.73 ---- Compound 2

Mass ratio of Cu/Cl : 0.8964 g Cu/1 g Cl

(1.793 g Cu/ 1g Cl)/(0.8964 g Cu/1 g Cl) = 2.000

The Philosophers:

Democritus proposed that matter was not infinitely divisible. Believed matter was made up of tiny particles called atomos. Believed atoms cannot be destroyed, created, or further divided.

Aristotle then proposed that “nothingness” of empty space could not exist.

Question reference (Order of events : Atoms is a hard sphere 🡪 most of the atom is empty space 🡪 electrons exist in orbital’s outside the nucleus. )

John Dalton :

Dalton’s Atomic Theory (1803):

-All matter is composed of extremely small particles called atoms.

- All atoms of a given element are identical having the same size, mass, and chemical properties. Atoms of a single element are different from the elements of other elements.

-Different atoms combine in simple whole number ratios to form compounds.

-In a chemical reaction atoms are separated combined or rearranged.

- Atoms cannot be created, divided into smaller particles or destroyed.

Daltons atomic theory supports the law of conservation of mass as it demonstrates that in a chemical reaction no atoms are created or destroyed.

The smallest particle of an element that retains the properties of the elements is called an atom.

In order to visualize an atom, you have to use the “scanning tunneling microscope”.

Discovery of the electron: Sir William Crookes noticed a flash in a test tube of a substance.

This lead to the discovery of the cathode ray.

Negatively charged particles present in all forms of matter.

J.J Thomson determined the charge-to-mass ratio of the electron. He then compared this ratio to other known ratio and concluded that the electron was much smaller than any other charged particle known at the time.

The conclusion of this was that there did in fact exist subatomic particles that had a smaller mass than the atom itself.

Robert Milikan was in fact the first to determine the actual charge of the electron. In relativity the charge of the electron was 1-. But with the charge to mass ratio milikan concluded that the actual mass of the electron was 9.1 x 10-28 = 1/1840 mass of hydrogen atom.

J.J Thomson was also responsible for the formation of the plum pudding model which displayed evenly spread electrons layed out in an evenly distributed positive mass.

Later, a fellow named Ernest Rutherford conducted an experiment known as the gold foil experiment that involved shooting a beam of alpha particles at a thin piece of gold foil. He was aware of the plum pudding model and expected there to be only minor deflection.

The results of the experiment displayed very exetreme deflections of alpha particles at some point and slighter deflections, including some that passed right through. In essence there was a wide dispersion of alpha particles. What Rutherford concluded was that there was a centralized positive charge that was called the nucleus that contained the electron and the majority of the electrons mass.

This nucleus is extremely dense. Rutherford therefore introduced the nuclear atomic model which displayed the nucleus and the electrons that moved through the available space but were held in it due to the positive charge of the nucleus.

Rutherford had ultimately discovered the proton which had a relative charge of 1+.

James Chadwick is accredited with the discovery of the neutron whose mass is nearly equal to that of a proton, but carries no electrical charge. Together the mass of the protons, neutrons, and electrons account for the entire mass of the atoms.

If there is a question on the test regarding the order at which subatomic particles were discovered, it goes electron 🡪 proton 🡪 neutron.

Atoms are electrically neutral.

The number of protons in an atoms is considered to be the atomic number. (This statement is DIRECT) if your given an answer choice that says this and the atomic number is the number of electrons, always choose protons, the fact that it also defines the number of electrons is a mere coincidence.

When you have a notation with two numbers that appear one on top of another, followed by the symbol for an element, the top number represents the mass number and the bottom number represents the atomic number.

This kind of notation is used when showing isotopes which are atoms of the same element with the same number of protons but a different number of neutrons.

Number of neutrons = mass number – atomic number

Isotopes can also be represented as the full name of the element being dealt with and the mass number written right after it connected by a hyphen. For example carbon-14.

Differing isotopes have the same chemical behavior because chemical behavior depends on the number of electrons and not the number of neutrons

The Atomic Mass unit is defined as 1/12 the mass of a carbon-12 atom. However 1 amu also happens to be very close to the mass of one proton/neutron. Therefore we can approximate that the amu of an atom is its atomic mass.

Because the an element exists with multiple isotopes the atomic mass is actually the weighted mass of all the isotopes in that element.

In order to calculate this you have to calculate the percent abundance of each isotope

One example of this would be in calculating the atomic mass of chlorine. Chlorine exists naturally as 75 percent Chlorine-35 and 25 percent Chlorine-37. So you multiply the atomic mass of the first isotope (35) by its percent abundance (75) to determine its mass contribution. Then do the same for the other isotope. Chlorine-37 has a mass of about 37 multiply that by its percent abundance (25) and determine its mass contribution. Then add both mass contributions to determine the atomic mass of that substance which will be recorded in a.m.u.

Atomic Emission Spectra = A set of frequencies of electromagnetic waves emitted by atoms of an element.

For example when neon atoms are excited through the application of electricity, they release energy in the form of light.

The atomic emission spectra can be used to determine if an element is a member of an unknown compound.

The Bhor Model Of the Atom.

The lowest allowable energy state of an atom is called ground state. When an atom gains energy it is said to be in excited state. Thus atoms farther away from the nucleus have more energy that those closer to the nucleus.

If n = the numbered energy level increasing as you get farther from the nucleus, then the maximum number of electrons any given energy level can hold is represented as 2n2

Each orbit has a specific energy associated with it , and electrons will always seek the lowest energy level (that is closest to the nucleus).

When electrons go into an excited state, they gain energy and therefore jump to a more superficial energy level.

As electrons fall back into a less superficial energy level, energy is released in the form of light.

Rules for significant figures:

All non zero numbers are always significant.

All zeroes between non zero numbers are always significant.

All zeroes which are simultaneously to the right of the decimal point at the end of the numbers are always significant.

All zeroes which are written to the left of a written decimal point and are in a number that is greater than or equal to ten are always significant. Ex: 1000. 4 significant figures.

Rules for rounding significant figures:

If the digit to the right of the last significant figure is less than 5, do not change the last significant figure.

Ex: 2.532 🡪 2.53

If the digit to the right of the last significant figure is greater than 5, round up the last significant figure.

Ex .2.536 🡪 2.54

If the digit to the right of the last significant figure are a 5 followed by a nonzero deigit