

Chemical earth notes



The earth's solid outer mantle and crust * Mixtures: metal ores, sandstone, granite * Compounds: quartz/sand (SiO_2), calcite (CaCO_3) * Elements: oxygen, silicon, aluminium, iron, calcium, sodium, potassium, magnesium

Hydrosphere The earth's water * Mixtures: sea water * Compounds: water, carbon dioxide and sodium, calcium and magnesium chlorides and sulphates * Elements: oxygen, hydrogen, chlorine, sodium, magnesium

Atmosphere The mixture of gases surrounding the Earth * Mixtures: air Compounds: water, carbon dioxide, nitrogen dioxide, sulphur dioxide and carbon monoxide * Elements: nitrogen, oxygen, argon * Identify and describe procedures that can be used to separate naturally occurring mixtures of: * Solids of different sizes * Solids and liquids * Dissolved solids in liquids * Liquids * Gases * Assess separation techniques for their suitability in separating examples of earth materials, identifying the differences in properties which enable these separations

Separation Method	Property used in separation
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Sieving	Particle size of solids
Evaporation	Solubility
Crystallisation	Solubility
Distillation	Boiling points (big difference) of liquids
Fractional distillation	Boiling points (small difference) of liquids
Filtration	Particle size of solids and liquids
Decantation (using a separating funnel)	Density of immiscible liquids
Sedimentation and decantation	Density of solids
Magnetic separation	Magnetic properties

Describe situations in which gravimetric analysis supplies useful data for chemists and other scientists

Qualitative analysis – identifying components in a mixture

Quantitative analysis – calculating how much of each component is found in the mixture

Gravimetric analysis – quantitative analysis carried out by calculating its

mass Volumetric analysis – quantitative analysis carried out by calculating its volume Gravimetric analysis can be used to determine the: * composition of a mixture using physical separation techniques * percentage composition of a compound using chemical and physical separation techniques.

It can be used to determine the: * percentage by weight of ingredients (sugar, fat, fibre) in food. This analysis is recorded on the packaging. * purity and composition of alloys used for building construction * extent of heavy metal pollution in river water and human food * percentage composition of new compounds produced by chemical and medical research. * Apply systematic naming of inorganic compounds as they are introduced in the laboratory Ionic compounds: * Write the name of the metal first * Write the beginning of the non-metal * Add '-ide' as a suffix to the non-metal Covalent compounds: Use the normal element name for the first element and add the '-ide' suffix for the second element * The first element named is the one that occurs further to the left of the periodic table * If both the elements occur in the same group, the one lower down the group is named first (exception: oxygen is always name last, except when with fluorine) * The prefixes mono (1), di (2), tri (3), tetra (4), penta (5), hexa (6) are added to the front of each word to indicate the number of atoms present in each type * Identify IUPAC names for carbon compounds as they are encountered Series| Suffix| General Formula| Bonding in C series|

ALKANE| -ane| C_nH_{2n+2} | Single Bond C - C| ALKENE| -ene| C_nH_{2n} | Double Bond C = C| ALKYNE| -yne| C_nH_{2n-2} | Triple Bond C \equiv C| Prefix| Number of carbon| Meth| 1| Eth| 2| Prop| 3| But| 4| Pent| 5| Hex| 6| Hept| 7| Oct| 8| Non| 9| Dec| 10| 8. 2. 2 Although most elements are found in combinations on

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earth, some elements are found uncombined * Explain the relationship between the reactivity of an element and the likelihood of its existing as an uncombined element * Reactivity is a chemical property that is related to the electronic structure of the element.

As a result of this: * Unreactive elements can exist as free elements in nature. * Reactive elements combine with other substances in the environment to form compounds. * Examples of highly reactive metals include Group 1 and 2 metals such as potassium and magnesium. Examples of less reactive metals include gold, copper and titanium. * Examples of highly reactive non-metals include oxygen and fluorine. Examples of inert non-metals include helium and radon which belong to Group 8 (noble gases). The more reactive an element is, the less chance there is of finding it in the Earth as an uncombined element. * Classify elements as metals, non-metals and semi-metals according to their physical properties

Physical Property	Metals	Non-metals	Semi-metals
Appearance	Lustrous	Low sheen	Dull
Electrical conductivity	High	Low (semi-conductors)	Nil (insulators)
Heat conductivity	High	High	Low (insulators)
Malleability and ductility	High	Moderate	Nil (brittle)
Density	Generally high	Moderate	Low
Boiling point	Generally high	Very high	Low
Strength	High	Variable	Low

Examples| Sodium, Magnesium, Iron, Copper, Gold, Silver, Zinc, Mercury, Lead| Boron, Silicon, Arsenic, Tellurium, Germanium, Antimony| Hydrogen, Helium, Oxygen, Carbon, Nitrogen, Fluorine, Neon| * Account for the uses of metals and non-metals in terms of their physical properties The uses of metals and non-metals will be determined by their physical properties as well as their chemical properties

Metals – e. g. copper is used for electrical circuits (wiring) for its good conductivity of electricity and its low reactivity. Non-metals – e. g. neon is used for neon lighting for its low reactivity. * Process information from secondary sources and use a Periodic Table to present information about the classification of elements as: * Metals, non-metal and semi-metals * Solids, liquids and gases at 25°C and normal atmospheric pressure

8. 2. 3 Elements in Earth material are present mostly as compounds because of interactions at atomic level

* Identify that matter is made up of particles that are continuously moving and interacting Matter can exist in three states: solid, liquid and gas. | Solid | Liquid | Gas |

Particle position| Particles are close together & vibrating in the same place | Particles are close together & moving more freely | Particles are far apart & moving very freely | Diagram| | | Shape| Definite shape | Shape depends on container | Shape depends on container | Volume| Definite volume | Definite volume | Fills all available space | Compressibility| Cannot be compressed | Cannot be compressed | Can be compressed | * Describe qualitatively the energy levels of electrons in atoms Electrons surround the nucleus by orbiting in certain stationary energy levels.

Each of the energy levels can accommodate only a certain number of electrons. The $2n^2$ rule is used to determine the maximum number of electrons that are able to reside in each energy level. * Describe atoms in terms of mass number and atomic number Atoms are made up of three sub-atomic particles: protons, neutrons and electrons. Protons are positively charged particles, electrons are negatively charged and neutrons have no

charge. Protons and neutrons make up the nucleus and the electrons surround the nucleus in stationary energy levels.

The nucleus constitutes 99.95% of the mass of an atom. The atomic number (Z) of an element is the number of protons in the nucleus. The mass number (A) of an element is the total number of protons and neutrons in the nucleus. Electrons have a very small mass of 0.00055 amu compared with protons and neutrons. The mass of electrons of atoms are not considered since its relative mass to protons and neutrons is negligible. * Describe the formation ions in terms of atoms gaining or losing electrons Ions are formed due to the imbalance of protons and electrons.

In a neutrally charged atom, the number of protons equals the number of electrons. When an atom loses electrons, it becomes positively charged as there are more protons than electrons (becomes a cation). When an atom gains electrons, it becomes negatively charge as there are more electrons than protons (becomes a anion). * Apply the Periodic Table to predict the ions formed by atoms of metals and non-metals * Group 1 metals (Li, Na, K, Rb, Cs) all tend to lose one electron and therefore form singly charged positive ions: Li^+ , Na^+ , K^+ , Rb^+ , Cs^+ . Group 2 metals (Be, Mg, Ca, Sr, Ba) tend to lose two electrons and therefore form doubly charged positive ions: Be^{2+} , Mg^{2+} , Ca^{2+} , Sr^{2+} , Ba^{2+} . * Group 3 elements except for boron tend to lose three electrons and therefore form cations: Al^{3+} , Ga^{3+} , In^{3+} . * Group 6 elements (non-metals, O, S, Se, Te) tend to gain two electrons and thus form doubly charged negative ions: O^{2-} , S^{2-} , Se^{2-} , Te^{2-} . * Group 7 elements (non-metals, F, Cl, Br and I) all tend to gain one electron and therefore they form singly charged negative ions: F^- , Cl^- , Br^- , I^- . * Group 8

elements (non-metals; inert gases) will not form ions. The transition metals all lose electrons to form positive ions (for example Cr^{3+} , Fe^{2+} , Cu^{2+} , Ag^+ , Zn^{2+}), but it is not possible from a simple look at the Periodic Table to predict just how many electrons any particular atom will lose. * Apply Lewis electron dot structures to: * The formation of ions * The electron sharing in some simple molecules
Ions Covalent * Describe the formation of ionic compounds in terms of the attraction of ions of opposite charge Ionic bonds involve atoms losing and gaining electrons, thus forming ions (charged atoms).

The attraction of opposite charges (electrostatic force) is what brings ions together to form an ionic compound. * Describe molecules as particles which can move independently of each other The intermolecular force between molecules is a weak force in comparison to the intermolecular force holding the atoms of the molecule together. This weak force gives the molecule the ability to move independently. * Distinguish between molecules containing one atom (the noble gases) and molecules with more than one atom Some molecules are elements and some are compounds. Examples of molecules include: monatomic molecules * helium atoms, He argon atoms, Ar diatomic molecules * oxygen, O_2 * nitrogen, N_2 * hydrogen iodide, HI * carbon monoxide, CO triatomic molecules * ozone, O_3 * water, H_2O * sulfur dioxide, SO_2 * carbon dioxide, CO_2 tetra-atomic molecules * white phosphorus, P_4 * ammonia, NH_3 * Describe the formation of covalent molecules in terms of sharing of electrons Covalent bonds are attractive forces between atoms that occur because the atoms are sharing one or more pairs of electrons.

The shared pair of electrons orbits the nuclei of both atoms, thus holding the atoms together and form a covalent compound. There are three types of covalent bonds: single bond - One electron pair is shared. (e. g. water - H₂O)

* double bond - Two electron pairs are shared. (e. g. oxygen gas - O₂) *

triple bond - Three electron pairs are shared. (e. g. butyne - C₈H₆) *

Construct formulae for compounds formed from: * Ions * Atoms sharing

electrons Ionic bond: Na⁺ + Cl⁻ > NaCl (s) Covalent bond: 2H₂ + O₂ > 2H₂O

8. 2. 4 Energy is required to extract elements from their naturally

occurring sources * Identify the differences between physical and chemical

change in terms of rearrangement of particles Physical change is the change of state where no new substances are formed.

Particles of the substance remain the same. Chemical change is when new substances have been made, old bonds have been broken between the atoms in molecules and new bonds have been formed. They usually require a large input or output of energy and are not easily reversible.