

Atoms, Elements and Compounds

The Atom ? Smallest particle that can take place in a chemical reaction ? Consists of three sub-atomic particles, electrons, protons, neutrons

Electrons ? Negatively charged, found in energy shells outside the central part of the atom ? Move at very high speeds in orbit ? Have very negligible mass ? Mass is 0.0005 of a proton Protons ? Are positively charged and found in the nucleus of an atom ? Have a unit mass of one (ie. 1 a.m.u)

Neutrons ? Have no charge at all and are located in the nucleus ? Have a unit mass each 1 atomic mass unit (1 a.m.u) = 1.67×10^{-27} kg) The Atomic Number is also called the proton number (distinguishes element) The proton number equals the electron number so that charges balance The mass number is the total mass of the atom. Calculated with proton + neutron. (Electron neglected) Nucleon number: total number of particles inside the nucleus (ie. Protons + neutrons) Energy Shells ? Shells increase as they become full ? The first shell only contains 2 electrons and following shells contain 8 each Chemical Stability ? Electrons are spaced out regularly at intervals as shown below. The presence of unpaired electrons determines the chemical reactivity of the atom. ? The electrons in the outer shell of an atom are referred to as valence electrons ? If the valence electrons for the outer shell are not enough to fill the shell, then the atom is chemically reactive and unstable. (E.g. Sodium Na+) ? Atoms with fully filled outer shells such as noble gases, are chemically unreactive and stable. Noble Gases ? Also called inert gases have fully filled outer shelled atoms (E.g. Helium, Neon, Argon, Krypton) Electronic Configuration ? A group of numbers which show the arrangement of electrons in their various shells ? The numbers represent number of electrons in each shell starting with the innermost shell, separating each number (shell) by a comma E.g. He: 2, Ne: 2,8, O: 2,6 Isotopes ? Atoms of the same element having different mass #s but the same atomic number (ie. Different neutrons) ? Most elements exist as a mixture of their isotopes ? Hydrogen has 3 isotopes: Protium (0n), Deuterium (1n) and Tritium (2n). These are called H-1, H-2 and H-3 The two types of isotopes are: (i) Radioactive and (ii) Non-radioactive isotopes ? Radioactive isotopes are isotopes with an unstable nucleus (the general term for radioactive substances since they are all isotopes). ? Non-Radioactive isotopes are stable and unreactive Medical uses: ? Isotope cobalt-60 emits gamma radiation which can be used to sterilize medical equipment Industrial Uses: ? Uranium-238 can be used to estimate the ages of rocks Differences between Elements, Mixtures and Compounds ? An Element is a pure and simple substance which cannot be broken down into any simpler substances other than itself by any ordinary chemical means. ? A Mixture is made up of two or more substances physically mixed together. The components in a mixture can always be separated by physical means A compound is a pure substance which is made up of two or more elements chemically combined. When these combine chemically they lose their identities and the compound takes its own properties.

are held together by bonds ? Bond is formed by the use of a valence electron (ie. The electron in the outer shell of an atom.) ? Types are (i) Ionic (ii) Covalent (iii) Metallic Ionic Bonding ? The attraction between the positive and negative ions (anions and cations) formed by loss/gain of electrons (ie. Metals and non-metals) ? This attraction results in a chemical union known as bonding ? The union involves transfer of electrons ? It is exhibited by elements far apart in the periodic table (metals and non-metals) ? In the formation of sodium chloride (Na+Cl- are the ions in the compound) the metallic element (sodium) burns in chlorine (the non-metallic element). ? Sodium atom has 1 valence electron and will tend to lose this. Each sodium atom will lose one electron to become a sodium ion. Similarly, Chlorine has 7 valence electrons and needs to gain one to become chloride ion. ? Sodium atom outer shell and Chlorine outer shell now both contain 8 electrons. However, the two atoms are now bonded and share opposite charges. There is hence an electrostatic force between them holding them together. ? This electrostatic force is an ionic bond or electrovalent bond. ? Electrovalent bonds exist between electrovalent compounds. These compounds can conduct electricity when melted or dissolved. ? Magnesium Fluoride is also an ionic compound ? Magnesium (2,8,2) has two electrons in its outermost shell. It needs to lose these to gain a stable, full outer shell. Fluorine needs to gain one electron. One magnesium atom needs two fluorine atoms to accept two electrons. Formula is $Mg^{2+}2F^{-}$ or MgF_2 .

About the Author

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