CARBON COMPOUND CHEMISTRY pdf

1: Compounds of carbon - Wikipedia

Compounds of carbon are defined as chemical substances containing carbon. More compounds of carbon exist than any other chemical element except for hydrogen. Organic carbon compounds are far more numerous than inorganic carbon compounds. In general bonds of carbon with other elements are covalent bonds.

Organic chemistry is the study of carbon compounds. Discovery and naming Humans have been aware of carbon since the earliest of times. When cave people made a fire, they saw smoke form. The black color of smoke is caused by unburned specks of carbon. The smoke may have collected on the ceiling of their caves as soot. Later, when lamps were invented, people used oil as a fuel. When oil burns, carbon is released in the reaction, forming a sooty covering on the inside of the lamp. That form of carbon became known as lampblack. Lampblack was also often mixed with olive oil or balsam gum to make ink. And ancient Egyptians sometimes used lampblack as eyeliner. One of the most common forms of carbon is charcoal. Charcoal is made by heating wood in the absence of air so it does not catch fire. Instead, it gives off water vapor, leaving pure carbon. This method for producing charcoal was known as early as the Roman civilization B. He studied the differences between wrought iron, cast iron, and steel. The main difference among these materials, he said, was the presence of a "black combustible material" that he knew was present in charcoal. Carbon was officially classified as an element near the end of the eighteenth century. In , four French chemists wrote a book outlining a method for naming chemical substances. The name they used, carbone, is based on the earlier Latin term for charcoal, charbon. Coal, soot nearly pure carbon , and diamonds are all nearly pure forms of carbon. Physical properties Carbon exists in a number of allotropic forms. Allotropes are forms of an element with different physical and chemical properties. Two allotropes of carbon have crystalline structures: In a crystalline material, atoms are arranged in a neat orderly pattern. Graphite is found in pencil "lead" and ball-bearing lubricants. Among the non-crystalline allotropes of carbon are coal, lampblack, charcoal, carbon black, and coke. Carbon black is similar to soot. Coke is nearly pure carbon formed when coal is heated in the absence of air. Carbon allotropes that lack crystalline structure are amorphous, or without crystalline shape. The allotropes of carbon have very different chemical and physical properties. For example, diamond is the hardest natural substance known. It has a rating of 10 on the Mohs scale. The Mohs scale is a way of expressing the hardness of a material. It runs from 0 for talc to 10 for diamond. Its density is 3. On the other hand, graphite is a very soft material. It is often used as the "lead" in lead pencils. It has a hardness of 2. Sublimination is the process by which a solid changes directly to a gas when heated, without first changing to a liquid. Its density is about 1. The numerical value for these properties varies depending on where the graphite originates. The amorphous forms of carbon, like other non-crystalline materials, do not have clear-cut melting and boiling points. Their densities vary depending on where they originate. Chemical properties Carbon does not dissolve in or react with water, acids, or most other materials. It does, however, react with oxygen. It burns in air to produce carbon dioxide CO_2 and carbon monoxide CO. The combustion burning of coal gave rise to the Industrial Revolution Another highly important and very unusual property of carbon is its ability to form long chains. It is not unusual for two atoms of an element to combine with each other. Oxygen O_2 , nitrogen N_2 , hydrogen H_2 , chlorine Cl_2 , and bromine Br_2 are a few of the elements that can do this. Some elements can make even longer strings of atoms. Rings of six and eight sulfur atoms S_6 and S_8 , for example, are not unusual. Carbon has the ability to make virtually endless strings of atoms. If one could look at a molecule of almost any plastic, for example, a long chain of carbon atoms attached to each other and to other atoms as well would be evident. Carbon chains can be even more complicated. Some chains have side chains hanging off them. Arrangement of carbon atoms in a diamond. There is almost no limit to the size and shape of molecules that can be made with carbon atoms. Buckyballs are a recently discovered form of pure carbon. These spheres are made up of exactly 60 linked carbon atoms. Occurrence in nature Carbon is the sixth most common element in the universe and the fourth most common element in the solar system. It is the second most common element in the human body after oxygen. Its abundance has been estimated to be between and parts per million. It rarely occurs as a diamond or graphite. Carbon reacts with oxygen by burning in air. Both allotropes are formed in the earth over millions of years, when dead plant materials are squeezed together at very high temperatures. Africa has many diamond mines. Carbon also occurs in a number of minerals. Carbon also occurs in the form of carbon dioxide CO 2 in the atmosphere. Carbon dioxide makes up only a small part of the atmosphere about parts per million , but it is a crucial gas. Plants use carbon dioxide in the atmosphere in the process of photosynthesis. Photosynthesis is the process by which plants convert carbon dioxide and water to carbohydrates starches and sugars. This process is the source of life on Earth. Carbon also occurs in coal, oil, and natural gas. These materials are often known as fossil fuels. They get that name because of the way they were formed. They are the remains of plants and animals that lived millions of years ago. When they died, they fell into water or were trapped in mud. Over millions of years, they slowly decayed. The products of that decay process were coal, oil, and natural gas. Some forms of coal are nearly pure carbon. Oil and natural gas are made primarily of hydrocarbons, which are compounds made of carbon and hydrogen. Isotopes Three isotopes of carbon occur in nature, carbon, carbon, and carbon One of these isotopes, carbon, is radioactive. Isotopes are two or more forms of an element. Isotopes differ from each other according to their mass number. The mass number represents the number of protons plus neutrons in the nucleus of an atom of the element. The number of protons determines the element, but the number of neutrons in the atom of any one element can vary. Each variation is an isotope. Five artificial radioactive isotopes of carbon are known also. A radioactive isotope is one that breaks apart and gives off some form of radiation. Artificial radioactive isotopes can be made by firing very small particles such as protons at atoms. These particles stick in the atoms and make them radioactive. Carbon has some limited applications in industry. For example, it can be used to measure the thickness of objects, such as sheets of steel. The steel must always be the same thickness. Carbon is the sixth most common element in the universe and the fourth most common element in the solar system. In this process, a small sample of carbon is placed above the conveyor belt carrying the steel sheet. A detection device is placed below the sheet.

2: Introduction To Carbon and Compounds - Organic Compounds Structure

Carbon compounds are chemical substances that contain carbon atoms bonded to any other element. There are more carbon compounds than for any other element except hydrogen. The majority of these molecules are organic carbon compounds (e.g., benzene, sucrose), although a large number of inorganic carbon compounds also exist (e.g., carbon dioxide).

International Union of Pure and Applied Chemistry gave following rules for naming various compounds: Alcohol with three carbons is propanol. Carboxylic acid with three carbons is propanoic acid. Chemical properties of carbon compounds: Main properties of carbon compounds are: A chemical reaction in which a substance burns in the presence of air or oxygen is called combustion reaction. Saturated hydrocarbons can give sooty flame in limited supply of oxygen. The addition of oxygen in a compound upon combustion is called oxidation. In addition to combustion, oxidation can also be brought about by some substances which are capable of giving oxygen to others, i. Formation of larger molecules by addition of more radicals is known as addition reaction. For example; ethene is converted into ethane when heated with the catalyst nickel. Replacement of a functional group or any atom by another atom or functional group is known as substitution reaction. Substitution reactions are single displacement reactions. When methane reacts with chlorine gas in the presence of sunlight, it gives chloromethane and hydrogen chloride. General name of ethanol is ethyl alcohol. Ethanol is the main constituent of all alcoholic drinks Ethanol is soluble in water Ethanol is a very good solvent Ethanol is used in manufacturing of medicines, such as tincture iodine, cough syrup, etc. Taking even small quantity of pure ethanol may prove lethal Taking dilute ethyl alcohol can cause drunkenness Reaction of ethanol with sodium metal: When ethanol reacts with sodium, it gives sodium ethoxide and hydrogen gas. Ethanol gives ethanoic acid on oxidation. Ethanol gives ethene and water when it is heated with concentrated sulphuric acid. General name of ethanoic acid is acetic acid. Melting point of ethanoic acid is K. Ethanoic acid freezes in winter and hence it is also known as glacial acetic acid. Ethanoic acid is a colorless liquid. Vinegar is used as preservative in pickles. Carboxylic acids are weak acid compared to mineral acids. Reaction of ethanoic acid with base: Ethanoic acid gives sodium acetate when it reacts with sodium hydroxide. Ethanoic acid gives ethyl acetate when it reacts with ethanol in presence of conc. This reaction is called esterification reaction. Ethyl acetate is also known as ester. Ester is a sweet smelling compound. It is used in making perfumes and as a flavouring agent. When ethyl ethanoate reacts with a base or acid, it gives back ethanol and ethanoic acid. Hydrolysis of ester Ethyl ethanoate: Ethyl ethanoate gives parent alcohol and sodium ethanoate when heated with sodium hydroxide solution. Ester of higher fatty acids gives sodium salt of higher fatty acid; when heated with glycerol and sodium hydroxide. Sodium salts of higher fatty acid are known as soaps. This reaction is called saponification soap making. Reaction of ethanoic acid with sodium carbonate and sodium bicarbonate: Ethanoic acid gives sodium acetate, water and carbon dioxide when reacts with sodium carbonate or sodium bicarbonate sodium hydrogen carbonate. These acids are present in the form of their esters along with glycerol an alcohol containing three hydroxyl groups. Soap cannot form lather in hard water. To overcome this problem, detergents were introduced. Detergent is also known as soapless soap. Chemically, detergents are sodium salts of sulphonic acids, i. Cleansing action of soap: Soap molecule has two ends. One end is hydrophilic and another end is hydrophobic. In other words, one end is lipophobic hydrophilic and another end is lipophilic hydrophobic. When soap is dissolved in water and clothes are put in the soapy solution, soap molecules converge in a typical fashion to make a structure; called micelle. The hydrophobic ends of different molecules surround a particle of grease and make the micelle; which is a spherical structure. In this, the hydrophilic end is outside the sphere and hydrophobic end is towards the centre of the sphere. That is how, soap molecules wash away dirt and grease by making micelles around them. Soap and Hard Water: Hard water often contains salts of calcium and magnesium. Soap molecules react with the salts of calcium and magnesium and form a precipitate. This precipitate begins floating as an off-white layer over water. This layer is called scum. Soaps lose their cleansing property in hard water because of formation of scum. Detergents are used; instead of soaps; in hard water to overcome the problem. Detergents are usually ammonium or sulphonate salts of carboxylic acids. The charged ends of these compounds do not form precipitate with calcium or magnesium salts in hard water. Hence, detergents retain their cleansing property in hard water. The cleansing action of a detergent is considered to be more effective than a soap. Cleansing Action of Soaps and Detergents: The cleansing action of soaps and detergents follows the same principle. When a soap or detergent is dissolved in water, the molecules gather together as clusters, called micelles. The tails stick inwards and the heads outwards. In cleansing, the hydrocarbon tail attaches itself to oily dirt. When water is agitated, the oily dirt tends to lift off from the dirty surface and dissociates into fragments. This gives an opportunity to other tails to stick to oil. The solution now contains small globules of oil surrounded by detergent molecules. The negatively charged heads present in water prevent the small globules from coming together and form aggregates. Thus, the oily dirt is removed from the object. The insoluble precipitates formed by soap molecule when they react with calcium and magnesium ions present in hard water. Due to this, lot of soap gets wasted and cleansing action gets reduced to a larger extent.

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3: Common Names of Some Chemical Compounds

Inorganic Carbon. For more than years, chemists have divided compounds into two categories. Those that were isolated from plants or animals were called organic, while those extracted from ores and minerals were inorganic. Organic chemistry is often defined as the chemistry of carbon.

Student Answers krishna-agrawala Student Compounds are substances that have molecules containing atoms of more than one elements. Compounds are formed by chemical combination of elements. Perhaps the most common compound we know is water, which has the chemical formula H2O. Each molecule of water contains two atoms of hydrogen and one atom of oxygen. Some other common compounds include the following: Carbon dioxide gas CO2 formed by combination of carbon and oxygen. Human beings absorb oxygen from the air they breathe, which combines with carbon present in the food in the body to produce energy. During this process carbon dioxide is produces which is released with the air we breathe out. Common salt NaCl , which has the chemical name of sodium chloride and is composed of sodium and chlorine. Alcohol C6H5OH is an organic compound composed of carbon, hydrogen and oxygen. It must be in a fixed composition, and can be broken down by heat during thermal decomposition or by using electricity. There are many types of compound, like carbon dioxide carbon and oxygen , common salt sodium, chlorine , marble calcium, carbon, oxygen , copper II sulphate copper, sulphur, oxygen and hydrogen chloride chlorine and hydrogen. Water H2O is a compound made by joing together two atoms of hydrogen to one atom of oxygen and the ratio between them is 2: Some of the more common compounds are table salt which is NaCl. Soidium Nitrate is also known as Salt Peter and when combined with sugar makes smoke bombs. They are relatively safe to make but should be lit outside. Take a frying pan and heat the two ingredients until they melt and look Carmel colored. Put onto tin foil in small clumps. Take outside and light. Jyotsana Student Compound is made up more than 2 elements and compound can be broken up.

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4: Carbon - Wikipedia

Modern carbon chemistry dates from the development of coals, petroleum, and natural gas as fuels and from the elucidation of synthetic organic chemistry, both substantially developed since the s. bituminous coal Bituminous coal.

The atomic number of carbon is 6 and atomic mass is Carbon is a member of 14th group. According to the data, it is the seventeenth most abundant element found on earth. It is found in both free as well as in the combined state. You can find it available as coal, graphite in It is found in both free as well as in the combined state. You can find it available as coal, graphite in elemental state. Whereas it is present as metal carbonates, hydrocarbons and carbon dioxide gas in the combined state. When it combines with other elements such as dihydrogen, dioxygen, chlorine and sulphur provides amazing arrays of materials that can vary from tissues to medicines. In Organic Chemistry everything is surrounded around carbon compounds. It is one of the most essential components of the living organisms. There are two stable isotopes of carbon 12C and 13C.. After these two one more isotope of carbon is present 14C. Carbon is used for radiocarbon dating and it is also a radioisotope with the half-life of years. One of the most amazing properties of carbon is its ability to make long carbon chains and rings. This property of carbon is known as catenation. Just because of these two properties of carbon i. Do you know what does allotrope of carbon means? Allotrope is nothing but the existence of an element in many forms which will have different physical property but will have similar chemical properties and its forms are called allotropes or allotropic forms. C1 of glucose is linked to C2 of fructose Maltose: C1 of galactose is linked to C4 of fructose Submit.

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5: The Chemistry of Carbon

As per the syllabus you will cover the following topics: 1) Carbon compounds and covalent bonding. 2) Versatile nature of carbon. 3) Homologous series 4) Nomenclature of carbon compounds.

Inorganic Carbon For more than years, chemists have divided compounds into two categories. Those that were isolated from plants or animals were called organic, while those extracted from ores and minerals were inorganic. Organic chemistry is often defined as the chemistry of carbon. But this definition would include calcium carbonate CaCO3 and graphite, which more closely resemble inorganic compounds. The chemistry of carbon is dominated by three factors. Carbon therefore forms covalent bonds with many other elements. Carbon forms strong double and triple bonds with a number of other nonmetals, including N, O, P, and S. Carbon occurs as a variety of allotropes. There are two crystalline forms diamond and graphite and a number of amorphous noncrystalline forms, such as charcoal, coke, and carbon black. References to the characteristic hardness of diamond from the Greek adamas, "invincible" date back at least years. It was not until , however, that Smithson Tennant was able to show that diamonds consist solely of carbon. The properties of diamond are remarkable. The properties of diamond are a logical consequence of its structure. Carbon, with four valence electrons, forms covalent bonds to four neighboring carbon atoms arranged toward the corners of a tetrahedron, as shown in the figure below. Each of these sp3-hybridized atoms is then bound to four other carbon atoms, which form bonds to four other carbon atoms, and so on. As a result, a perfect diamond can be thought of as a single giant molecule. The strength of the individual C-C bonds and their arrangement in space give rise to the unusual properties of diamond. In some ways, the properties of graphite are like those of diamond. Both compounds boil at oC, for example. But graphite is also very different from diamond. Whereas diamond is the hardest substance known, graphite is one of the softest. Diamond is an excellent insulator, with little or no tendency to carry an electric current. Graphite is such a good conductor of electricity that graphite electrodes are used in electrical cells. The physical properties of graphite can be understood from the structure of the solid shown in the figure below. Graphite consists of extended planes of sp2-hybridized carbon atoms in which each carbon is tightly bound to three other carbon atoms. The strong bonds between carbon atoms within each plane explain the exceptionally high melting point and boiling point of graphite. The distance between these planes of atoms, however, is very much larger than the distance between the atoms within the planes. Because the bonds between planes are weak, it is easy to deform the solid by allowing one plane of atoms to move relative to another. As a result, graphite is soft enough to be used in pencils and as a lubricant in motor oil. This is fortunate because many people chew pencils and lead compounds are toxic. Increasing the percentage of clay makes the pencil harder, so that less graphite is deposited on the paper. The characteristic properties of graphite and diamond might lead you to expect that diamond would be more stable than graphite. This is not what is observed experimentally. At very high temperatures and pressures, diamond becomes more stable than graphite. In General Electric developed a process to make industrial-grade diamonds by treating graphite with a metal catalyst at temperatures of to K and pressures above , atm. Although gem-quality diamonds can be synthesized, the costs involved are prohibitive. Both diamond and graphite occur as regularly packed crystals. Other forms of carbon are amorphous they lack a regular structure. Charcoal, carbon black, and coke are all amorphous forms of carbon. Charcoal results from heating wood in the absence of oxygen. To make carbon black, natural gas or other carbon compounds are burned in a limited amount of air to give a thick, black smoke that contains extremely small particles of carbon, which can be collected when the gas is cooled and passed through an electrostatic precipitator. Coke is a more regularly structured material, closer in structure to graphite than either charcoal or carbon black, which is made from coal. Covalent, Ionic, and Interstitial Although carbon is essentially inert at room temperature, it reacts with less electronegative negative elements at high temperatures to form compounds known as carbides. When carbon reacts with an element of similar size and electronegativity, a covalent carbide is produced. Silicon carbide, for example, is made by treating silicon dioxide from quartz with an excess of carbon in an electric furnace at K.

6: Organic Chemistry:

Carbon and its Compounds - CBSE Notes for Class 10 Science. CBSE Notes CBSE Notes Science NCERT Solutions Science. 1. The earth's crust, has only % carbon in the form of minerals (like carbonates^bicarbonates, coal, and petroleum).

The number of isomers of a compound increases rapidly with additional carbon atoms. There are over 4 billion isomers for C30H62, for example. The Cycloalkanes If the carbon chain that forms the backbone of a straight-chain hydrocarbon is long enough, we can envision the two ends coming together to form a cycloalkane. One hydrogen atom has to be removed from each end of the hydrocarbon chain to form the C C bond that closes the ring. Cycloalkanes therefore have two less hydrogen atoms than the parent alkane and a generic formula of CnH2n. The smallest alkane that can form a ring is cyclopropane, C3H6, in which the three carbon atoms lie in the same plane. The angle between adjacent C C bonds is only 60, which is very much smaller than the Cyclopropane is therefore susceptible to chemical reactions that can open up the three-membered ring. Any attempt to force the four carbons that form a cyclobutane ring into a plane of atoms would produce the structure shown in the figure below, in which the angle between adjacent C C bonds would be One of the four carbon atoms in the cyclobutane ring is therefore displaced from the plane of the other three to form a "puckered" structure that is vaguely reminiscent of the wings of a butterfly. The angle between adjacent C C bonds in a planar cyclopentane molecule would be , which is close to the ideal angle around a tetrahedral carbon atom. Cyclopentane is not a planar molecule, as shown in the figure below, because displacing two of the carbon atoms from the plane of the other three produces a puckered structure that relieves some of the repulsion between the hydrogen atoms on adjacent carbon atoms in the ring. By the time we get to the six-membered ring in cyclohexane, a puckered structure can be formed by displacing a pair of carbon atoms at either end of the ring from the plane of the other four members of the ring. One of these carbon atoms is tilted up, out of the ring, whereas the other is tilted down to form the "chair" structure shown in the figure below. C Bonds As one looks at the structure of the ethane molecule, it is easy to fall into the trap of thinking about this molecule as if it was static. Nothing could be further from the truth. While it moves through space, the molecule is tumbling around its center of gravity like an airplane out of control. At the same time, the C H and C C bonds are vibrating like a spring at rates as fast as 9 x s There is another way in which the ethane molecule can move. The CH3 groups at either end of the molecule can rotate with respect to each around the C C bond. When this happens, the molecule passes through an infinite number of conformations that have slightly different energies. The highest energy conformation corresponds to a structure in which the hydrogen atoms are "eclipsed. The lowest energy conformation is a structure in which the hydrogen atoms are "staggered," as shown in the figure below. The difference between the eclipsed and staggered conformations of ethane are best illustrated by viewing these molecules along the C C bond, as shown in the figure below. But it is large enough that rotation around the C C bond is not smooth. Although the frequency of this rotation is on the order of revolutions per second, the ethane molecule spends a slightly larger percentage of the time in the staggered conformation. The different conformations of a molecule are often described in terms of Newman projections. These line drawings show the six substituents on the C C bond as if the structure of the molecule was projected onto a piece of paper by shining a bright light along the C C bond in a ball-and-stick model of the molecule. Newman projections for the different staggered conformations of butane are shown in the figure below. Because of the ease of rotation around C C bonds, there are several conformations of some of the cycloalkanes described in the previous section. Cyclohexane, for example, forms both the "chair" and "boat" conformations shown in the figure below. As a result, even though the rate at which these two conformations interchange is about 1 x s-1, we can assume that most cyclohexane molecules at any moment in time are in the chair conformation. The Nomenclature of Alkanes Common names such as pentane, isopentane, and neopentane are sufficient to differentiate between the three isomers with the formula C5H They become less useful, however, as the size of the hydrocarbon chain increases. Find the longest continuous chain of carbon atoms in the skeleton structure. Name the compound as a derivative of the alkane with this number of carbon atoms. The following compound, for example, is a derivative of pentane because the longest chain contains five carbon atoms. Name the substituents on the chain. Substituents derived from alkanes are named by replacing the -ane ending with -yl. This compound contains a methyl CH_3- substituent. Number the chain starting at the end nearest the first substituent and specify the carbon atoms on which the substituents are located. Use the lowest possible numbers. This compound, for example, is 2-methylpentane, not 4-methylpentane. Use the prefixes di-, tri-, and tetra- to describe substituents that are found two, three, or four times on the same chain of carbon atoms. Arrange the names of the substituents in alphabetical order.

7: What are some examples of compounds? | eNotes

The chemistry of carbon is richly variable and serves as the basis for life on Earth. Away from Earth, in the solar system and beyond, carbon and its compounds are abundant. Indeed, the range of chemical structures found on and off Earth are virtually countless. The variations in structure provide.

Only hydrogen , helium , oxygen , neon , and nitrogen are atomically more abundant in the cosmos than carbon. In the crust of Earth, elemental carbon is a minor component. However, carbon compounds i. Coral and the shells of oysters and clams are primarily calcium carbonate. Carbon is widely distributed as coal and in the organic compounds that constitute petroleum , natural gas , and all plant and animal tissue. A natural sequence of chemical reactions called the carbon cycle â€”involving conversion of atmospheric carbon dioxide to carbohydrates by photosynthesis in plants, the consumption of these carbohydrates by animals and oxidation of them through metabolism to produce carbon dioxide and other products, and the return of carbon dioxide to the atmosphere â€”is one of the most important of all biological processes. Thus, together with sulfur , iron , tin , lead , copper , mercury , silver , and gold , carbon was one of the small group of elements well known in the ancient world. Modern carbon chemistry dates from the development of coals , petroleum , and natural gas as fuels and from the elucidation of synthetic organic chemistry, both substantially developed since the s. Mineral Information Institute Elemental carbon exists in several forms, each of which has its own physical characteristics. Two of its well-defined forms, diamond and graphite , are crystalline in structure, but they differ in physical properties because the arrangements of the atoms in their structures are dissimilar. A third form, called fullerene , consists of a variety of molecules composed entirely of carbon. A fourth form, called Q-carbon, is crystalline and magnetic. Yet another form, called amorphous carbon, has no crystalline structure. Other formsâ€”such as carbon black , charcoal , lampblack , coal , and coke â€”are sometimes called amorphous, but X-ray examination has revealed that these substances do possess a low degree of crystallinity. Diamond and graphite occur naturally on Earth, and they also can be produced synthetically; they are chemically inert but do combine with oxygen at high temperatures , just as amorphous carbon does. Fullerene was serendipitously discovered in as a synthetic product in the course of laboratory experiments to simulate the chemistry in the atmosphere of giant stars. It was later found to occur naturally in tiny amounts on Earth and in meteorites. Q-carbon is also synthetic, but scientists have speculated that it could form within the hot environments of some planetary cores. Before the discovery in that graphite when burned in air forms carbon dioxide, graphite was confused with both the metal lead and a superficially similar substance, the mineral molybdenite. Pure diamond is the hardest naturally occurring substance known and is a poor conductor of electricity. Graphite, on the other hand, is a soft slippery solid that is a good conductor of both heat and electricity. Carbon as diamond is the most expensive and brilliant of all the natural gemstones and the hardest of the naturally occurring abrasives. Graphite is used as a lubricant. Because it conducts electricity but does not melt, graphite is also used for electrodes in electric furnaces and dry cells as well as for making crucibles in which metals are melted. Molecules of fullerene show promise in a range of applications, including high-tensile-strength materials, unique electronic and energy-storage devices, and safe encapsulation of flammable gases, such as hydrogen. Elemental carbon is nontoxic. All are products of oxidation and other forms of decomposition of organic compounds. Coal and coke, for example, are used extensively as fuels. Charcoal is used as an absorptive and filtering agent and as a fuel and was once widely used as an ingredient in gunpowder. Coals are elemental carbon mixed with varying amounts of carbon compounds. Coke and charcoal are nearly pure carbon. In addition to its uses in making inks and paints , carbon black is added to the rubber used in tires to improve its wearing qualities. Bone black , or animal charcoal, can adsorb gases and colouring matter from many other materials. Carbon, either elemental or combined, is usually determined quantitatively by conversion to carbon dioxide gas, which can then be absorbed by other chemicals to give either a weighable product or a solution with acidic properties that can be titrated. Production of elemental carbon Until all diamonds were obtained from natural deposits, most significant in southern Africa but occurring also in Brazil , Venezuela , Guyana , and Siberia. The single known source in the United States , in

Arkansas , has no commercial importance; nor is India , once a source of fine diamonds, a significant present-day supplier. The primary source of diamonds is a soft bluish peridotic rock called kimberlite after the famous deposit at Kimberley, South Africa , found in volcanic structures called pipes, but many diamonds occur in alluvial deposits presumably resulting from the weathering of primary sources. Isolated finds around the world in regions where no sources are indicated have not been uncommon. Woudloper Natural deposits are worked by crushing, by gravity and flotation separations, and by removal of diamonds by their adherence to a layer of grease on a suitable table. The following products result: The successful laboratory conversion of graphite to diamond was made in The procedure involved the simultaneous use of extremely high pressure and temperature with iron as a solvent or catalyst. Subsequently, chromium , manganese , cobalt , nickel , and tantalum were substituted for iron. Synthetic diamonds are now manufactured in several countries and are being used increasingly in place of natural materials as industrial abrasives. Graphite occurs naturally in many areas, the deposits of major importance being in China , India, Brazil, Turkey, Mexico , Canada , Russia , and Madagascar. Both surface- and deep-mining techniques are used, followed by flotation , but the major portion of commercial graphite is produced by heating petroleum coke in an electric furnace. A better crystallized form, known as pyrolytic graphite, is obtained from the decomposition of low-molecular-weight hydrocarbons by heat. Graphite fibres of considerable tensile strength are obtained by carbonizing natural and synthetic organic fibres. Carbon products are obtained by heating coal to give coke , natural gas to give blacks , or carbonaceous material of vegetable or animal origin, such as wood or bone to give charcoal , at elevated temperatures in the presence of insufficient oxygen to allow combustion. The volatile by-products are recovered and used separately. Page 1 of 3.

8: Chemical compound | www.enganchecubano.com

Carbon monoxide, with the chemical formula CO, is a colorless, odorless, and tasteless gas. It is the product of the incomplete combustion of carbon-containing compounds, notably in internal-combustion engines. It consists of one carbon atom covalently bonded to one oxygen atom. It is a gas at room temperature.

Diamond crystallizes in the cubic system. Amorphous carbon is completely isotropic. Carbon nanotubes are among the most anisotropic materials known. Allotropes Atomic carbon is a very short-lived species and, therefore, carbon is stabilized in various multi-atomic structures with different molecular configurations called allotropes. The three relatively well-known allotropes of carbon are amorphous carbon , graphite , and diamond. Once considered exotic, fullerenes are nowadays commonly synthesized and used in research; they include buckyballs , [32] [33] carbon nanotubes , [34] carbon nanobuds [35] and nanofibers. As of , graphene appears to be the strongest material ever tested. It could also be used to safely store hydrogen for use in a hydrogen based engine in cars. It is present as a powder, and is the main constituent of substances such as charcoal , lampblack soot and activated carbon. At normal pressures, carbon takes the form of graphite, in which each atom is bonded trigonally to three others in a plane composed of fused hexagonal rings, just like those in aromatic hydrocarbons. This gives graphite its softness and its cleaving properties the sheets slip easily past one another. This results in a lower bulk electrical conductivity for carbon than for most metals. The delocalization also accounts for the energetic stability of graphite over diamond at room temperature. Some allotropes of carbon: Here, each atom is bonded tetrahedrally to four others, forming a 3-dimensional network of puckered six-membered rings of atoms. Diamond has the same cubic structure as silicon and germanium , and because of the strength of the carbon-carbon bonds , it is the hardest naturally occurring substance measured by resistance to scratching. The bottom left corner of the phase diagram for carbon has not been scrutinized experimentally. The missing or additional atoms warp the sheets into spheres, ellipses, or cylinders. The properties of fullerenes split into buckyballs, buckytubes, and nanobuds have not yet been fully analyzed and represent an intense area of research in nanomaterials. The names "fullerene" and "buckyball" are given after Richard Buckminster Fuller , popularizer of geodesic domes , which resemble the structure of fullerenes. The buckyballs are fairly large molecules formed completely of carbon bonded trigonally, forming spheroids the best-known and simplest is the soccerball-shaped C60 buckminsterfullerene. It consists of a low-density cluster-assembly of carbon atoms strung together in a loose three-dimensional web, in which the atoms are bonded trigonally in six- and seven-membered rings. Carbon in this modification is linear with sp orbital hybridization , and is a polymer with alternating single and triple bonds. Q-carbon is reported to exhibit ferromagetism, fluorescence , and a hardness superior to diamonds. Carbon is abundant in the Sun , stars , comets , and in the atmospheres of most planets. PAHs seem to have been formed "a couple of billion years" after the Big Bang , are widespread throughout the universe, and are associated with new stars and exoplanets. This is much more than the amount of carbon in the oceans or atmosphere below. Hydrocarbons such as coal , petroleum , and natural gas contain carbon as well. Various estimates put this carbon between , Gt , [58] or 3, Gt. According to one source, in the period from to about gigatonnes of carbon were released as carbon dioxide to the atmosphere from burning of fossil fuels. Natural diamonds occur in the rock kimberlite , found in ancient volcanic "necks", or "pipes". Diamonds are now also being recovered from the ocean floor off the Cape of Good Hope. These asteroids have not yet been directly sampled by scientists. The asteroids can be used in hypothetical space-based carbon mining , which may be possible in the future, but is currently technologically impossible. Isotopes of carbon Isotopes of carbon are atomic nuclei that contain six protons plus a number of neutrons varying from 2 to Carbon has two stable, naturally occurring isotopes. Carbon 14C is a naturally occurring radioisotope , created in the upper atmosphere lower stratosphere and upper troposphere by interaction of nitrogen with cosmic rays. The amount of 14C in the atmosphere and in living organisms is almost constant, but decreases predictably in their bodies after death.

9: CARBON AND ITS COMPOUNDS - CLASS X (CHEMISTRY) - CURIOSITY EDUCATION

In most stable compounds of carbon (and nearly all stable organic compounds), carbon obeys the octet rule and is tetravalent, meaning that a carbon atom forms a total of four covalent bonds (which may include double and triple bonds).

What other chemical elements and compounds were present? What was the pressure? What mineral surfaces were available? What sort of electromagnetic radiation was present? Knowing the limits on conditions could provide clues that might reveal a biotic or an abiotic origin for compounds sampled. Benzene is the simplest example Figure 1. Aromatic compounds are particularly unreactive, or stable, and despite the name are not necessarily volatile. Benzene rings are easily elaborated into more complex, polycyclic structures by the one-ring build-up mechanism. Some simple examples are shown in Figure 1. PAHs in nature, particularly those in interstellar particles, can include hundreds of benzene rings fused so that most share all of their sides. In all structure diagrams, the lines represent chemical bonds. The letters C and H represent atoms of carbon and hydrogen, respectively. Structures 1 and 2 are identical except that the double bonds between the carbon atoms are rearranged. Structure 3 is an organic-chemical-shorthand version equivalent to structures 1 and 2. In such shorthand structures, bonds to H are omitted. Each carbon is known to have four bonds and, wherever one is missing, it is understood that an unseen bond to H is present. This convention removes clutter from the drawings. Wherever a bond ends or two bonds meet and no elemental symbol is shown, it is understood that a carbon atom is present. Page 13 Share Cite Suggested Citation: Exploring Organic Environments in the Solar System. The National Academies Press. Aliphatic hydrocarbons also called paraffins are straight-chain alkanes i. They are currently biologically synthesized but can also form abiotically in aqueous media at elevated temperatures and pressures. The natural products e. Stereoisomerism Molecules are three-dimensional. A carbon atom with four single bonds lies at the center of a tetrahedron. The atoms to which the carbon is bonded are at the vertices of the tetrahedron. Those atoms are in turn likely to be bonded to other atoms. If the chemical structures at the four corners all differ, however slightly, the mirror images of the tetrahedron will not be superimposable Figure 1. Mirror-image stereoisomers that are not superimposable are called enantiomers; stereoisomers that are not enantiomers are called diastereomers. Enantiomers possess chirality, or handedness, and when dissolved rotate the plane of polarized light when it is passed through the solution. Life on Earth makes use of only a limited number of diastereomers of all those that are possible. Carbon atoms bearing four different substituents are said to be chiral centers. If a molecule has n chiral centers it will, in most cases, have 2n stereoisomers. There will, for example, be stereoisomers of a compound with eight chiral centers. Each will have exactly the same chemical formula and pattern of connectivity among its atoms A is connected to B is connected to C and D, and so on. Only the arrangements of those atoms in space will differ, and there will be variations. Life functions by using only a small subset of all possible stereoisomers. In these depictions of tetrahedral carbon atoms, bonds represented by straight lines lie in the plane of the paper. Those represented by wedges project in front of the paper the filled wedges or to the rear the broken wedges. W, X, Y, and Z represent different chemical groups, anything from a single atom an H, for example to a complex chemical substituent with many atoms in addition to the one that is bonded directly to the carbon atom. In structure 7, all four groups are different. The mirror images, 7a and 7b, cannot be rotated so that the structures are superimposable. In structure 8, by contrast, two of the groups are identical. Mirror images of tetrahedra will be nonsuperimposable only when all four vertices are different. Page 14 Share Cite Suggested Citation: The first of these terms is practically self-defining. The functional groups are chemical ornaments attached to that skeleton. Carbon skeletons are best described by structural formulas like those shown in Figures 1. If the structure contains no double bonds or rings, seven carbon atoms can be assembled to produce the nine distinct carbon skeletons shown in Figure 1. As drawn, the structural formulas in Figure 1. As indicated by the elemental formula, which indicates that only carbon and hydrogen are present, it is a hydrocarbon, unadorned by functional groups. Numbers of possible structures for such compounds increase rapidly with the number of carbon atoms. The molecular formula C10H22 leads to 75 distinct structures.

Doubling the number of carbon atoms i. Another doubling, to C40H82, yields 62,,,, possible structures. However, as discussed above for stereoisomers, life functions by using only a small subset of all possible structures, patterns, and isomers. The number of possible structures increases even more rapidly when multiple bonding and ring formation are considered. As an example, Figure 1. Many further structures could be drawn for C7 hydrocarbons. These would include 3-, 4-, 6-, or 7-membered rings and double and triple bonds limited only by the requirement that each carbon atom always have four bonds. Functional groups contain elements in addition to carbon and hydrogen. The resulting polarity and presence of nonbonding electrons make them likely sites for chemical reactions. Examples are shown in Figure 1. It is not practical here to review in detail the chemistry of functional groups, but the basic factors are easy to appreciate. Nitrogen and oxygen contain respectively one and two more valence electrons than does carbon. Nitrogen has to make only three chemical bonds to complete its valence octet. Oxygen can only make two. Both nitrogen and oxygen are more electronegative than carbon. C-N and C-O bonds are therefore polar. Simultaneously, the nonbonding electron pairs on nitrogen and oxygen two pairs in that case are available to participate in electronic rearrangements. The asterisks mark chiral centers see Figure 1. Each of the structures that contain a chiral center will exist as two stereoisomers. Page 15 Share Cite Suggested Citation: Both of the structures containing two chiral centers happen also to contain a plane of symmetry. The open bonds represent points of attachment to carbon skeletons. From left to right in the top row, these examples include an alcohol, an aldehyde, a ketone, a carboxylic acid, a carboxylic acid anhydride, and an ether. Nitrogen-containing functional groups are shown in the second row. Commonly, two carbon skeletons can be, in essence, glued together when the functional group on one attacks a functional group on the other and, as a result, a chemical bond is formed. An example is shown in Figure 1. In this case an alcohol with a carbon skeleton similar to those shown in Figure 1. The products are a molecule of water and an organic molecule in which the two carbon skeletons are connected by an ester linkage. Polymers are synthesized from one or more monomers. Often, the monomers have functional groups that allow them to link their carbon skeletons together to form endless chains addition polymers like polyethylene are the exception. Dacron and nylon are familiar polymers. The former is a polyester containing linkages like that illustrated in Figure 1. The latter is a polyamide the amide structure is shown in Figure 1. The pertinent monomers and reactions are summarized in Figure 1. Coal is a natural macromolecule but does not qualify as a polymer because it has no regular, repeating structure based on a restricted set of monomers. The alcohol and carboxylic acid shown as reactants are examples of carbon skeletons similar to those introduced in Figures 1. For each carbon skeleton, the addition of the functional group has created a new chiral center by introducing asymmetry at a formerly symmetrical carbon position. Chemical reactions depicting the formation of two familiar polymers, namely Dacron top and nylon bottom. The dashed bonds indicate that the repeating, polymeric structures extend indefinitely. Values of n can exceed The monomers used to form Dacron are a benzene dicarboxylic acid and a C2 dialcohol. The product is a polyester. Nylon is formed by polymerizing two C6 monomers, a dicarboxylic acid and a diamine. The product is a polyamide. Both polymerizations are condensation reactions.

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