Aromatic compounds ncert pdf windows 10 full

Huckel rule is used to determine the possession of aromatic properties in a planar ring compound or molecule in organic chemistry. It is named after the German Physical Chemist and Physicist Erich Armand Arthur Joseph Huckel, who also solved the quantum mechanics required for the formulation of this rule. Key Terms:- Huckel's rule, Hydrocarbons, electrons, Aromatic compounds, organic chemistry, Resonance. Huckel Rule of Aromaticity (4n+2) Pi Electron Rule [Click Here for Sample Questions] Huckel's rule stated mathematically says that all planar aromatic compounds must have 4n+2 pi-electrons where n is a positive integer or zero (i.e. n= 0, 1, 2, 3...etc.). Aromatic compounds are comparatively stable due to the presence of resonance energy and delocalized electron clouds. Example: Let us understand the Huckel Rule by the compounds given below that have a ring structure. (4×1)+2 = 6 = 6 pi-electrons in Benzene Hence, benzene is an aromatic compound and possesses aromaticity. (4×1)+2 = 6 ≠ 8 pi-electrons in Cyclo octa-tetraene Hence, Cyclo octa-tetraene is not an aromatic compound and does not possess aromaticity. Likewise, any compound that follows the Huckel rule with the formula 4n+2 is said to have aromatic properties. According to the structures, Benzene has 6 pi-electrons and Cyclo octa-tetraene has 8 pi-electrons. Applying 4n+2 for both the compounds, where n=1, Read More: Criteria for Aromatic Compounds [Click Here for Sample Questions] In a system of connected p orbitals with delocalized electrons, the molecule should have 4n+2 electrons The molecule has to have a roughly planar structure with almost parallel p orbitals and the ability to engage with one another. It should be a cyclic molecule with a ring of p orbitals without any sp3 hybridized atoms. Huckel Rule Applications [Click Here for Sample Questions] Stability: Used to determine the stability of monocyclic hydrocarbons. Benzene is a monocyclic hydrocarbon and we saw how it possesses aromaticity. This happens due to the occurrence of a substitution reaction that retains the 6 pi-electrons. Refer to the video for understanding aromatic stability. Cation & Anion: Cation and anion of the same molecule can possess different stability and hence different aromatic properties. For example, cyclopentadienyl anion [C5H5]− is stable and aromatic as it has 6 pi-electrons while its cation C5H5+ has 4 pi-electrons and are hence unstable and non-aromatic. Double ring compounds: Naphthalene is a double ring compound containing 5 pi-bonds in its rings, i.e.,10 pi-electrons. This satisfies the Huckel rule with n=2. (4n+2 = 4×2+2 = 10). Thus, Naphthalene is an aromatic compound. Read More:- Rate of Reaction Huckel Rule Exceptions [Click Here for Sample Questions] Generally, planar ring molecules with 4are unstable but cyclobutadiene (C4H4) is stable below 35K temperature. Compounds like pyrene, a polycyclic compound, are aromatic compounds but do not follow Huckel's rule. Trans-bicalicene is a polycyclic compound having 8 pi-bonds which is aromatic but does not follow Huckel's rule. Hence, we can conclude that Huckel's Rule is a very important discovery for the estimation of the aromaticity of planar ring-shaped compounds. Points to Remember based on Huckel Rule of Aromaticity [Click Here for Sample Questions] Huckel rule is used to determine the possession of aromatic properties in a planar ring compound or molecule. All planar aromatic compounds must have 4n+2 pi-electrons where n is a positive integer or zero (i.e. n= 0, 1, 2, 3...etc.) Benzene, Naphthalene and cyclopentadienyl anion are few examples of aromatic compounds that follow Huckel Rule. Not every compound that is aromatic will necessarily follow Huckel Rule. Unit 12, 13, 14 has a combined weightage of 18 marks. Hydrocarbons is the 13th unit containing 10 periods. Read More: Ques 1. Identify aromatic compounds from the following. (1 mark) a) b) c) d) Ans. a) is the correct answer. According to the Huckel rule and it's equation 4n+2 (where n in this formula is an integer), if a compound has 2,6,10, … pi-electrons, along with being flat, cyclic and conjugated, then it is considered as an aromatic compound. In the options given above, only (a) and (d) have 6 pi-electrons but (d) is non-cyclic. Hence, (a) is the aromatic compound. Ques 2. State Huckel's Rule. Using this rule, prove that Naphthalene is aromatic. (3 marks) Ans. In organic chemistry, the Huckel rule is used to assess if a planar ring compound or molecule has aromatic characteristics. It states that all planar aromatic compounds must have 4n+2 pi-electrons where n is a positive integer or zero (i.e. n= 0, 1, 2, 3...etc.). Molecular formula of Naphthalene is C10H8 containing two fused benzene rings as shown below: Naphthalene possess following properties to be proved as an aromatic compound: Naphthalene molecule follows Huckle rule- This molecule has 10 pi-electrons in the planar ring. If we put n=2 in the Huckel's rule, we get, 4n+2 = 4×2+2 = 10 = pi-electrons in the molecule. Naphthalene molecule has a ring system, i.e., it is a cyclic molecule. The ring system contains pi-electrons that are fully delocalized and all the atoms present are sp2 hybridized. Ques 3. How many pi-electrons does the given molecule have? (1 mark) Ans. The given molecule contains 14 molecules. 6 double bonds contribute to 12 pi-electrons and 1 oxygen atom contributes 2 pi-electrons. Ques 4. Define the criteria for a compound to be aromatic. (2 marks) Ans. The molecule or compound should have following properties to be aromatic: A ring of atoms or cyclic molecule All the atoms lie in the same plane or planar molecule Molecules are conjugated i.e., p orbitals are present at every atom in the ring. Molecules follow Huckel Rule i.e., they have 4n+2 pi-electrons where n=0,1,2,... Ques 5. Is the given molecule aromatic? Given reasons for your answer. (3 marks) Ans. The given molecule has following properties: It is a planar ring molecule. It forms a conjugated molecule by sp2 or sp3 hybridization of atoms (due to oxygen molecule) Contains an odd number of delocalized electron pairs. If the oxygen is sp3-hybridized, the molecule lacks a continuous chain of unhybridized p orbitals and so is not aromatic (it will be non-aromatic). If the oxygen is sp2-hybridized, it will form a conjugated π system by having a continuous chain of unhybridized p orbitals. This will have 6 pi-electrons in total. This makes it aromatic. Ques 6. Assuming that this molecule is planar, determine whether this molecule is aromatic, and name the number of π electrons (π molecular orbitals). (2 marks) Ans. The molecule is planar and has a ring structure but it does not have a fully conjugated pi system due to lack of p orbital around the Boron atom. It has 8 π electrons and hence, it doesn't follow Huckel's rule. So this is not an aromatic compound. Also Check: Click here to get PDF DOWNLOAD for all questions and answers of this Book - VMC MODULES ENGLISH Class 12 CHEMISTRY Aromatic compounds have played an indispensable role in improving the quality of our lives in the past and continue to play the same in present. Computer parts, DVDs, and linchpin components of automotive parts are made up of aromatic compounds. Drugs such as Aspirin and paracetamol which we are used for ages are aromatic compounds. Not only this, the drug used for the treatment of malaria, chloroquine is also an aromatic hetropolycyclic compound that is also being studied to treat novel Coronavirus (COVID - 19) as well. The contribution of aromatic compounds is huge in the development of mankind and they still have more potential to do the same. So, in this scenario, it becomes a must for all of us to have at least a basic understanding of aromatic compounds. What are Aromatic Compounds? The chemical compounds that contain conjugated planar ring systems with delocalized pi-electron clouds instead of discrete alternating single and double bonds are called aromatic compounds. They are also known as aromatics or arenes. The most common example of aromatic compounds is benzene. These are unsaturated compounds that are stable in nature. Arene and Aryl GroupsStudents generally get confused between arene and aryl groups. Let us clear this doubt here only. Arene is a compound containing one or more benzene rings. While when we remove a hydrogen atom from an arene, the aryl group is formed. It means benzene is an arene, but phenyl is an aryl group. All arenes are aromatic compounds but it's not necessarily that all aromatic compounds are arenes. AromaticityAll aromatic compounds show aromaticity. The term aromaticity is used to describe a property of a cyclic, planar molecule with a ring of resonance bonds that exhibits more stability than other geometric or connective arrangements with the same set of atoms. The word aromaticity comes from the word 'aroma' which means fragrance or odor. Since most of the aromatic compounds are derivatives of benzene and benzene gives a distinct odor so, the compounds were named aromatic compounds. Although presently many non – benzene aromatic compounds have been discovered which do not have any odor. The term aromatic was first used by August Wilhelm Hofmann in 1855. Compounds must fulfill the following have four conditions to be an aromatic compound –The molecule must be cyclic. Example – Benzene and pyrrole are aromatic in nature while acyclic compound C4H5NH2 is a non-aromatic compound. Structures are given below – (image)Every atom in the cyclic ring must be conjugated. As it will provide the cyclic ring delocalized pi-electron system. Thus, we can say every atom in the cyclic ring must have an empty p orbital and must be capable of participating in resonance. Examples are given below – (image)Huckel's Rule of Aromaticity: All compounds must obey Huckel's Rule i.e. molecule must have 4n+2 pi-electrons where n is an integer (i.e. n= 0, 1, 2, 3, 4...etc.). For example, Benzene has 6 pi-electrons and (4×1)+2 = 6, thus it obeys Huckel's Rule while cyclooctatetraene has 8 pi-electrons 4n+2 ≠ 8, thus it does not follow Huckel's Rule. So, benzene is aromatic and cyclooctatetraene is a non-aromatic compound.The molecule should be planar or flat. Those compounds which follow the above 4 rules of aromaticity are generally flat as in that condition they possess large enough potential energy. Examples of Aromatic Compounds All aromatic compounds are hydrocarbons. A few examples of aromatic hydrocarbons are listed below –BenzeneAnilineAspirinParacetamolBenzyl AlcoholBenzeneIs the best example for representing aromatic compounds. Scientists struggled a lot to determine the structure of benzene. Because benzene is unreactive towards addition reactions being a highly unsaturated compound. Thus, it shows exceptional stability. The cyclohexatriene structure for benzene was 1st proposed by August Kekule in 1865. After Kekule, many other scientists also proposed the structure of benzene. The quantum mechanical origins of stability or aromaticity were 1st modeled by Huckel in 1931. Benzene is a colourless, clear, highly flammable, and volatile, liquid aromatic hydrocarbon. Benzene is found in crude oils, as a by-product of oil-refining processes, as a solvent, and in the synthesis of numerous chemicals. It is formed from both natural processes and human activities. Natural sources of benzene are forest fires, volcanos, crude oil, gasoline, and cigarette smoke. Benzene is also used to make other chemicals that are used to produce nylon, synthetic fibers, plastics, and resins. It is also used to make some lubricants, dyes, detergents, types of rubbers, drugs, and pesticides. AnilineIt is also an aromatic compound. Most of the aromatic compounds are benzene derivatives. Although not all aromatic compounds are benzene based. With an amine attached to a benzene ring, aniline is the prototypical aromatic amine. It was first obtained by the destructive distillation of indigo in the year 1826. It's named after the indigo-yielding plant Indigofera anil. Aniline is prepared commercially by the catalytic hydrogenation of nitrobenzene or by the action of ammonia on chlorobenzene and possesses somewhat of an unpleasant smell, like that of a rotten fish. It is used in manufacturing precursors to polyurethane. It is also used to make antioxidants, dyes, rubber accelerators, photographic chemicals, pharmaceuticals, urethane foams, petroleum refining, explosives, fungicides, and herbicides, among others.AspirinAspirin, also known as acetylsalicylic acid, is a drug used to reduce pain, fever, and inflammation. It was discovered by chemist Charles Frederic Gerhardt in 1853. Phenol, an aromatic compound, is one of the raw materials used in making the drug.ParacetamolIt is also a drug that is used to treat fever and pain. It was 1st made in 1877. Since then we are using this medicine for pain relief. It appears to be safe during pregnancy and breastfeeding.Benzyl alcoholIt is an aromatic alcohol. It is a clear colorless liquid with a pleasant odor, and is slightly denser than water. Like all aromatic alcohols, benzyl alcohol is also a compound in which the -OH group is not directly attached to the benzene ring. Its role is that of a solvent, an antioxidant, a metabolite, and a fragrance. It is used as an anti-parasite medication. It is mainly used as a medicine to treat head lice in people. Properties of Aromatic CompoundsAromatic compounds have extremely high resonance energy.These are stable unsaturated compounds.They are generally non – polar and immiscible with water.They give a sooty yellow flame due to the high ratio of carbon to hydrogen.Aromatic compounds undergo substitution reactions rather than addition reactions.These have delocalized pi-electrons. They show a coplanar structure.They are used as a solvent for non - polar compounds.They show electrophilic aromatic substitution and nucleophilic aromatic substitution reactions. Difference Between Aromatic Hydrocarbons and Aliphatic Hydrocarbons Both aromatic hydrocarbons and aliphatic hydrocarbons are organic compounds composed of hydrogen and carbon but still, they are different from each other and show different properties. Some of the differences between the two are listed below –S. No.Aromatic HydrocarbonsAliphatic Hydrocarbons1These hydrocarbons contain carbon and hydrogen attached in a ring system with delocalized pi-electronsThese hydrocarbons contain carbon and hydrogen attached in straight chains, branched chains, or in non-aromatic ring forms2.They show aromaticity.They do not show aromaticity.3.All aromatic compounds follow Huckel's rule.It is not necessary that ll aliphatic hydrocarbons will follow Huckel's rule4.Most aromatic compounds have a pleasant odor.They do not have a pleasant odor.5.In these compounds, the carbon to hydrogen ratio is low.In these compounds, the carbon to hydrogen ratio is high.6.These compounds generally burn with sooty flame (yellow).These compounds burn with a non-sooty flame.7.These are unsaturated compounds.Aliphatic hydrocarbons can be saturated and unsaturated.8.They have delocalized pi-electrons. They do not have delocalized pi-electrons.9.These are conjugated compounds.The majority of these compounds are not conjugated.10.Benzene, toluene, naphthalene, etc. are examples of these compounds.Methane, ethane, propane, etc. are examples of these compounds.This ends our coverage of aromatic compounds. We hope you enjoyed learning and were able to grasp the concepts. We hope after reading this article you will be able to recognize aromatic compounds through their structures. If you are looking for solutions to NCERT Textbook problems based on this topic, then log in to the Vedantu website or download Vedantu Learning App. By doing so, you will be able to access free PDFs of NCERT Solutions as well as Revision notes, Mock Tests, and much more.

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