

Think It Over

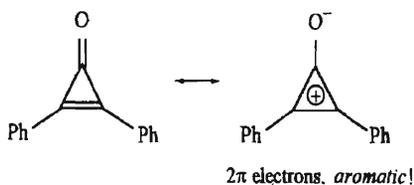


This section of *Resonance* presents thought-provoking questions, and discusses answers a few months later. Readers are invited to send new questions, solutions to old ones and comments, to 'Think It Over', *Resonance*, Indian Academy of Sciences, Bangalore 560 080. Items illustrating ideas and concepts will generally be chosen.

Answer to Think-it-Over problems posed by A Krishna Murthy in Vol.2, No.9, 1998, p.73.

Three questions were asked with the hint that the answers had a common basis. All answers are derived from Hückel's rule: cyclic conjugated systems with $(4n+2)\pi$ electrons are aromatic.

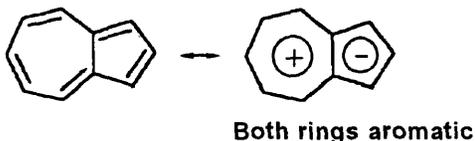
The first question was about the large dipole moment of diphenylcyclopropanone. Normally carbonyl groups are polarized such that the carbon has a partial positive charge, and the oxygen has a partial negative charge. This polarization is enhanced in cyclopropanones because the three membered ring effectively becomes aromatic with 2π electrons. As a result, the molecule has a high dipole moment of 5.07 D.



The acidity of the hydrocarbons cyclopentadiene, indene and fluorene result from the aromatic character of the corresponding anions (six π electrons in the 5-membered ring). The extraordinarily high acidity of pentakis (trifluoromethyl) cyclopentadiene (stronger acid than nitric acid) is due to further stabilization of the aromatic carbanion by the combined strong electron withdrawing effects of the trifluoromethyl groups.

Correct answers were sent by the following:
Shubham Sharma (Hardwar)
Prमित Chowdhury (Kanpur)
R G Revaiah (Shimoga)

Azulene is a fused 7/5 ring system with five double bonds. One can rearrange the double bonds to write an ionic structure shown below in which both rings have six π electrons – which makes both rings aromatic. This necessarily leads to a charge separation (as in the first example) which results in a moderate dipole moment for the hydrocarbon even without any polar substituent.



Answer to 'A Poser' ¹

By convention, a nuclide is defined as fissile if even a slow moving neutron with very low energy (about 0.025 electron-volt at room temperature) can cause it to fission. There are other nuclides that undergo fission only upon collision with neutrons of higher energy (as much as one million electron-volt, or more), but these do not fall in the same category. While uranium-235 is fissile, uranium-238 is not and the reason for this is explained below.

While the incoming neutron is absorbed, a compound nucleus is formed, which is in an excited state. The excitation energy of the compound nucleus is equal to the binding energy of the absorbed neutron plus its kinetic energy. For low energy neutrons, of negligible kinetic energy, the excitation energy is equal to the binding energy.

For the compound nucleus uranium-236 (resulting from absorption of a slow neutron in uranium-235), the excitation energy is about 6.8 MeV, while it is 5.5 MeV for the compound nucleus uranium-239 (resulting from absorption of a slow neutron in uranium-238). The excitation energy for uranium-239 is lower because the nucleus contains an odd number of neutrons and the last neutron is an unpaired one with lower

¹ Think-it-Over problem posed by Manpreet Singh, *Resonance*, Vol.3, No.10, 1998, p.99.

'When we bombard $^{235}\text{U}_{92}$ with a neutron it undergoes fission, while $^{238}\text{U}_{92}$ on bombarding with a neutron initiates β -decay and changes into $^{239}\text{Pu}_{94}$. According to neutron/proton ratio $^{238}\text{U}_{92}$ should be less stable than $^{235}\text{U}_{92}$. Then why does not $^{238}\text{U}_{92}$ undergo fission?

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