



# MCAT-TEST<sup>Q&As</sup>

Medical College Admission Test: Verbal Reasoning, Biological Sciences, Physical Sciences, Writing Sample

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**QUESTION 1**

Slight gaps are intentionally left between blocks of a building:

- A. to drain water accumulated on the roof.
- B. to avoid cracks due to temperature impacts.
- C. to allow light to internal of room.
- D. None of them.

Correct Answer: B

**QUESTION 2**

Every atomic orbital contains plus and minus regions, defined by the value of the quantum mechanical function for electron density. When orbitals from different atoms overlap to form bonds, an equal number of new molecular orbitals results. These are of two types: or bonding orbitals, formed by overlap between orbital regions with the same sign, and antibonding \* or \* orbitals, formed by overlap between regions with opposite signs. Bonding orbitals have lower energy than their component atomic orbitals, and antibonding orbitals have higher energy. The electron pairs reside in the lower-energy bonding orbitals; the higher-energy, less stable orbitals remain empty when the molecule is in its ground state. A benzene ring has six unhybridized p<sub>z</sub> orbitals (one from each carbon atom), which together form six molecular orbitals, each one delocalized over the entire ring. Of the possible orbital structures for benzene, the one with the lowest energy has the plus region of all six p orbital functions on one side of the ring. The six electrons occupying the orbitals fill the three most stable molecular orbitals, leaving the other three empty. Molecular orbitals are filled from the lowest to the highest energy level. The number of bonds between atoms is determined by the number of filled bonding orbitals minus the number of filled antibonding orbitals; each antibonding orbital cancels out a filled bonding orbital. For a diatomic molecule, orbitals in the n = 2 energy level are filled as follows:

$\sigma_{2s}$ ,  $\sigma^*_{2s}$ ,  $\sigma_{2p_z}$ ,  $\pi_{2p_x}$  and  $\pi_{2p_y}$

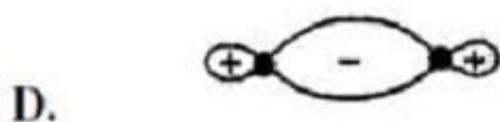
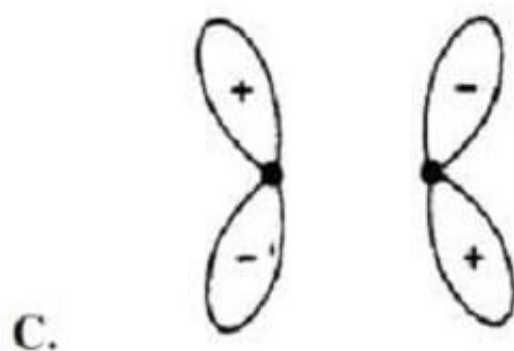
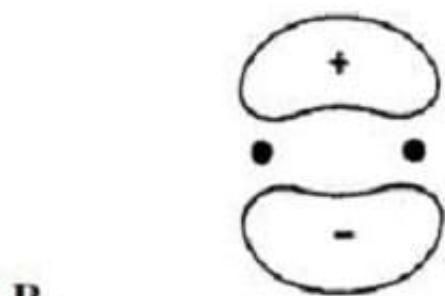
$\pi^*_{2p_x}$

$p_z$

(equal in energy), and \* (equal in energy), \*<sub>2</sub>. (The designation of the three p orbitals as  $p_x$ ,  $p_y$ , and  $p_z$  are interchangeable.) Absorption of a photon can raise an electron to a higher-energy molecular orbital. The excited electron does not immediately change its spin, which is opposite to that of the electron with which it was previously paired. This singlet state is relatively unstable: the molecule may interact with another molecule, or fluoresce and return to its ground state. Alternatively, there may be a change in spin direction somewhere in the system; the molecule then enters the so-called triplet state, which generally has lower energy. The molecule now cannot return quickly to its ground state, since the excited electron no longer has a partner of opposite spin with which to pair. It also cannot return to the singlet state, because the singlet has greater energy. Consequently, the triplet state, which has two unpaired electrons in separate orbitals, is long-lived by atomic standards, with a lifetime that may be ten seconds or more. During this period, the molecule is highly reactive.



Which of the following figures describes the shape of  $\sigma^*_{2p_z}$  molecular orbital?



A. Option A

B. Option B

C. Option C

D. Option D

Correct Answer: A

The molecular orbital you have been asked to choose is an antibonding sigma orbital. Examining the question, the star above the sigma sign indicates that the orbital is antibonding. You should know that sigma orbitals are formed in a straight line; choice D is a bonding sigma orbital and choice A, the correct choice, is an antibonding sigma orbital. In pi orbitals, the lobes of the p orbitals are perpendicular to the line connecting the two atoms. When a pi orbital is bonding, the lobes above and below the plane of the molecule connect to form a shape such as that shown in choice B. When a



pi orbital is antibonding, the perpendicular p lobes cancel each other out where they overlap. This produces an electron cloud that looks as if the p orbitals were repelling each other, as in choice C.

### QUESTION 3

The mind, just like the body, has its needs. The needs of the body are the foundations of society; those of the mind are its amenities. While government and laws provide for the safety and well-being of men when they gather together, the sciences and the arts, which are less despotic but perhaps more powerful, spread garlands of flowers over the iron chains that bind them, stifle in them the sense for that original liberty for which they seem to have been born, cause them to love their own enslavement, and turn them into so-called "civilized people." Necessity raised thrones; the sciences and the arts have strengthened them. O earthly powers: cherish talents and protect those who cultivate them. O civilized people, cultivate them: you happy slaves owe to them that delicate and refined taste of which you are so proud, that gentleness of character and urbanity of manner which make relations among you so amiable and easy -- in other words, that semblance of all the virtues, none of which you actually possess... ..How pleasant it would be to live among us, if our external appearance were always a reflection of what is in our hearts, if decency were virtue, if our maxims served as our rules, and if true philosophy were inseparable from the title of philosopher! But so many qualities are seldom found together, and virtue hardly ever walks in such great pomp. Richness of adornment may be the mark of a man of taste, but a healthy, robust man is known by other signs: it is beneath the rustic clothes of a farmer, and not the gilt of a courtier, that strength and vigor of the body will be found. Ornamentation is just as foreign to virtue, which is the strength and vigor of the soul. The good man is an athlete who prefers to compete in the nude: he disdains all those vile ornaments which would hinder the use of his strength, ornaments which were for the most part invented only to hide some deformity. Before art had molded our manners and taught our passions to speak an affected language, our customs were rustic but natural, and differences in conduct revealed clearly differences in character. Human nature, basically, was no better, but men found security in being able to see through each other easily, and this advantage, which we no longer appreciate, spared them many vices. Now that more subtle refinements and more delicate taste have reduced the art of pleasing to set rules, a base and deceptive uniformity prevails in our behavior, and all minds seem to have been cast in the same mold. Incessantly politeness and propriety make demands on us, and incessantly we follow usage but never our own inclinations. We no longer dare to appear as we are, and under this perpetual constraint, the men who form this herd called society, when placed in the same circumstances, will all act similarly unless stronger motives direct them to do otherwise. Therefore we will never know well those with whom we deal, for to know our friends we will have to wait for some crises to arise -- which is to say that we will have to wait until it is too late, as it is for these very crises that it is essential to know one's friends well. What vice would not accompany this uncertainty? No more sincere friendships, no more genuine esteem, no more well-based confidence. Suspicion, offenses, fears, coldness, reserve, hatred and betrayal will constantly hide under the same false veil of politeness, under that much touted urbanity which we owe to the enlightenment of our times. The name of the Master of the Universe will no longer be profaned by swearing, but insulted by blasphemies that will not offend our scrupulous ears. Men will not boast of their own merits, but belittle those of others. An enemy will not be crudely insulted, but adroitly slandered. National hatreds will die, but so will patriotism. A dangerous skepticism will take the place of the scorning of ignorance. Some excesses will be forbidden, some vices dishonored, but others will be dignified with the name of virtues, and one must either have them or feign them. Let those who want to praise the sobriety of the sages of our time do so; as for me, I see in it only a refinement of intemperance that is as unworthy of my praise as their hypocritical simplicity.

According to the author, an "urbane" person is most likely to put the highest value on which of the following characteristics?

- A. simple, unadorned clothing.
- B. reflection on one's individual character.
- C. polite relations in public discourse.
- D. natural behavior and action.

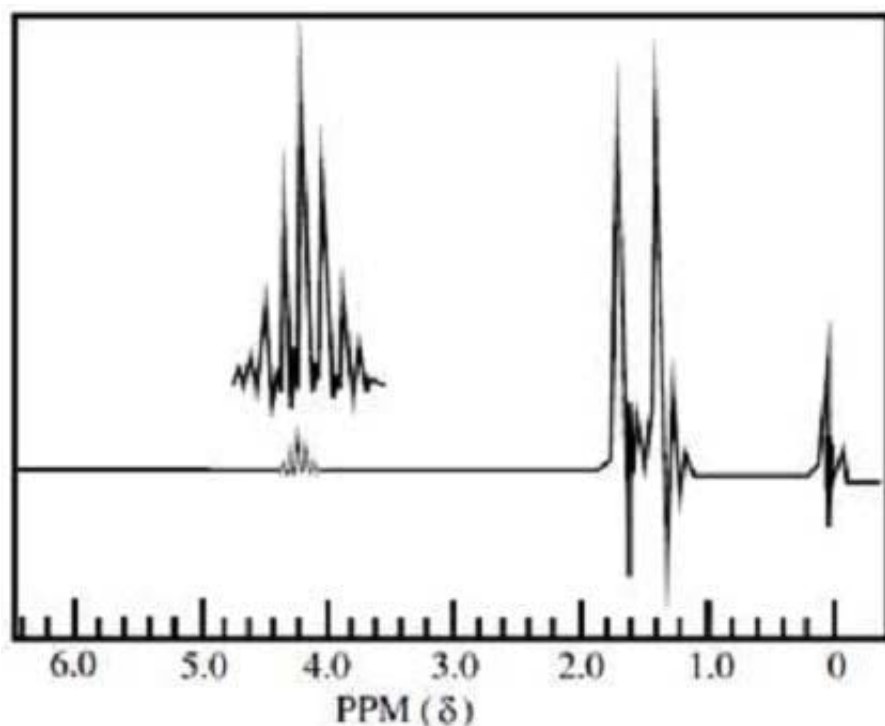
Correct Answer: C



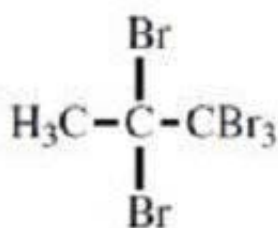
In lines 16-17 the author indicates that urbanity of manner makes relations amiable and easy, and later on in the fourth paragraph he claims that the demands of politeness and propriety have stifled honesty in our public behavior. From this, then, one can infer that choice C contains the characteristics prized by an urbane person.

#### QUESTION 4

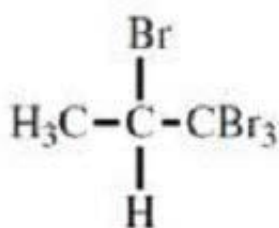
Which of the following molecules would produce the NMR spectrum shown below?



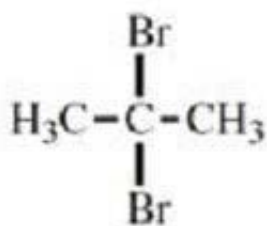
A.



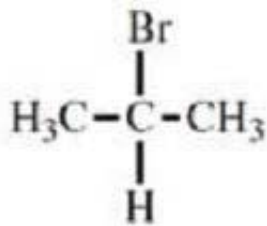
C.



B.



D.





A. Option A

B. Option B

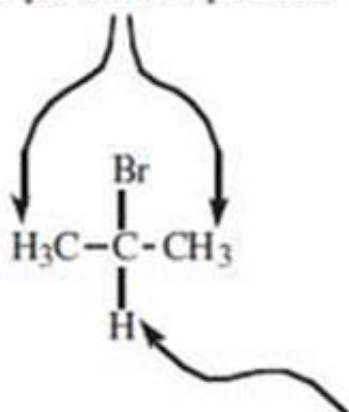
C. Option C

D. Option D

Correct Answer: D

The NMR spectra shows a distinct absorption split into 7 peaks, the classic absorption of an isopropyl group. This absorption is downfield, indicating that it is deshielded. From this information alone, we can determine that there is at least one proton with 6 equivalent neighboring protons, that is near some electronegative species. Only choice A has 6 neighboring protons that can lead to splitting into (N+1) seven peaks. The downfield shift is caused by the bromine bonded to the same carbon as the single hydrogen.

these 6 equivalent neighboring protons split the single protons peak into 7 peaklets



this proton's absorption is shifted downfield (to higher PPM)

Choice A is incorrect because there are no neighboring protons, and so there will be no splitting. Choice B is incorrect because there are no neighboring protons and so, splitting into seven peaklets will not occur.

Choice C is incorrect because the single proton has only 3 neighboring protons and will only be split into 4 peaklets (a quadruplet). Note that the absorption for the single proton in this molecule will be shifted more downfield because there are

many electronegative species around it.

## QUESTION 5

Which of following must be present in human's diet to prevent thyroxine deficiency?

A. Iron

B. Calcium



C. Iodine

D. Phosphorus

Correct Answer: C

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