INORGANIC CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 19

Total Marks : 29

Max. Time : 30 min.

Topic : Chemical Bonding

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.3	(3 marks, 3 min.)	[12, 12]
Multiple choice objective ('–1' negative marking) Q.4	(4 marks, 4 min.)	[4, 4]
Comprehension ('–1' negative marking) Q.5 to Q.7	(3 marks, 3 min.)	[9, 9]
Subjective Questions ('–1' negative marking) Q.8	(4 marks, 5 min.)	[4, 5]

1. Which of the following forms only π-bond using Molecular orbital theory :

(A) Li_2 (B) C_2 (C) N_2 (D) O_2

2. Which of the following statements is not correct from the point of view of molecular orbital theory :

(A) Be_2 is not a stable molecule.

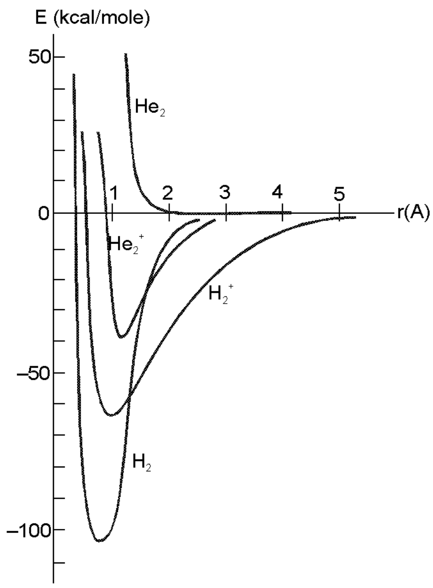
(B) He_2 is not stable, but He_2^+ is expected to exist.

(C) Bond strength of N_2 is maximum amongst the homonuclear diatomic molecules.

(D) The order of energies of molecular orbitals in F_2 molecule is :

$E(\sigma 2s) < E(\sigma^* 2s) < E(\pi 2p_x) = E(\pi 2p_y) < E(\sigma 2p_z) < E(\pi^* 2p_x) = E(\pi^* 2p_y) < E(\sigma^* 2p_z)$

3. The following graph is given between total energy and distance between the two nuclei for species H_2^+, H_2, He_2^+ & He_2. Which of the following statements is correct :



(A) He_2^+ is more stable than H_2^+.

(B) Bond dissociation energy of H_2^+ is more than bond dissociation energy of He_2^+.

(C) Since bond orders of He_2^+ and H_2^+ are equal, hence both will have equal bond dissociation energy.

(D) Bond length of H_2^+ is less than bond length of H_2 .

4.*_ Which of the following is/are gerade molecular orbitals :

(A) σ (B) σ^* (C) π (D) π^*

Comprehension # (Q.5 to Q.7)

In principle, Schrondinger equation can be written for any molecule. However, since it cannot be solved exactly for any system containing more than one electron, molecular orbitals which are one electron wave functions for molecules are difficult to obtain directly from the solution of the Schrondinger equation. This difficulty is overcome by resorting to an approximation method called linear combination of atomic orbitals (LCAO) method to form molecular orbitals.

The molecular orbtial formed by the addition of atomic orbtials is called the bonding molecular orbital and the molecular orbital formed by the substration of atomic orbitals is called antibonding molecular orbital. Qualitaively, the formation of molecular orbitals can be understood in terms of the constructive or destructive interference of the electron waves of the combining atoms. In the formation of bonding molecular orbital, the two electron waves of the bonding atoms reinforce each other (constructive interference) while in the formation of antibonding molecular orbtial, these electron waves cancel each other (destructive interference). The result is that in a bonding molecular orbital most of the electron density is located between the nuclei of the bonded atoms and hence the repulsion between the nuclei is very low while in an antibonding molecular orbital, most of the electron density is located away from the space between the nuclei, as a matter of fact there is a nodal plane (i.e., plane in which the electron density is zero)

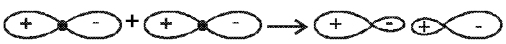
5. How many nodal plane is/are present in σ_{1s} bonding molecular orbital :

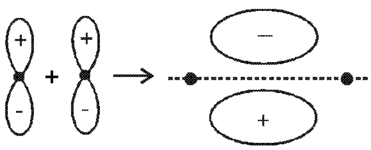
(A) zero (B) 1 (C) 2 (D) 3

6. Which of the following combination of orbitals is correct :

(A) 

(B) 

(C) 

(D) 

7. Which of the following statements is not correct regarding bonding molecular orbitals :

(A) Bonding molecular orbtials possess less energy than the atomic orbitals from which they are formed.

(B) Bonding molecular orbtials have low electron density between the two nuclei.

(C) Every electron in bonding molecular orbitals contibutes to the attraction between atoms

(D) They are formed when the lobes of the combining atomic orbtials have the same sign i.e. proper symmetry of electron waves.

8. Predict whether the He_2^+ ion in its electronic ground state is stable toward dissociation into He and He^+.

Answer Key

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1.	(B)	**2.**	(D)	**3.**	(B)	**4.***	(A)	**5.**	(A)
6.	(C)	**7.**	(B)						

Hints & Solutions

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1. C_2 :KK $(\sigma\ 2s)^2\ (\sigma^*\ 2s)^2\ \underbrace{(\pi 2p_x^2 = \pi 2p_y^2)}_{2\pi-\text{bonds}}$.

2. (A) Be_2 : BO = 0 (zero) $\therefore$ unstable molecule.

(B) He_2 : BO = 0 (not stable) , He_2^+ : BO = 0.5 (expected to exist).

(C) N_2 : BO = 3 , maximum bond order means maximum bond strength.

(D) For F_2 molecule, $E(\sigma 2p_z) < E(\pi 2p_x) = E(\pi 2p_y)$.

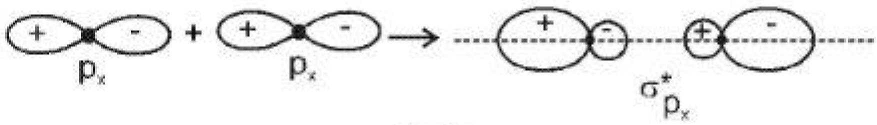
3. From the graph

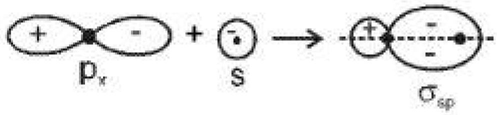
B.E. of H_2 > B.E. of H_2^+ > B.E of He_2^+ > BE of He_2 where BE = bond energy or bond dissociation energy

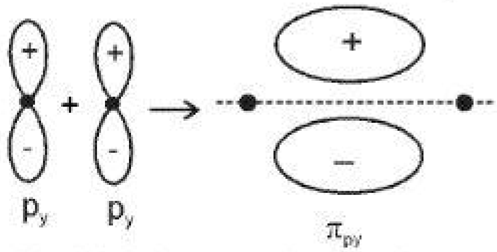
and B.L. of H_2 < B.L. of H_2^+ < B.L. of He_2^+ < B.L. of He_2

where B.L. = bond length

so stability order = $H_2 > H_2^+ > He_2^+ > He_2$

6. (A) 

(B) 

(D) 

7. Bonding M.O. has maximum electron density between two nuclei

8. It should be stable because it has one more bonding electron than antibonding