INORGANIC CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 20

Total Marks : 27

Max. Time : 29 min.

Topic : Chemical Bonding

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.5	(3 marks, 3 min.)	[15, 15]
Multiple choice objective ('–1' negative marking) Q.6	(4 marks, 4 min.)	[4, 4]
Subjective Questions ('–1' negative marking) Q.7 to Q.8	(4 marks, 5 min.)	[8, 10]

1. Which of the following pairs of species would you expect to have largest difference in spin magnetic moment:

(A) O_2, O_2^+ (B) O_2, O_2^{2-} (C) O_2^+, O_2^{2-} (D) O_2^-, O_2^+

2. According to Molecular orbital theory, HOMO in O_2^- is :

(A) $\pi\ 2p_x = \pi\ 2p_y$ (B) $\pi^*\ 2p_x = \pi\ ^*2p_y$ (C) $\sigma\ 2p_z$ (D) $\sigma^*\ 2p_z$

3. Order of stability of N_2, N_2^+ and N_2^- is :

(A) $N_2 > N_2^+ > N_2^-$ (B) $N_2^+ > N_2 > N_2^-$ (C) $N_2^- > N_2 > N_2^+$ (D) $N_2^- = N_2^+ > N_2$

4. The bond order in NO is 2.5 while that in NO^+ is 3. Which of the following statements is true for these two species :

(A) Bond length comparison is unpredictable.
(B) Bond length in NO is greater than in NO^+.
(C) Bond length in NO^+ is equal to that in NO.
(D) Bond length in NO^+ is greater than in NO.

5. According to Molecular orbital theory, which of the following statement about the magnetic character and bond order of O_2^+ is correct :

(A) Paramagnetic and bond order less than that of O_2
(B) Paramagnetic and bond order greater than that of O_2.
(C) Diamagnetic and bond order less than that of O_2
(D) Diamagnetic and bond order greater than that of O_2.

6.* Which of the following is/are correct :

(A) Carbon-carbon bond length in CaC_2 will be more than in CH_2CCH_2
(B) O–O bond length in KO_2 will be more than in Na_2O_2.
(C) O–O bond length in $O_2[PtF_6]$ will be less than that in KO_2
(D) N–O bond length in NO gaseous molecule will be smaller than in NOCl gaseous molecule.

7. Of the following species, which has the highest bond order and shortest bond length : NO, NO^+, NO^{2+}, NO^-

8. Explain why NO^+ is more stable towards dissociation than NO, whereas CO^+ is less stable towards dissociation than CO.

Answer Key

DPP No. # 20

1.	(B)	**2.**	(B)	**3.**	(A)	**4.**	(B)	**5.**	(B)
6.*	(CD)	**7.**	NO^+.						

8. NO has lost an antibonding electron to form NO^+. So NO^+ is more stable.
CO has lost a bonding electron to form CO^+. So CO^+ is less stable.

Hints & Solutions

DPP No. # 20

1. O_2 = 2 unpaired e^-
O_2^+ = 1 unpaired e^-
O_2^- = 1 unpaired e^-
O_2^{2-} = 0 unpaired e^-
O_2 and O_2^{2-} have largest difference in no. of unpaired electrons.So, they have largest difference in magnetic moment.

2. O_2^- :KK $(\sigma\ 2s)^2\ (\sigma^*\ 2s)^2\ (\sigma\ 2p_z)^2\ (\pi\ 2p_x^2 = \pi\ 2p_y^2)\ \underbrace{(\pi^*2p_x^1 = \pi^*2p_y^1)}_{\text{HOMO}}$

3. Bond order of N_2 = 3
Bond order of N_2^+ = 2.5
Bond order of N_2^- = 2.5
But N_2^+ consist of lesser electrons in anti bonding molecular orbital. So it is more stable than N_2^-.

as $N_2^+ = \sigma_{1s}^2 < \sigma_{1s}^{*2} < \sigma_{2s}^2 < \sigma_{2s}^{*2} < \pi_x 2p^2 = \pi_y 2p^2 < \sigma_{2p_z}^1$

$N_2^- = \sigma_{1s}^2 < \sigma_{1s}^{*2} < \sigma_{2s}^2 < \sigma_{2s}^{*2} < \pi_x 2p^2 = \pi_y 2p^2 < \sigma_{2p_z}^2 < \pi_x 2p^{*1} = \pi_y 2p^{*0}$

4. Greater bond order $\Rightarrow$ Lesser bond length.

5. O_2^+ = BO = 2.5 > BO_{O_2}
15 electron $\therefore$ paramagnetic.

6.* In CaC_2 there is C $\equiv$ C , while in CH_2CCH_2, there is only C = C.
$KO_2 = K^+ + O_2^-$
Bond order = 1.5
$Na_2O_2 = 2Na^+ + O_2^{2-}$
Bond order = 1.0
$O_2(PtF_6] = O_2^+ + [PtF_6]^-$
Bond order = 2.5
NO Bond order = 2.5
while in NOCl, bond order = 2.

7.

Species	No. of electrons	Bond order	Magnetic nature
NO	15	1/2 (10 – 5) = 2.5	Paramagnetic
NO^+	14	1/2 (10 – 4) = 3.0	Diamagnetic
NO^{2+}	13	1/2 (9 – 4) = 2.5	Paramagnetic
NO^-	16	1/2 (10 – 6) = 2.0	Diamagnetic

Highest bond order $\Rightarrow$ shortest bondlength (NO^+).

8. NO has lost an antibonding electron to form NO^+. So NO^+ is more stable. CO has lost a bonding electron to form CO^+. So CO^+ is less stable.