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.