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Class: 11
Subject: Chemistry
Topic: Chemical bonding and molecular structure
No. of Questions: 20
Duration: 60 Min
Maximum Marks: 60

1. Which of the following molecular orbitals in N2 has least energy?
   A. $\pi 2py$
   B. π *2Py
   C. σ*2PZ
   D. σ2PZ
   Sol: A
   The increasing order of energy level of molecular orbitals in N2 molecule is
   ó1s ó *1s ó2s ó*2s [ð2px= ð2py] ó2pz [ð*2px= ð*2py] ó*2pz Orbital with least energy is ð2py

2. **Assertion (A)** Band gap is germanium is small.
   Reason (R) The energy spread of each germanium level is infinitesimally small.
   A. Both (A) and (R) are true and (R) is the correct explanation of (A).
   B. Both (A) and (R) are true but (R) is not the correct explanation of (A).
   C. (A) is true but (R) is false.
   D. (A) is false but (R) is true.
   Sol: C

3. The hybridization of the central atom in water, ammonia and acetylene molecules respectively is
   A. sp^3 sp^3 sp
   B. sp, sp^3 sp^2
   C. sp^2 sp, sp^3
   D. sp, sp^3 sp^3
   Sol: A
   In water, central oxygen atom (to which hydrogen atoms are linked) undergoes sp^3 hybridization. Even in ammonia molecule nitrogen undergoes sp^3 hybridization. Thus the order is sp^3, sp^3, sp

4. Malleability and ductility, of metals are is due to
   A. sliding of layers of metal atoms
   B. sliding of layers of metal ions
   C. mobility of electrons in a regid structure of metal ions
   D. the presence of Vander Waal's forces binding the metals ions in the crystal lattice
   Sol: B

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5. The decreasing order of stability and bond dissociation energy of the following species are
   A. $O_2^+ > O_2 > O_2^- > O_2^{2-}$
   B. $N_2 > N_2^+ > N_2^- > N_2^{2-}$
   C. $H_2 > H_2^+ > H_2^-$
   D. All correct

   Sol: D
   Lower the bond order less is the stability of the molecule and hence lower is the bond dissociation energy. If bond order is same than if one of them contains more electrons in the antibonding orbitals then both the stability and bond dissociation energies decrease

6. The bond order in hydrogen molecule is
   A. 1
   B. 2
   C. 3
   D. 4
   Sol: A
   The electronic configuration of H_2 molecule is $\sigma ls2s$. ∴ Bond order = $\frac{2-0}{2}$=1

7. In NH3 molecule H - N - H bond angle is
   A. 120°
   B. 109° 28’
   C. 104.5°
   D. 107°
   Sol: D
   In ammonia out of the four sp^3 hybrid orbitals, 3 are used for bonding with hydrogen. The 4th hybrid orbital contains a lone pair electron. According to VSEPR theory there is greater repulsion between lone pair-bond pair than bond pair-bond pair the N-H bonds are pushed closer to 107°

8. The bond order in the super oxide ion is
   A. 1
   B. 1.5
   C. 2
   D. 2.5
   Sol: B

   KO_2 is a super oxide. Hence the super oxide ion is O_2^- ($KO_2 \rightarrow K^+ + O_2^-$) The bond order is 1.5.

9. Which contains both polar and non-polar bonds?
   A. NH_4Cl
   B. HCN
   C. H_2O_2
   D. CH4
   Sol: C

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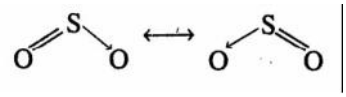
The structure of H_2O_2 can be represented as H-O-O-H. Here O-O bond is non polar and the O-H bonds are polar. In other molecules there are no bonds between like atoms. Hence perfect non polar bonds are not present

10. Which of the following metals will exhibit photoelectric effect most easily?
A. Sodium
B. Magnesium
C. Caesium
D. Lithium
Sol: C
Ionisation energy of caesium is so low that electrons are ejected even by light radiation

11. Co-ordinate bond is present in
A. carbon monoxide
B. carbon dioxide
C. ammonia
D. sulphur dioxide
Sol: D
The structure of SO is a resonance hybrid of the following two structures.



12. **Assertion (A)** On cooling, the brown colour of nitrogen dioxide disappears.
Reason (R) On cooling NO2 undergoes dimerisation resulting in the pairing of odd electrons of NO2.
A. Both (A) and (R) are true and (R) is the correct explanation of (A).
B. Both (A) and (R) are true but (R) is not the correct explanation of (A).
C. (A) is true but (R) is false.
D. (A) is false but (R) is true.
Sol: A

13. Which one of the following compound is polar?
A. $CHCl_3$
B. CCl_4
C. CO_2
D. BF_3
Sol: A
There is no symmetry in chloroform. Hence the molecule becomes polar. There is molecular symmetry in each of the remaining molecules

14. **Assertion (A)** The bond angle in the molecule H2S is less than 109.5°
Reason (R) The lone pairs force the H-atoms close together.
A. Both (A) and (R) are true and (R) is the correct explanation of (A).
B. Both (A) and (R) are true but (R) is not the correct explanation of (A).
C. (A) is true but (R) is false.
D. (A) is false but (R) is true.

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Sol: A

15. Which will form the strongest bond?
A. F and Cl
B. Cl and Br
C. Mg and F
D. Na and F
Sol: D

16. In homo atomic molecules which sets of orbitals degenerate?
A. $\sigma 2P_Z$ and $\pi 2P_x$
B. $\pi\ 2P_x$ and $\pi\ x2P_x$
C. $\pi 2P_x$ and $\pi\ 2P_Y$
D. $\sigma\ 2P_Z$ and $\sigma x \pi\ 2P_Z$
Sol: C
Degenerate orbitals have same energy. In the 2nd level 2 sets of orbitals degenerate. They are 1) ð$2p_x$ and ð$2p_y$ 2) ð *$2p_x$ and ð * $2p_y$

17. Which one of the molecular species has unpaired electrons?
A. N_2
B. N_2^{2+}
C. N_2^{2-}
D. O_2^{2-}

Sol: C
The electronic configurat ion of the various species are

$N_2 : KK\,\sigma 2s^2\,\sigma^* 2s^2\ \pi 2p_x^2\ \pi 2p_y^2 \sigma 2p_z^2$

$N_2^{2+} : KK\,\sigma 2s^2\,\sigma^* 2s^2\ \pi 2p_x^2\ \pi 2p_y^2$

$N_2^{2-} : KK\,\sigma 2s^2\,\sigma^* 2s^2\ \pi 2p_x^2\ \pi 2p_y^2 \sigma 2p_z^2 \pi^* 2p_x^1 \pi^* 2p_y^1$

$O_2^{2-} : KK\,\sigma 2s^2\,\sigma^* 2s^2\ \sigma 2p_z^2\ \pi 2p_x^2 \pi 2p_y^2 \pi^* 2p_x^2 \pi^* 2p_y^2$

Hence only N_2^{2-} contains 2 unpaired electrons.

18. The strongest hydrogen bond present in
A. H_2O
B. H_2S
C. NH_3
D. HF

Sol: D
Fluorine is the most electronegative element. Hence fluorine forms the strongest. hydrogen bond

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19. The number of antibondin g electrons present in O_2^- molecular ion is
    A. 8
    B. 6
    C. 5
    D. 4

    Sol: C

    Electronic configurat ion of O_2^- molecular ion is

    $K\ K\ \sigma 2s^2\ \sigma * 2s^2\ \sigma 2p_z^2\ \pi 2p_x^2\ \ \pi 2p_y^2\ \pi * 2p_x^2\ \pi * 2p_y^1$.

    Hence a total of 5 antibondin g electrons are present

20. Polarisability is maximum for
    A. F^-
    B. Cl^-
    C. Br^-
    D. I^-
    Sol: D

    After the formation of an ionic bond, the cation tries to pull the electron 'cloud towards itself. This phenomenon is called polarization of the ionic bond. Polarisation increases with the increase in the size of the negative ion or decrease in size of positive ion. It also increases with the increase in the charge on the ion. Thus the polarisability increases in the order F^-, Cl^-, Br^-, I^- for anions and for the cations the order is K^+, Na^+

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