Blue Print (As per PU Board)

Topic	1 mark questions	2 marks questions	3 marks questions	5 marks questions	Total Marks
Chemical Bonding & Molecular Structure	–	1	3	–	10

One mark questions

1. **What is a chemical bond?**
   Answer: The attractive force which holds various constituents (atoms or ions etc) together in different chemical species is called a chemical bond.
2. **In the periodic table, the group of highly electronegative elements is _____.**
   Answer: Halogens
3. **How does resonance stabilize a molecule?**
   Answer: Resonance stabilizes the molecule as the energy of the resonance hybrid is less than the energy of any single canonical structure.
4. **Give the mathematical expression for dipole moment.**
   Answer: $\mu = Q \times r$
   Dipole moment = charge × distance

Two marks questions

5. **Among KCl and NaCl, which is more stable? Give reason.**
   Answer: NaCl is more stable than KCl.
   Lattice energy of NaCl (788KJ/mol) greater than lattice energy of KCl (718KJ/mol) because smaller ionic radius of Na^+ (95pm) when compared to K^+ (133pm).
6. **The dipole moment in BF_3 is zero. Explain**
   Answer: In BF_3 $\mu = = 0$, although the B-F bonds are oriented at an angle of $120°$ to one another. This is because the bond moments give a net sum of zero as the resultant of any two is equal and opposite of third.
7. **Explain the LCAO method for the formation of molecular orbitals from the atomic orbitals.**
   Answer: The molecular orbitals are formed by the linear combination of wave functions of the participating atomic orbitals. They may combine either by addition or by subtraction. Let Ψ_A and Ψ_B represent the wave functions of the two combining atomic orbitals A and B taking part in chemical combination.

8. **Distinguish between bonding molecular orbital and anti-bonding molecular orbital.**
   Answer: **Bonding molecular orbitals**
   1. Formed by symmetric combination of atomic orbitals.
   2. Has more electron density between the nuclei.

   Antibonding molecular orbitals.
   1. Formed by asymmetric combination of atomic orbitals.
   2. Has less electron density between the nuclei.

Three marks questions

9. **Explain the diamagnetic behaviour of Hydrogen molecule on the basis of molecular orbital theory.**
   Answer: It is formed by the combination of the two hydrogen atoms.
   Each hydrogen atom has one electron in 1s orbital.
   Hence there are two electrons in Hydrogen molecule.
   The molecular orbital configuration is $\sigma 1s^2$

The bond order is calculated as follows

$$\text{Bond order} = N_b - \frac{N_a}{2}$$

$$= \frac{2-0}{2}$$

$$= 1$$

10. **Show that oxygen molecule is paramagnetic based on molecular orbital theory.**
Answer: It is formed by the combination of the two oxygen atoms.
Each oxygen atom has eight electrons and its electronic configuration is
$1s^2, 2s^2, 2p_x^2, 2p_y^1, 2p_z^1$
Hence there are 16 electrons in oxygen molecule.
The molecular orbital configuration is
$\sigma 1s^2, \sigma^* 1s^2, \sigma^* 2s^2, \sigma 2pz^2, \pi 2px^2 = \pi 2py^2, \pi^* 2px^1 = \pi^* 2py^1$
The bond order is calculated as follows

$$\text{Bond order} = N_b - \frac{N_a}{2}$$

$$= \frac{10-6}{2}$$

$$= 2$$

11. **Define octet rule. Write its significance and limitations.**
Answer: Octet rule: Atoms can combine either by transfer of valence electrons from one atom to another (gaining or losing) or by sharing of electron in order to acquire stable gas configuration.
Significance: It helps to explain why different atoms combine with each other to form ionic compounds or covalent compounds.
Limitations:
(1) According to octet rule, atoms take part in chemical combination to achieve the configuration of nearest noble gas elements. However some of noble gas elements like Xenon have formed compounds with fluorine and oxygen.
(2) The theory does not account for shape of molecule.
12. **Among O_2 and N_2 which is more stable and why?**
Answer:

	Bond order	bond length	bond dissociation enthalpy
$N_2 \rightarrow N \equiv N$	3	110nm	945 kJ mol^{-1}
$O_2 \rightarrow O = O$	2	121nm	498 kJ mol^{-1}

Greater the bond order, bond enthalpy (energy required to break the bond) increases, bond length decreases. Hence stability of the molecule increases. Thus N_2 is more stable than O_2.