

### Atomic and Molecular Structure

- 1) Define orbitals. Explain the concept of charge clouds or orbitals.
- 2) Give the important characteristics of atomic orbitals.
- 3) Give the definition of atomic orbitals. Name different types of atomic orbitals.
- 4) Explain the shapes of different types of atomic orbitals.
  - 5) Define s- orbitals. Explain it's shape.
  - 6) Define p- orbitals. Explain it's shape.
  - 7) Define d- orbitals. Explain it's shape.
- 8) What are the governing rules for filling the electrons in orbitals?
- 9) Give the rules of writing the electronic configurations of atoms of different elements? Explain by examples of second period elements of modern periodic table.
- 10) MOT is better than VBT. Explain Why?
- 11) What is molecular orbital theory? Give it's postulates.
- 12) Give the rules for writing molecular orbital configurations. Give suitable examples.
  - 13) What is molecular orbital configuration of
    - a)  $O^{2-}$  ion
    - b)  $N_2$  molecule
    - c)  $Be_2$
  - 14) Differentiate atomic and molecular orbitals.
  - 15) Explain combination of atomic orbitals by LCAO method.
  - 16) Sketch and describe the molecular orbital resulting from the combinations of following atomic orbitals.
    - a) Two s-orbitals
    - b) Head on overlap of Two p-orbitals.
  - 17) Differentiate  $\sigma$  and  $\pi$  molecular orbitals.
  - 18) Explain the term bonding molecular orbitals with examples.
  - 19) Explain the term antibonding molecular orbitals with examples.
  - 20) Explain the formation of BMO and ABMO by the combinations of atomic orbitals of hydrogen atoms.
  - 21) Explain the energy difference of bonding and antibonding molecular orbitals.
  - 22) Differentiate bonding and antibonding molecular orbitals.

- 23) Define bond order in molecular orbitals theory.
- 24) Explain magnetic behavior of molecules in the basis of MOT.
- 25) Why does  $\text{Be}_2$  molecule not formed? Explain on the basis of MOT.
- 26) Explain the structure of  $\text{O}_2$  molecule on the basis of MO theory. Show that  $\text{O}_2$  is para magnetic according to MO theory.
- 27) Draw the molecular orbitals structure of CO molecule and answer the following:
- How many bonding and antibonding orbitals there in the molecules.
  - How many unpaired electrons are there?
  - How many  $\sigma$  and  $\pi$  bonds are there.
- 28) Write the ground state electronic configurations of NO on the basis of MO theory and calculate it's bond order.
- 29) Discuss the main features of the molecular orbital approach in context of bond formation in diatomic molecules.
- 30) Write the electronic configurations of  $\text{Be}_2$  molecules and calculate it's bond order.

### **1) Aromatic systems and their molecular structure**

1) State Huckel's rule of aromaticity.

2) Define aromaticity. Give suitable examples of compound showing aromaticity.

3) What are the conditions of aromaticity for cyclic aromatic compounds?

4) Write a note on structure and bonding of benzene.

5) Explain aromaticity in benzene.

6) Explain aromatic nature of pyrrole.

7) Explain structure and bonding of pyrrole in details.

8) Explain resonance structure of benzene.

9) Explain Kekule's structure benzene. Give it's limitations.

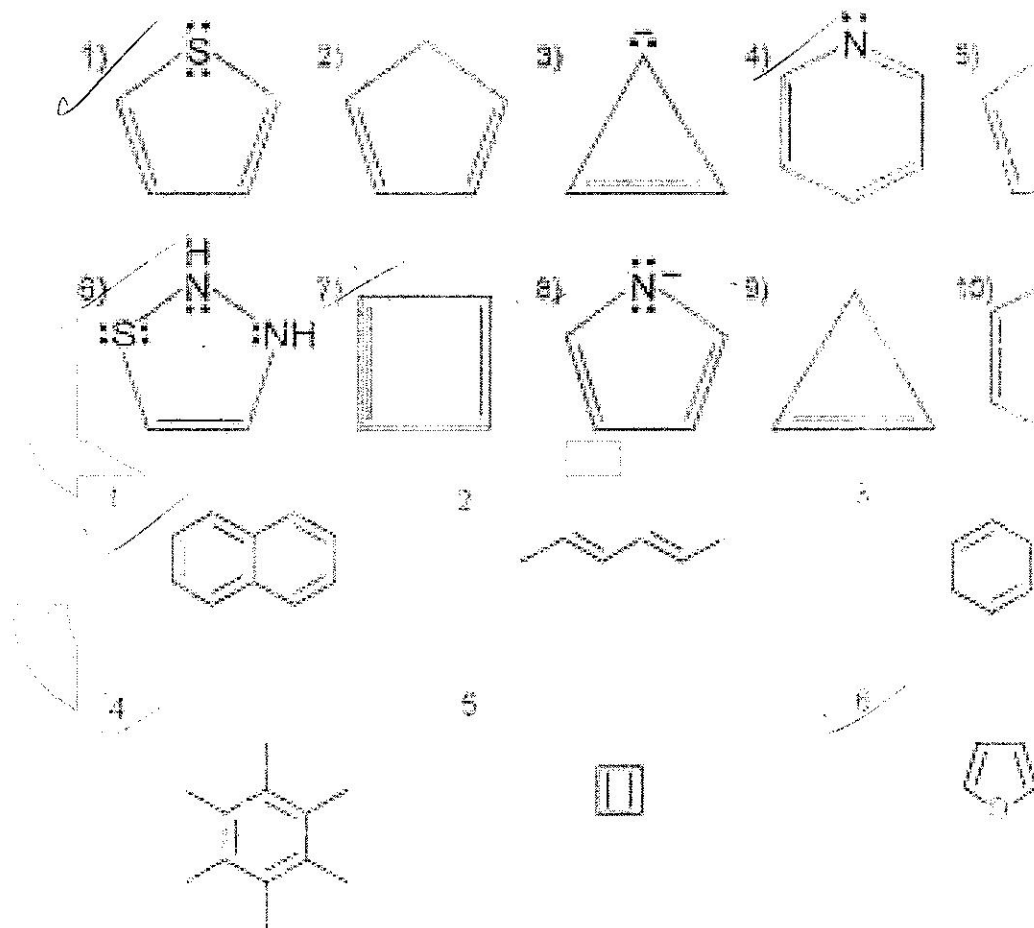
10) Explain reason of aromaticity in pyrrole.

11) Give the difference in aromatic and aliphatic compounds.

12) Give any three reactions of benzene involving electrophilic substitution.

13) Give a short introduction of benzene and it's physical properties.

- 15) Give a short introduction of pyrrole and its physical properties.
- 16) Explain aromatic sextet theory.
- 17) Explain molecular orbital structure of benzene..
- 18) Give a short introduction of pyrrole.
- 19) Explain chemical nature (bonding) of pyrrole.
- 20) Classify the following into aromatic, antiaromatic and nonaromatic



- 21) Draw the structure of following compounds and check whether they are aromatic, antiaromatic and nonaromatic :Tropyllium ion, cyclooctatetraene, cyclopentadienyl cation, imidazole, pyridine, cyclopentadienyl anion, cyclopropenyl cation, naphthalene, anthracene, phenanthrene, azulene, cycloheptatriene

- 1) Define intermolecular interactions. Give the names of different types of intermolecular forces.
- 2) What is molecular dipole? Define with suitable examples.
- 3) What are the dipole interaction forces? Explain their types with appropriate examples and diagrams.
- 4) Define dipole induced dipole interaction. Explain with neat and labeled diagrams.
- 5) Give the characteristics of dipole -dipole interactions.
- 6) Give any three properties of dipole induced dipole interactions.
- 7) Define Van Der Waals force. Give the examples of Van Der Waals forces.
- 8) Give properties of Van Der Waals forces.
- 9) Explain the origin of Van Der Waals forces.
- 10) What are the London forces or dispersion forces? Explain with suitable diagrams.
- 11) What is an instantaneous dipole? Explain in brief.
- 12) Give properties of London forces or dispersion forces.
- 13) Define ionic interaction.
- 14) Explain ion dipole interaction in details.
- 15) Explain hydration of NaCl on the basis of ion dipole interaction.
- 16) Give the general properties of ion dipole interaction.
- 17) Explain ion induced dipole in short.
- 18) What is a real gas?
- 19) Explain the deviation of real gas from ideal behavior.
- 20) What is compressibility factor? Explain in brief.
- 21) Give a brief introduction of equation of state real gases.
- 22) Derive the Van Der Waals equations of state real gas.
- 23) Explain correction in volume and pressure in the Van Der Waals equations of state real gas.
- 24) What are the Van Der Waals constants? Give the equations of their numerical values.

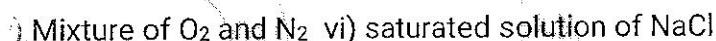
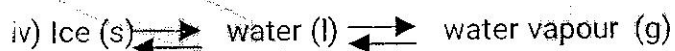
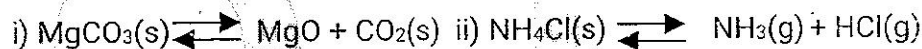
Also give some examples of Van Der Waals constants for some common gases.

- 25) Write different equations of state real gases.
- 26) Define critical phenomena.
- 27) Explain how does a gas liquefy.
- 28) Give the definition of critical constants.
- 29) Give the examples of critical constants for some common gases.
- 30) Explain the critical phenomena of real gases with the help of Andrews isotherms.
- 31) Define dipole -dipole interactions. Explain with appropriate diagram.
- 32) Give any three properties of dipole – dipole interactions.

### Phase Rule

#### Questions carrying 1 to 2 marks:

- 1) Define a) Phase b) Eutectic Point c) Eutectic Mixture d) degree of freedom e) Triple Point
- 2) Calculate the number of phase present in the following system:

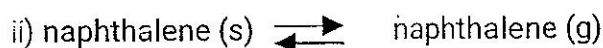


fine component with example.

fine Gibbs Phase Rule.

#### Questions carrying 3 to 4 marks:

- 1) Explain Gibb's Phase Rule and the terms involved in it.
- 2) Find degree of freedom for this system;
- $\text{NaCl}(\text{s}) \rightleftharpoons \text{NaCl}(\text{aq})$



- 3) Enumerate the limitations of phase rule.
- 4) What are merits of Phase Rule?
- 5) What is meant by Triple point? Apply phase rule and degree of freedom for Triple point.
- 6) Explain "Pattinson's Process".
- 7) What is metastable curve? Describe significant features.
- 8) Draw the phase diagram for lead silver system. Or Discuss the phase rule for two-component system.

### III. Questions carrying 5 to 6 marks:

- 1) What is the mathematical form of Gibb's phase rule equation? Explain the meaning of each one of the terms involved in it.
- 2) Explain the application of Gibb's phase rule to one component system (water system) or explain one component system on basis of Gibb's phase rule. Or

Draw the phase diagram of water system and find the degree of freedom for areas, curves and point. Or

Explain behavior of water with respect to temperature and pressure as one component system with phase diagram.

What is reduced phase rule? When is it used? Or Explain the phase rule applicable for isobaric two component systems.

- 3) What is condensed Phase rule? Explain Phase diagram of Ag-Pb system.

### IV. Numerical Problems:

- 1). An alloy of tin and lead contain 73% tin. Find the mass of eutectic in 1 kg of solid alloy if the eutectic contains 64% of tin.
- 2). An alloy AB of 10 g weight contains 25% of A. The molten AB on cooling gave out B and a eutectic alloy with A and B at equal percentage. What is the amount of B that has formed?
- 3). An alloy of Cd and Bi contains 25% of Cd. Find the mass of eutectic in 1 Kg of alloy, if the eutectic system contains 40% Cd.
- 4). 1000 kg of sample of argentiferous lead containing 0.1% silver is melted and then allowed to cool. If eutectic contains 2.6% Ag, what mass of :
  - i) Mass Eutectic will be formed
  - ii) Mass of lead will separate out?

4).An alloy AB having weight 20 g contains 20% of A.The molten AB on cooling gave out B and a eutectic alloy with A and B at equal percentage.What is the amount of B formed?

5).An alloy of tin and lead contains 80% tin.Find the mass of eutectic in 1 kg of solid alloy if the eutectic contains 60% of tin.

## POLYMERS

### **I. QUESTIONS CARRYING 1to 2 MARKS**

- 1) With example mention the role of Plasticizers in moulding of plastic.
- 2) Thermoplastic polymers can be reclaimed from waste while thermosets cannot justify.
- 3) Give reasons: i) PVC is soft while Bakelite is a hard.
- 4) Give the preparation of Plexi glass.
- 5) What structural features a molecule must have to behave as a monomer?
- 6) Define Degree of Polymerization
- 7) Explain the term viscoelasticity as applied to polymers.
- 8) Discuss the structural features required a molecule to allow it to behave as a conducting polymer.
- 9) A sample of polymer has 4 molecules with molecular weights of  $2 \times 10^5$ ,  $1 \times 10^5$ ,  $3 \times 10^5$  and  $4 \times 10^5$ . Calculate the number average molecular weight.
- 10) A sample of polymer has 3 molecules with molecular weights of 100, 2 molecules with molecular weights of 300, 2 molecules with molecular weights of 100, 1 molecule with molecular weight of 200 and 1 molecule with molecular weight of 500. Calculate the number average molecular weight.

### **II. QUESTIONS CARRYING 3to 4 MARKS**

- 1) Define number-average molecular mass. State its mathematical expression. Also its significance.
- 2) Write the preparation, properties and uses of:
  - a) Kevlar b) PMMA
- 3) Give any four differences between thermosetting and thermoplastic polymers./ Differentiate between thermoplastic and thermosetting polymers.
- 4) Give examples for conducting polymers and mention their applications. Or What are conducting polymer? Classify with suitable examples.
- 5) Define Glass transition Temperature. How is it important? What are the factors affecting it?
- 6) Discuss any two of the following:
  - i) Glass transition temperature
  - iii) Conducting polymers
- 7) Write short note on Doped conducting polymers.

- 8) What are thermoplastic polymers? Name any two thermoplastic polymer. Give preparation, properties and uses of any one thermoplastic polymer.
- 9) A polymer sample contains 20%, 10%, 40% and 30% molecules with molecular weights of 14000, 13000, 16000, 15000 respectively. Calculate the number average and weight average molecular weight of polymer sample.
- 10) A polymer sample contains 40%, 30%, 20% and 10% molecules with molecular weights of 16000, 12000, 12000, 10000 respectively. Calculate the number average and weight average molecular weight of polymer sample.
- 11) A polymer with 10 chains has 3 molecules of molecular weight 30000, 2 molecules of molecular weight 60000 and 5 molecules of molecular weight 10000. Calculate number average and weight average molecular weights of the given polymer.
- 12) A polymer with 10 chains has 2 molecules of molecular weight 50000, 3 molecules of molecular weight 15000 and 5 molecules of molecular weight 10000. Calculate number average and weight average molecular weights of the given polymer.

### QUESTIONS CARRYING 5 to 6 MARKS

- 1) Write the role of a) Stabilizers b) Plasticizers c) Fillers in moulding of plastics.
- 2) What is Fabrication of polymers? Mention its types and explain Injection moulding with the help of neat diagram.
- 3) Explain Transfer Moulding for fabrication of plastic with a neat diagram.
- 4) Advanced polymeric materials like, conducting polymers have gained increasing importance in the recent years. Explain the above sentence, what are their main structural features with one example each.
- 5) Define conducting polymers. Explain intrinsic and doped conducting polymer with appropriate examples.
- 6) What is moulding? Explain with the help of a neat diagram Extrusion moulding of an insulated cable.
- 7) Explain any three compounds added to plastics to improve its properties.
- 8) Describe the moulding method for thermoplastic polymers.
- 9) What is meant by compounding of plastics? What are the different constituents of compounding. Write their uses.

### Water

#### 1-2 mark questions

- 1) What is "Hard Water"?
- 2) Differentiate between BOD and COD.
- 3) Write softening reaction involved in demineralization process.
- 4) Why hard water does not lather with soap?



- 5) What is degree of hardness? How is it calculated?
- 6) Distinguish between temporary and permanent hardness of water.
- 7) Why  $\text{CaCO}_3$  is used as the standard in degree of hardness. Give the general equation of degree of hardness.
- 8) Explain the role of bleaching powder as a disinfectant.
- 9) Which buffer solution added during determination of hardness of water by EDTA titration and why?
- 10) With the help of reaction explain what happens when hard water is boiled?
- 11) Write two balanced equations to describe the changes that occur when hard water is boiled.

**3-4 mark questions**

- 1) Give a brief account of reverse osmosis.
- 2) Give a brief account of ultrafiltration
- 3) Give a brief account of electro dialysis.
- 4) Explain the following terms:- BOD and COD
- 5) Define BOD, COD and write its significance
- 6) What do you mean by hardness of water? Distinguish between alkaline and non-alkaline hardness of water.
- 7) What are cation and anion exchanger.
- 8) Write a note on ultra-filtration method for purification of water
- 9) Explain the principle of EDTA method or What is the principle involved in the determination of total hardness by EDTA method?
- 10) Explain the principle of reverse osmosis.
- 11) Explain the principle of EDTA method for determination of hardness.
- 12) What is reverse osmosis and ultrafiltration? How these two are different from each other.
- 13) Write advantages and disadvantages of ion exchange process.
- 14) What is reverse osmosis and ultrafiltration?
- 15) Explain Electro dialysis process and write its applications.

**5-6 mark question**

- 1) Discuss the following treatment methods for municipal water.
  - i) Bleaching powder ii) Ozone iii) Chlorine

- a) Hard water consumes lot of soap.
  - b) Hardness is expressed in terms of  $\text{CaCO}_3$  equivalents.
- 3) Draw the diagram for demineralization process and write suitable reactions involved in the process what are the advantages and disadvantages of the method.

S.F.