Department of Chemistry/CET
B.Tech/I year
Question Bank [3marks]
Module I-V
Part B

Question Paper Type: Pattern II for Virtual mode test

1. What is the Physical significance of Wave function?
2. Explain the term wave function.
3. Define Eigen value and Eigen function.
4. Give any two applications of Schrodinger wave equation.
5. Write down the one-dimensional Schrodinger time independent wave equation and the same for a free particle.
6. What is Normalization process and give normalized wave function for an electron in one dimensional potential well of length "a" meter.
7. What is Heisenberg uncertainty principle?
8. Give the plots of radial wave functions for hydrogen atom.
9. What is the significance of angular wave function?
10. What is Linear Combination of Atomic Orbitals (LCAO)? Give the wave function equations for the formation of molecular orbitals by the combination of atomic orbitals?
11. Differentiate bonding and anti-bonding molecular orbital.
12. Give the differences between atomic and molecular orbitals.
13. What is s-s orbital overlapping? Give examples.
14. Give the Molecular orbital diagram for Carbon Monoxide molecule {N.B: Only the diagram is required}and calculate its bond order.
15. Draw the shape of Molecular Orbitals obtained by overlap of **s**-**p** orbitals.
16. What is **p**-**p** orbital overlapping? Give only the molecular orbital diagram taking an example.
17. Give the type of overlapping that the following molecules undergo?
    i. H_2 ii. O_2 iii. HF
18. Calculate the bond order for i. Hydrogen molecule ii. CO and iii. He
19. Give a neat sketch on five d-orbitals.
20. Give the splitting pattern of d-orbitals in Oh complexes in the presence of ligands.
21. What is CFSE? Give the formula for calculating it in Oh complexes.
22. What is Huckel's rule of aromaticity? Give an example.
23. Compare Non-aromatic with Anti-aromatic compounds [Any two points].
24. What is HOMO and LUMO in Benzene?
25. What is HOMO and LUMO for 1,3-butadiene molecule?
26. Calculate CFSE for high spin octahedral complexes having d^5, d^6, d^7, and d^8 configurations. [N.B: Same can be asked for Low spin Oh complexes too]
27. What is meant by a nodal plane? Explain with an example.

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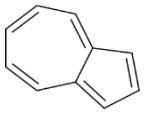
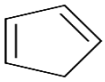
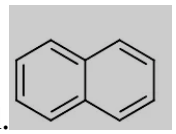
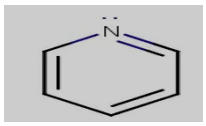
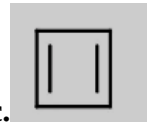
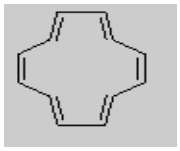
28. Identify aromatic, non-aromatic and anti-aromatic compounds using Huckel's rule from the following:

a.  b.  c.  d. 

29. Based on Huckel's rule, justify which of the following are aromatic, non aromatic and anti-aromatic.

a.  **b.**  **c.**  **d.** 

30. Calculate CFSE for $[Fe(CN)_6]^{3-}$ and $[CoF_6]^{3-}$ ions.
31. Give any two factors that influences on crystal field splitting in octahedral complexes.
32. What is Pairing energy (P)? Give the relation between crystal field splitting in octahedral complexes (Δo) and pairing energy (P).
33. Give the splitting pattern of d-orbitals in T_d complexes in the presence of ligands.
34. Give the formula for calculating CFSE in T_d complexes.
35. Why T_d geometry favors to form High spin rather low spin complexes?
36. What is a spectrochemical series? Mention its importance.
37. Calculate CFSE for high spin T_d complexes having d^5, d^6, d^7, and d^8 configurations.
38. Calculate the magnetic moment value for the following complexes and predict whether paramagnetic or diamagnetic.
    i. Low spin O_h complex with d^7 and ii. High spin T_d complex with d^4 configurations
39. Classify the following as high spin or low spin complexes and calculate the magnetic moment of the complexes.
    i. $[CoF_6]^{3-}$ ii. $[NiCl_4]^{2-}$ iii. $[Fe(CN)_6]^{3-}$ iv. $[CoCl_4]^{2-}$
40. What is electromagnetic spectrum and give its different regions?
41. What is the significance of selection rule in spectroscopy?
42. What are the criteria for a molecule to absorb in Microwave region?
43. Give examples for microwave active and inactive molecules.
44. Write a short note on the selection rule for Rotational (microwave) spectroscopy?
45. What are allowed and forbidden transitions in spectroscopy?
46. Define Hooke's law and give its significance in IR spectroscopy.
47. What are the criteria for a molecule to absorb in IR region?

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48. Give the selection rule for IR spectroscopy?
49. What is IR active and Inactive molecule? Give examples.
50. What is spin selection rule in electronic spectra?
51. Write a note on Laporte or orbital selection rule.
52. Explain the criteria for a molecule to absorb radio frequency waves in NMR region.
53. What is NMR active and inactive nuclei? Give examples.
54. What are the two scales used to calculate chemical shift values?
55. Give any two references (or) standards used in NMR spectroscopy.
56. What is shielding and de-shielding effect in NMR spectra?
57. What is Larmor (or) precessional frequency?
58. Define the term chemical shift and give the model of NMR spectrum for ethanol molecule.
59. How many values can the magnetic quantum number have?
60. Write down possible values m can have for a nucleus with I=1. Draw the energy level diagram for it.
61. Why is XPS a more qualitative than quantitative technique?
62. Give the number of electrons and best suitable pressure required for XPS measurement.
63. What is the principle of XPS?
64. Give only schematic diagram for XPS instrumentation.
65. What are the merits and demerits of XPS analysis?
66. Define the terms: Binding energy and Work function in XPS analysis.
67. What are the applications of XPS? [Any two]
68. Define Miller indices with examples.
69. For the intercepts x, y, and, z with values of 3, 1, and 2 respectively, find the Miller indices [Give the steps].
70. Compute the Miller Indices for a plane intersecting at x= ¼, y=1, and z=1/2. [Give the steps].
71. Give the expression for Bragg's law and explain the terms involved in it.
72. What is inter-plane spacing's in lattices? Give the expression taking an example.
73. Determine the Miller indices (hkl) of the shaded planes below.

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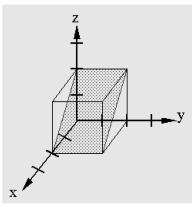

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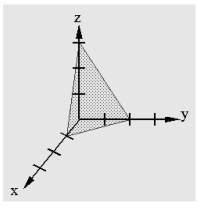

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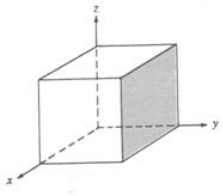

74. Define Bragg's law and give diffraction pattern diagram.
75. Define the terms i. Critical temperature ii. Critical volume iii. Critical pressure.
76. Write a short note on ion-ion interactions.
77. What is Dipole-diploe interaction? Give an example.
78. What are London forces of interactions? Give examples.
79. Write a note on ion-dipole interactions.
80. What is modified form of Vander Waals equation?
81. Give the Clausius equation for real gases.
82. What are the postulates of Fajan's rule for ionic and covalent bond? Give an example for the bonds mentioned.
83. First ionization energy of Al is lower than that of Mg. Comment on the statement.
84. How many numbers of geometries are possible in C.N 4? Give an example.
85. How many numbers of geometries are possible in C.N 6? Give an example.
86. Define the terms i. Ionization energy, ii. Electron affinity and iii. Electronegativity
87. What is effective nuclear charge and Shielding constant? Give their relation.
88. Give the formula to calculate Shielding constant [σ] for an electron residing in n^{th} [s or p] subshell and also in "d" subshell.
89. List out the elements from the following the most electropositive and electronegative element and give reasons.

    Li, Be, B, C, K and Flourine.
90. Arrange Br, F, I and Cl in the order of increasing electron affinity and give reasons.
91. Give the increasing order for Na, Al, Mg and Si atoms based on effective nuclear charge and give reasons.
92. What are atomic radii? Give its variation along the period and down the group taking examples.

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93. Arrange the following in the increasing order of atomic radii and give reasons: N, S, P and O.
94. Give reasons for: on-going from C to N in the second period, the values of electron affinity decrease instead of increasing.
95. Sr has larger atomic size when compared to Mg. Justify.
96. Ca^{2+}has a smaller ionic radius than K^{+}. Give reasons.
97. Define Polarizability and Polarizing power for an ion.
98. CuCl is more covalent than NaCl. Why?
99. Give the differences between hard and soft acids.
100. What are hard acids and bases? Give examples.
101. What are soft acids and bases? Give examples.
102. Define the terms i. Entropy ii. Enthalpy and iii. Internal energy.
103. What is the relation between enthalpy and Internal energy?
104. What is entropy? Explain its significance.
105. Give only the Nernst and Gibb's-Helmotz equations.
106. Define Chemical corrosion. Give the schematic diagram for depicting the mechanism of oxidation corrosion.
107. Define Electro chemical corrosion. Give a neat sketch for depicting the mechanism of oxygen absorption and Hydrogen evolution corrosion.
108. Write a note on free energy for corrosion reaction.
109. What is solubility product, K_{sp} and give the expression for the solubility product constant of common salt.
110. What is an Electrochemical cell or Galvanic cell? Give its representation.
111. Define Single electrode potential and standard electrode potential. Write the mathematical expression for Nernst equation for $Zn(s)/Zn^{2+}$ (aq) // Cu^{2+} (aq) / Cu(s)
112. Define Plane of symmetry with an example.
113. Define Centre of symmetry with an example.
114. Define Alternating axis of symmetry with examples.
115. Differentiate geometrical with optical isomerism.

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116.Mention the types of isomerism exhibited by each of the following pairs:

i. Maleic acid and Fumaric acid, ii.n-Butyl alcohol and Diethyl ether and iii. Diethyl ether and Methyl propyl ether

117. Differentiate Chirality and Achirality with an example for each.

118.What are Enantiomers and Diastereomers? Give examples.

119. Write a note on Newmann projection with an example.

120. What is Sawhorse projection? Give an example.

121.Based on Pourbaix diagram, define the terms passivity and immunity.

122.Give a neat sketch on Pourbaix diagram.

123. What is Fischer Projection?

124. Give the steps to determine R/S configuration on a Fischer Projection or Cahn-Ingold Prelog priority rules to determine R/S configuration on a Fischer Projection.

125. Define the terms i. Racemic mixture and ii. Mesoisomers with suitable examples.

126.What are dextro and laevo rotatory isomers? Give examples.

127.What is a reducing agent? Give an example with an equation.

128.What is an oxidising agent? Give an example with an equation.

129.What is the reaction of the following with Cyclopropane?

i. Halogens ii. HI iii. Sulphuric acid and iv. Hydrogen

130.What is a medicinal drug? Give the use of Aspirin and Paracetamol.

131.Write the synthesis of Aspirin. Give its uses.

132.Give the synthesis and uses of Paracetamol.

133.Explain the role of the following reagents in oxidation / reduction reactions.

a) $NaBH_4$ b) $K_2Cr_2O_7$ c) $KMnO_4$ and d) $LiAlH_4$

134.What is Dieckmann condensation? Give the equation taking an example.

135.What are addition reactions? Give an example. [equation required]

136.What are subsitution reactions? Give an example. [equation required]

137.What are elimination reactions? Give an example. [equation required]

138.What is Markovnikov's rule? Give an example to illustrate it.

139.Illustrate peroxide effect with an example.

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140. Compare Nucleophilic with Electrophilic substitution reactions.
141. Give an example [equation required] for bimolecular elimination[E2] and unimolecular nucleophilic substitution [SN1] reactions.
142. What is free radical addition reaction? Give an example with equation.
143. What is Structural isomerism? Give examples.
144. What is Coordination isomerism? Give examples.
145. What are Hydrate isomers? Give examples.
146. What are Linkage isomers? Give examples.
147. How many conformations does n-butane has?
148. Which conformation is the most stable one in n-butane?
149. Draw the least stable conformation for n-butane.
150. Illustrate the difference between gauche and staggered conformations for n-butane with neat sketches.

N.B: The questions can be changed [by either including or excluding] according to the pattern 2 type QP/ 3 Marks