

014/21

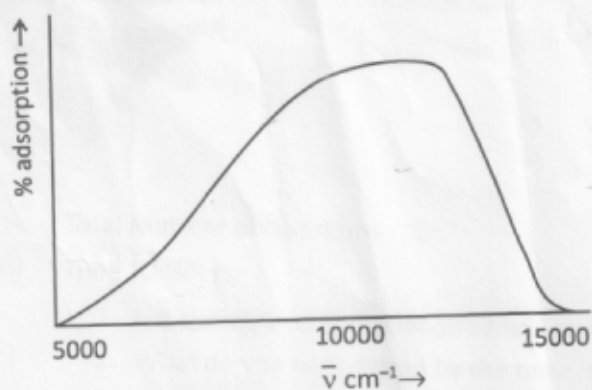
Total Number of Questions : 24  
Time : 2.00 Hours

Max. Marks : 100

1. Zinc is an important micronutrient in human metabolism. Illustrate the role of Zinc in our respiratory system. (3 Marks)
2. Compare the aromaticity of naphthalene and 1, 6 – Methano[10] annulene. (3 Marks)
3. Arrange the following carbonyls in the order of increasing CO bond order :  
diene  $\text{Mo}[\text{CO}]_3$ ,  $(\text{Py})_3 \text{Mo}[\text{CO}]_3$ ,  $(\text{Ph}_3\text{As})_3 \text{Mo}[\text{CO}]_3$ ,  $(\text{Ph}_3\text{P})_3 \text{Mo}[\text{CO}]_3$ ,  $(\text{PhPCl}_2)_3 \text{Mo}[\text{CO}]_3$ ,  $(\text{PCl}_3)_3 \text{Mo}[\text{CO}]_3$ .  
Justify your answer. (3 Marks)
4. Graphically represent and explain the phase-transformation as vapour pressure-temperature curves for a substance undergoing mesomorphic change. (3 Marks)
5. The amount of chloride ions present in a solution was determined using precipitation titrations against a standard solution of  $\text{AgNO}_3$  with  $\text{K}_2\text{CrO}_4$  as indicator. The results obtained are :  
19.8, 20.2, 19.4, 19.0, 18.9, 21.1, 23.3 g/L. Determine if the value '23.3' can be rejected or not.  
 $Q_{\text{critical}}$  for 7 observations at 90% confidence limit is 0.51. (3 Marks)
6. Draw the Tanabe-Sugano diagram for  $d^6$ -octahedral system and discuss the utility of the same. (4 Marks)
7. Explain how the Curie point of Iron can be deduced using Mössbauer spectroscopy. (4 Marks)
8. How can the nanomaterials be classified on the basis of dimensions ? Give examples. (4 Marks)
9. Derive the molecular term symbol for the ground state of  $\text{B}_2$ . (4 Marks)
10. Express the BET adsorption isotherm mathematically and graphically. Explain the different types of adsorption isotherms based on the BET equation. (4 Marks)
11. Derive down the general equation for molecular partition function from Boltzmann distribution and comment on the physical significance. (4 Marks)
12. Explain the regioselectivity in the thermal reaction of a ketene with an olefin on the basis of FMO treatment. (4 Marks)
13. Predict the stereochemistry of the product formed on the hydroboration of 1-octyne followed by hydrolysis and coupling with Z-vinyl bromide in toluene with  $\text{Pd}(\text{O})$  catalyst and  $\text{KOH}$ . Write the mechanism for the reaction. (4 Marks)
14. Predict the product of condensation between acetaldehyde and benzophenone in presence of a small amount of a base,  $\text{NaOH}$ . Justify your answer. (4 Marks)

P.T.O.

15. The electronic spectrum of  $[\text{Cu}(\text{H}_2\text{O})_6]^{2+}$  is given below.



Explain the reason for this unsymmetric band formation.

16.  $A^m[B_2^n]O_4$  spinels are compounds in which tetrahedral sites are occupied by divalent cations and octahedral sites are occupied by trivalent cation. Account for the formation of inverse spinels when one of the cation is a transition metal. (5 Marks)
17. Illustrate Cram's rule with the stereochemistry of reaction between 2-phenylpropanol and methyl magnesium bromide. (5 Marks)
18. Use Hammett plots to deduce the sensitivity of an ester hydrolysis reaction to the electronic effects. (5 Marks)
19. The  $^1\text{H}$  NMR spectrum of a compound with formula  $\text{C}_{10}\text{H}_{12}\text{O}_3$  showed the following peaks:  $\delta$ : 1.4 ppm, triplet, (3.5, s), (4.00, q), (6.8, d), (7.2, d), (12.5, a broad peak). The DEPT - 135, DEPT - 90 and normal  $^{13}\text{C}$  peaks are tabulated below: (5 Marks)

$^{13}\text{C}$	DEPT 135	DEPT 90
15	+ ve	Nil
40	- ve	Nil
63	- ve	Nil
115	+ ve	+ ve
125	Nil	Nil
130	+ ve	+ ve
158	Nil	Nil
179	Nil	Nil

Deduce the structure of the compound.

20. Derive Gibbs-Duhem equation. (5 Marks)
21. Describe primary and secondary kinetic isotopic effect. How can it be used for mechanistic studies? (5 Marks)
22. Set up Hückel Secular Equation and HMO diagram for 1, 3-butadiene. Calculate the delocalization energy. (5 Marks)
23. Explain the use of calixarenes as molecular receptors. (5 Marks)
24. Construct the character table for  $\text{PH}_3$  molecule symmetry. (5 Marks)