MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL

Paper Code : BSCH101 Chemistry I(Gr B)

UPID : 001034

Time Allotted : 3 Hours *Full Marks :70*

The Figures in the margin indicate full marks.
Candidate are required to give their answers in their own words as far as practicable

Group-A (Very Short Answer Type Question)

1. Answer any ten of the following : [1 x 10 = 10]

   (I) Which spectroscopic technique is most useful to identify the presence of known impurity in a drug substance?

   (II) Van der Waal's forces are directly proportional to which factor?

   (III) Give one example of state function.

   (IV) Give an example of soft acid.

   (V) Give one example of ionization isomerism.

   (VI) What is the reactivity order of alkyl halide in SN_2 mechanism?

   (VII) What is fingerprint region range in IR spectra?

   (VIII) Write down the formula of critical volume for Van der Waal's gas.

   (IX) State one application of first law of thermodynamics.

   (X) What is the shielding constant value for 1s orbital electron?

   (XI) What will be the absorbance if % of Transmittance = 80?

   (XII) Write down the relation of critical temperature for Van der Waal's gas.

Group-B (Short Answer Type Question)

Answer any three of the following [5 x 3 = 15]

2. Why does germanium act as n-type semiconductor? What is the difference between n- type and p-type semiconductor? [5]

3. Intensity of spectral line depends on which factor? What is Lambert – Beer Law? [5]

4. [5]

   Prove that $\left(V - \frac{h^2}{8\pi^2 m \nabla^2}\right)\Psi = E\Psi$

5. What kind of molecules shows IR spectra? "IR spectra is often characterized as molecular finger prints". Justify statement. [5]

6. An electron is confined in 1 – d box of length 10^{-10} m with potential energy equal to 0 inside (V = 0) and V = $\propto$ outside the box. Calculate the ground state energy and separation between the levels with quantum number 2 and 3. [mass of electron = 9.11x 10^{-31} kg, Planck's constant = 6.627 x 10^{-34} Js]. [5]

   The energy of electron inside one – dimensional box is given by, $E = n^2h^2/ 8m_ea^2$ where m_e is mass of electron, 'a' is box length, h is Planck's constant and n is quantum number (n = 1, 2, 3, 4.....)

Group-C (Long Answer Type Question)

Answer any three of the following [15 x 3 = 45]

7. (a) Most of absorption bands in the UV – Visible spectra are very broad. Give reasons. [3]

   (b) Why does 1, 3 butadiene possess higher λ_{max} value than that of ethane? [3]

   (c) Why the colour of sky is blue? [2]

   (d) Predict the proton NMR spectra of CH_4. [3]

   (e) Name any four surface characterization techniques. [4]

8. (a) (a) Discuss types and conditions of hydrogen bonding. [5]

(b) (b) Write the equation of state for the real gas with proper notations. Mention the significance of constants a and b. 5 [5]

(c) (c) Discuss the critical phenomenon of real gas. 2 [2]

(d) (d) Calculate the Boyle temperature for a gas whose van der Waals constant a = 7.18 L^2 $atmMol^{-2}$, b = 0.854 L Mol^{-1} and R = 0.082L atm K^{-1} mol^{-1}. [3]

9. (a) Write the Nernst equation for the cell reaction in the Daniel cell. How will the E_{cell} effected when the concentration of Zn^{2+} is increased? [5]

(b) What do you mean by hardness of water? Explain how hard water fails to form lather with soap? What is alkalnity of water? [5]

(c) What is corrosion? What are the different types of corrosion? [5]

10. (a) What do you mean by shielding and deshielding effects involved in NMR spectroscopy? [3]

(b) (b)Given that the spacing of the lines in the microwave spectrum of $^{27}Al\ ^{1}H$ is constant at 12.604 cm^{-1}. Calculate the moment of inertia and bond length of the molecule. (Mass of ^{27}Al = 26.981 amu). 5 [5]

(c) (c) ^{13}C is NMR active while ^{12}C is not. Explain. [2]

(d) (d) Predict the kind of electronic transition in (a) Cl_2 and (b) carbonyl group. Also give their intensity. [5]

11. (a) "The complexes of first transition series are mainly high-spin while those of second and third transition series are ot low – spin type" ---- Explain. First ionisation energies of 5d elements are higher than 3d and 4d elements. Give reason. [5]

(b) Explain why the second ionization energies for copper and chromium are enormously high? Iron is a transition element but sodium is not. Explain. [5]

(c) First ionisation energies of copper is higher than those of alkali metals while second and third energies are lower. Explain. Why are lanthanides and actinides placed in separate rows at the bottom of the periodic table? [5]