MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL

Paper Code : BS-CH-101

CHEMISTRY-1

Time Allotted: 3 Hours | *Full Marks*: 70

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

Group – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for *any ten* of the following: 1×10=10

(i) Which of the following is the expression of Schrödinger wave equation?

(a) $\nabla^2\Psi + (h^2/8\Pi^2 m)(E - V)\Psi = 0$ (b) $\nabla^2\Psi + (8\Pi^2 m/h^2)(E - V)\Psi = 0$

(c) $(-\hbar^2/2m\nabla^2 + E)\Psi - V\Psi = 0$ (d) $(-2m/\hbar^2\nabla^2 + V)\Psi - E\Psi = 0$

(ii) All living body is the example of

(a) open system (b) closed system

(c) isolated system (d) exothermic system

(iii) The correct order of bond dissociation energy is

(a) $O_2 < O_2^+ < O_2^- < O_2^{2-}$ (b) $O_2^{2-} < O_2^- < O_2 < O_2^+$

(c) $O_2^{2-} < O_2 < O_2^- < O_2^+$ (d) $O_2 < O_2^{2-} < O_2^+ < O_2^-$

(iv) What is the hybridization of XeF_4?

(a) Sp^2 (b) Sp^3

(c) Sp^3d (d) Sp^3d^2

(v) (2R, 4S)–2, 4-dichloropentane and (2S, 4R) –2, 4-dichloropentane are

(a) enantiomers (b) diastereomers

(c) identical (d) constitutional isomers

(vi) In electrochemical corrosion
(a) oxidation occurs at the anode
(b) reduction occurs at the anode
(c) both oxidation-reduction occurs at the anode
(d) it is not an example of oxidation-reduction reaction

(vii) Which of these exhibit fluorescence?
(a) NaCl (b) BaF_2
(c) CaF_2 (d) $CaCl_2$

(viii) Unit of frequency is
(a) cm (b) sec
(c) hertz (d) gm

(ix) Which of the following is not part of a polarimeter?
(a) NICOL (b) Diffraction grading
(c) Simple tube (d) Analyser

(x) The nucleus which will not show any peak in the NMR spectrum is
(a) ^{1}H (b) ^{17}o
(c) ^{16}o (d) ^{2}H

(xi) Which of the following is true for the Galvanic cell?
(a) The cell potential is always negative.
(b) The product are less stable than the reactants.
(c) ΔG for the cell reaction is positive.
(d) Chemical energy is converted to Electrical energy.

(xii) van der Waals type of bond is formed by
(a) sharing of electron.
(b) transfer of electron from one atom to other atom.
(c) sharing of electron by one atom only.
(d) weak electrostatic force of interaction among fluctuating dipoles.

(xiii) Silicon doped with gallium forms
(a) *p*-type semiconductor (b) *n*-type semiconductor
(c) insulator (d) None of these

Group – B
(Short Answer Type Questions)
Answer *any three* of the following. 5x3=15

2. (a) Explain the term chemical potential.
(b) Derive the relation of EMF of cell with ΔG and ΔH. 1+4=5

3. (a) Draw the molecular energy level diagram for O_2.

(b) Explain the paramagnetic behaviour of O_2 under the light of MO theory as an evidence of failure of VBT. 3+2=5

4. Prove that, $\left(V - \frac{h^2}{8\pi^2 m}\nabla^2\right)\Psi = E\Psi$. 5

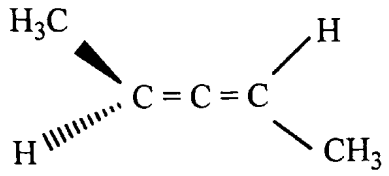
5. (a) Show that, entropy of mixing of ideal gases $\Delta S_{mix} > 0$.

(b) What is the physical significance of free energy change (ΔG)? 3+2=5

6. (a) Define specific rotation for an optically active molecule.

(b) What is the necessary and sufficient condition for a molecule to be optically active?

(c) The following compound does not have a chiral center still it shows optical activity— comment.



1+2+2=5

Group – C
(Long Answer Type Questions)
Answer *any three* of the following. 15×3=45

7. (a) State Hund's rule of spin multiplicity and Pauli Exclusion principle. Write down the electronic configuration of Fe (Z = 26).

(b) Calculate the effective nuclear charge of 4s electrons of Fe (Z = 26) with the help of Slater's rule.

(c) Define Pauling's Scale of electronegativity.

(d) Electron affinity of Cl is greater than F explain the phenomenon.

(e) Between $BeCl_2$ and $BaCl_2$ which one has more melting point and why?

(f) Show the hybridization and calculate the CFSE of $[Fe^{2+}(H_2O)_6]^{2+}$ and $[Fe^{3+}(H_2O)_6]^{3+}$ complex ions. (1+1+1)+2+2+2+2+4=15

8. (a) Draw all possible stereoisomers for butane-2, 3-diol. Are all of them optically active? Give reason.

(b) Draw the Fischer projection formula of following stereoisomers:

(i) (2R, 3R) –2, 3-dibromobutanedioic acid

(ii) S-2-Hydroxy-2-phenylpropanoic acid

(c) How enantiomers differ from diastereomers?

(d) S_N1 mechanism proceeds through partial racemization of the product. Explain.

(e) Halogens are ortho-para orienting and deactivating. Give reason. 4+(1+1)+3+3+3=15

9. (a) Define the following elements of symmetry with a suitable example in each case:

(i) Rotational axis of symmetry

(ii) Plane of symmetry

(iii) Centre of symmetry

(iv) Alternating axis of symmetry

(b) What is Beer-Lambert law? Show that absorption is linearly proportional to concentration of the solution.

(c) Explain-trans-Stilbene absorbs at a longer wavelength than cis-Stilbene. (4×2)+(2+3)+2=15

10. (a) Define corrosion. What are different types of corrosion?

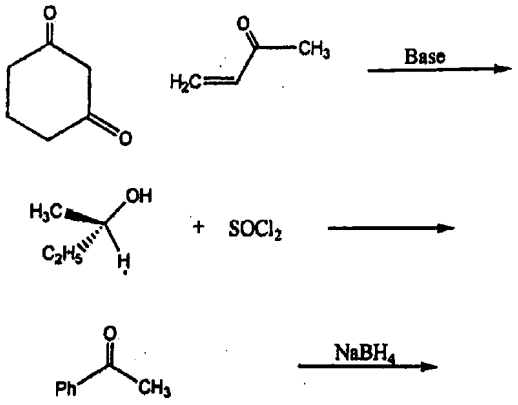
(b) What do you mean by hardness of water? Explain how hard water fails to form lather with soap? What are different types of hardness?

(c) Explain the potentiometric titration with suitable diagram of precipitation reactions between NaCl and $AgNO_3$. (1+4)+(1+2+2)+5=15

11. (a) State the postulates of Crystal Field Theory.

(b) Calculate the de Broglie wavelength associated with a stone having velocity 1 m s^{-1} and mass 100g; on the other side an electron having velocity 6×10^5 m s^{-1} and mass $9{\cdot}1\times10^{-31}$ kg. Which one of these is meaningful and why?

(c) Predict the product of the following reaction with a plausible mechanism.



(d) How do you measure the pH of unknown solution using calomel electrode?

(e) What type of storage cell is used in your mobile cell? 3+3+(2+2+1)+3+1=15

12. Write the short notes on *any five* of the following: 5×3=15

(i) Fluorescence and its application

(ii) Hard soft acids and bases

(iii) Gibbs-Helmholtz equation

(iv) Fajan's rule

(v) *n* and *p*-type semiconductor

(vi) Features of Ellingham diagram