Syllabus: Organic (Complete), Chemical Kinetics, Electrochemistry, Liquid Solution, Solid State, Ionic Equilibrium, Chemical Equilibrium, Atomic Structure, Gaseous State, Nuclear Chemistry, Coordination-Compounds.

CHEMISTRY

Section I

Straight objective type

*This section contains 8 multiple-choice questions numbered 1 to 8. Each question has 4 choices (A), (B), (C) and (D), out of which **only ONE** is correct.*

1. Two electro chemical cells are assembled in which the following reactions occur,
$V^{2+} + VO^{2+} + 2H^+ \rightarrow 2V^{3+} + H_2O$; $E^0_{cell} = 0.616$ V
$V^{3+} + Ag^+ + H_2O \rightarrow VO^{2+} + 2H^+ + Ag(s)$; $E^0_{cell} = 0.439$ V
Then E^0 for the half reaction $V^{3+} + e^- \rightarrow V^{2+}$, is: [Given : $E^0_{Ag+|Ag} = 0.799$ V]
(a) -0.256 V (b) +0.256 V (c) -1. 05 V (d) +1. 05 V

2. For the cell reaction, Cu^{2+} (aq) + Zn(s) $\rightarrow$ Zn^+ (aq) + Cu(s)
(C_1) (C_2)
of an electrochemical cell, the change in free energy ΔG at a given temperature is a function of:
(a) $\ln(C_1)$ (b) $\ln(C_2/C_1)$ (c) $\ln(C_1 + C_2)$ (d) $\ln(C_2)$

3. The ionization constant of a weak electrolyte is 64×10^{-6} while the equivalent conductance of its 0.01 M solution is 20 s $cm^2\,eq^{-1}$. The equivalent conductance of the electrolyte at infinite dilution (in S cm^2 eq^{-1}) will be:
(a) 250 (b) 196 (c) 392 (d) 384

4. An aqueous solution containing liquid A (M. wt = 128) 64% by weight has a V.P of 145 mm. If the vapour pressure of water is 155 mm then vapour pressure of A at the same temperature will be
(a) 205 mm (b) 105 mm (c) 185 mm d) 52.5 mm

5. Liquids A and B form an ideal solution and the B has stronger intermolecular forces. If X_A and X'_A are the mole fractions of A in the solution and vapour in equilibrium, then
(a) $\frac{X'_A}{X_A} = 1$ (b) $\frac{X'_A}{X_A} > 1$ (c) $\frac{X'_A}{X_A} < 1$ (d) $X'_A + X_A = 1$

6. two solutions each in 200 mL having 4 g glucose and 10g sucrose respectively. How much urea should be added to one of them in order to make them isotonic ?
(a) 0.4218 g urea in glucose solution (b) 0.77 g urea in glucose solution
(c) 0.72 g urea in sucrose solution (d) 0.421 g urea in sucrose solution.

7. In a compound XY_2O_4, oxide ions are arranged in CCP and cations X are present in octahedral voids. Cations Y are equally distributed among octachedral and tetrahedral voids. The fraction of the octahedral voids occupied is
(a) 1/2 (b) 1/4 (c) 1/8 (d) 1/6

8. Solubility of $Mg(OH)_2$ having K_{sp} equal to 8.9×10^{-13}, in a solution containing 500 ml of 0.2 M NH_4OH and 500 ml of 0.4 M $Ca(OH)_2$ is
(a) 3.4×10^{-19} (b) 55.63×10^{-13} (c) 2.34×10^{-9} (d) 8.34×10^{-13}

Section – II

Straight Objective Type (More than one options may be correct) **(+4, 0)**

9. Pick out the correct statements
(a) An electron accelerated through a potential difference of 150 volt has a wavelength of 1 Å.
(b) Uncertainty principle is applicable to subatomic particles.
(c) Electron microscope is based upon particle nature of moving electron
(d) de Broglie waves cannot be transmitted into space.

10. A radioactive element A disintegrates in the following manner $A \xrightarrow{\alpha} B \xrightarrow{-\beta} C \xrightarrow{-\beta} D$, then
(a) A and D are isotopes (b) B, C, D are isobars
(c) A and D are isobars but B, C, D are isotopes (d) A and B are isotopes

11. Following are the wrong statements regarding the disproportionate of Tin (II) in non – complexing media (Given $E^0_{Sn^{2+}_{(aq)}|Sn} = -0.15\ V;\ E^0_{Sn^{4+}_{(aq)}|Sn^{2+}} = +0.15\ V$)
(a) The disproportionation reaction is nonspontaneous, hence Sn^{2+} is stable.
(b) The disproportionation reaction is spontaneous hance Sn^{2+} is unstable
(c) The disproportionation reaction is nonspontaneous and hence Sn^{2+} is unstable
(d) Both (B) and (C) are correct

12. During esterification reaction , which is the correct order of the rate of the reaction?
(a) $CH_3OH > C_2H_5OH > C_3H_7OH$ (b) $(CH_3)_3C - OH > (CH_3)_2CH - OH > CH_3 - CH_2 - OH$
(c) $HCOOH > CH_3COOH > (CH_3)_2CH - COOH$ (d) $CH_3 - CH_2 - COOH > CH_3COOH > HCOOH$

Section III

*This section contains 2 paragraphs C_{13-15} ,and C_{16-18} . Based upon each paragraph, 3 multiple choice questions have to be answered. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE** is correct.*

C_{13-15}: Paragraph for Question Nos. 13 – 15

The potential of any electrode is the potential difference it and the electrolyte surrounding the electrode. Standard reduction potential (E^0) of a system predicts.
(i) the relative reducing strength of reducing agents
(ii) the relative activity of the metals
(iii) whether a metal can displace H_2 gas from a hydra acid or not

13. Given are the following half call reactions and the corresponding electrode potentials
(i) $A + e^- \leftrightarrows A^-$; $E^0_1 = -0.24$ V
(ii) $B^- + e^- \leftrightarrows B^{2-}$; $E^0_2 = 1.32$ V
(iii) $C^- + 2e^- \leftrightarrows C^{3-}$; $E^0_3 = -1.32$ V
(iv) $D^- + 2e^- \leftrightarrows D^{2-}$; $E^0_4 = 0.65$ V
Which combination of the two half cells would result in a cell with a largest emf?
(a) Pt, $C^- | C^{3-} || B^- | B^{2-}$, Pt (b) Pt, $B^- | B^{2-} || C^- | C^{3-}$, Pt
(c) Pt, $D^- | D^{2-} || C^- | C^{3-}$, Pt (d) Pt, $A | A^- || B^- | B^{2-}$, Pt

14. I_2 and Br_2 are added in a solution containing I^- and Br^- ions. The reaction that occurs is
(Given: $E^0_{I_2|I^-} = -0.54\ V;\ E^0_{Br_2|Br^-} = 1.09\ V$)
(a) $2I^- \rightarrow I_2 + 2e^-$ (b) $2Br^- \rightarrow Br_2 + 2e^-$ (c) $2I^- + Br_2 \rightarrow I_2 + 2Br^-$ (d) $2Br^- + I_2 \rightarrow Br_2 + 2I^-$

15. If $Fe^{2+} + FeO^{2+} + 2H^+ \rightarrow 2Fe^{3+} + H_2O$; $E_1^0 = 0.616$ V
$Fe^{3+} + Ag^+ + H_2O \rightarrow FeO^{2+} + 2H^+ + Ag_{(s)}$; $E_2^0 = 0.439$ V
And $E^0_{Ag|Ag} = 0.799$, then the standard reduction potential for $Fe^{3+} + e^- \rightarrow Fe^{2+}$ is
(a) -0.256 V (b) – 0.059 V (c) -0.721 (d) +0. 721 V

C_{16-18}: Paragraph for Question Nos. 16 – 18

The magnetic behaviour, Colour and shape of complexes depend upon the nature of the metal, nature of ligands, hybridization and the coordination number of central atom.

Weak ligands like F^-, Cl^-, H_2O and oxalate form outer orbital complexes while strong ligands like CO, CN^-, NH_3 and NO_2^- use inner orbitals to form complexes. The completes exhibit optical and geometrical isomerism.

16. The complex that will exhibit both geometrical and optical isomerism is
    (a) $PtCl_2(NH_3)_2$ (b) $Co(en)_2Cl_2$ (c) $[Co(NH_3)_4Cl_2]^+$ (d) $[Co(en)_3]^{3+}$

17. The complex that will have four isomers is
    (a) $[Co(en)_3]Cl_3$ (b) $[Co(en)_2Cl_2]Cl$ (c) $[Co(NH_3)_2(PPh_3)_2Cl_2]Cl$ (d) $[Co(en)(NH_3)_2Cl_2]Cl$

18. The number of unpaired electrons present in $Ni(CO)_4$ and $[Ni(PPh_3)_2Cl_2]$ are
    (a) 2, 0 (b) 0, 2 (c) 2, 2 (d) 0, 0

Section IV

Matching type: Multiple matching may be there. **(+8/ 0)**

This section contains 2 questions. And the questions contains statements given in two columns which have to be matched. Statements (a, b, c, d) in ***Column I*** *have to be matched with statements (p, q, r, s) in* ***Column II****.*

19.

Column - I	***Column – II***
(a) 1 M glucose ($C_6H_{12}O_6$) solution	(p) 180 g solute per litre of solution
(b) 3 M CH_3COOH solution	(q) % w/v = 18% solution
(c) 2M CH_3COOH solution (density = 1.2 g/ml)	(r) % w/w = 10% solution
(d) 3 M Urea (NH_2CONH_2) solution	(s) 1.85 m

20.

Column I	***Column II***
(a) H_2 gas at NTP	(p) Molar volume = 22.4 L
(b) O_2 gas having density = 10/7 g/L at NTP	(q) Molar volume > 22.4 L
(c) An unknown gas at 1 atm having Boyle's temperature 273.15K	(r) Behaves as an ideal gas
(d) He gas at NTP having density less Than 1/5.6 g/L.	(s) Less compressible with respect to ideal gas