विद्या सर्वार्थि साधिका

ANANDALAYA
PRE-BOARD EXAMINATION
CLASS: XII

Subject: Chemistry (043) MM: 70
Date : 15-12-2023 Time: 3 hours

General Instructions:
Read the following instructions carefully.
(a) There are 33 questions in this question paper with internal choice.
(b) Section A consists of 16 multiple -choice questions carrying 1 mark each.
(c) Section B consists of 5 short answer questions carrying 2 marks each.
(d) Section C consists of 7 short answer questions carrying 3 marks each.
(e) Section D consists of 2 case - based questions carrying 4 marks each.
(f) Section E consists of 3 long answer questions carrying 5 marks each.
(g) All questions are compulsory.
(h) Use of log tables and calculators is not allowed.

SECTION A

1. Identify the law which is stated as: (1)
"For any solution, the partial vapour pressure of each volatile component in the solution is directly proportional to its mole fraction."
(A) Henry's law (B) Raoult's law (C) Dalton's law (D) Gay-Lussac's Law

2. Which of the following reactions is used to prepare salicylaldehyde? (1)
(A) Kolbe's reaction (B) Etard reaction
(C) Reimer- Tiemann reaction (D) Stephen's reduction.

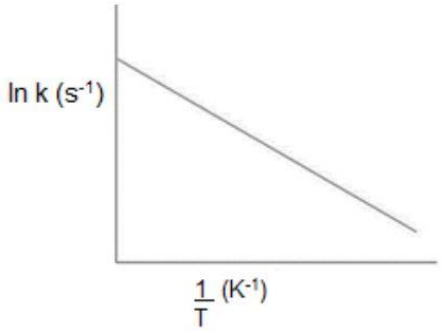
3. Which one of the following reactions is not explained by the open chain structure of glucose? (1)
(A) Formation of pentaacetate of glucose with acetic anhydride.
(B) formation of addition product with 2,4 DNP reagent
(C) Silver mirror formation with Tollen's reagent
(D) existence of alpha and beta forms of glucose.

4. Which of the following test/ reaction is given by aldehydes as well as ketones? (1)
(A) Fehling's test (B) Tollen's test
(C) 2,4 DNP test (D) Cannizzaro reaction

5. Which of the following isomer has the highest melting point? (1)
(A) 1,2-dicholorbenzene (B) 1,3 -dichlorobenzene
(C) 1,4-dicholorbenzene (D) all isomers have same melting points

6. The correct IUPAC name for $CH_2 = CH\text{-}CH_2\text{-}NH\text{-}CH_3$ is _____. (1)
(A) N - methylprop - 1 - en - 3 - amine (B) 2 - amino - 4 - pentene
(C) 4 - aminopent – 1- ene (D) N - methylprop - 2 - en - 1 - amine

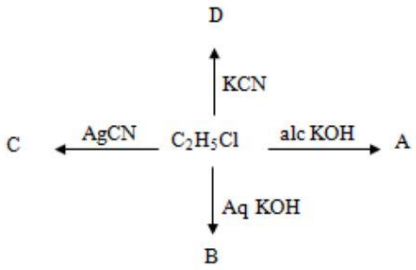
7. Arrhenius equation can be represented graphically as follows: (1)



The (i) intercept and (ii) slope of the graph are:

(A) (i) ln A (ii) Ea/R
(B) (i) A (ii) Ea
(C) (i) ln A (ii) - Ea/R
(D) (i) A (ii) -Ea

8. Identify A, B, C and D: (1)



(A) A = C_2H_4, B= C_2H_5OH, C= C_2H_5NC, D= C_2H_5CN
(B) A= C_2H_5OH, B= C_2H_4, C = C_2H_5CN, D=C_2H_5NC
(C) A = C_2H_4, B= C_2H_5OH, C= C_2H_5CN, D= C_2H_5NC
(D) A= C_2H_5OH, B= C_2H_4, C= C_2H_5NC, D= C_2H_5CN

9. For the reaction, A +2B → AB_2, the order w.r.t. reactant A is 2 and w.r.t. reactant B is zero. What will be the change in rate of reaction if the concentration of A is doubled and B is halved? (1)

(A) increases four times (B) decreases four times
(C) increases two times (D) no change

10. Williamson's synthesis of preparing dimethyl ether is an _____. (1)

(A) SN^1 reaction (B) Elimination reaction
(C) SN^2 reaction (D) Nucleophilic addition reaction

11. The CFSE of $[CoCl_6]^{3-}$ is 18000 cm^{-1}. The CFSE for $[CoCl_4]^-$ will be: (1)

(A) 18000 cm^{-1} (B) 8000cm^{-1} (C) 2000 cm^{-1} (D) 16000 cm^{-1}

12. Which set of ions exhibit specific colours? (Atomic number of Sc = 21, Ti = 22, V=23, Mn = 25, Fe = 26, Ni = 28 Cu = 29 and Zn =30) (1)

(A) Sc^{3+}, Ti^{4+}, Mn^{3+} (B) Sc^{3+}, Zn^{2+}, Ni^{2+}
(C) V^{3+}, V^{2+}, Fe^{3+} (D) Ti^{3+}, Ti^{4+}, Ni^{2+}

Q. 13 to Q. 16 are Assertion and Reason type questions. Select the most appropriate answer from the options given below:

(A) Both A and R are true and R is the correct explanation of A

(B) Both A and R are true but R is not the correct explanation of A.

(C) A is true but R is false.

(D) A is false but R is true.

13. **Assertion (A):** Both Aldehydes and ketones are planar molecules. (1)
Reason (R): sp^3 hybridised carbonyl carbon is responsible for this planar shape.

14. **Assertion (A):** Proteins are found to have two different types of secondary structures viz alpha-helix and beta-pleated sheet structure. (1)
Reason (R): The secondary structure of proteins is stabilized by hydrogen bonding.

15. **Assertion (A):** During electrolysis of aqueous copper sulphate solution using platinum electrodes hydrogen gas is released at the cathode. (1)
Reason (R): The reduction potential of Cu^{2+}/Cu is greater than that of H^+/H_2

16. **Assertion (A):** Bond angle in ethers is slightly more than the tetrahedral angle. (1)
Reason (R): There is a repulsion between the two bulky alkyl groups.

SECTION B

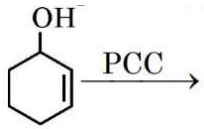
This section contains 5 questions with internal choice in one question. The following questions are very short answer type and carry 2 marks each.

17. Which radioactive isotope would have the longer half- life ^{15}O or ^{19}O? Why? (Given rate constants for ^{15}O and ^{19}O are $k = 5.63 \times 10^{-3}\ s^{-1}$ and $k = 2.38 \times 10^{-2}\ s^{-1}$ respectively.) (2)

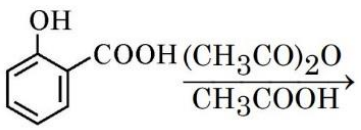
18. (a) State Henry's law. (2)
(b) Calculate the solubility of CO_2 in water at 298 K under 760 mm Hg. (K_H for CO_2 in water 298 K is 1.25×10^6 mm Hg)

19. Write the product of the following reactions. (2)

(i)



(ii)



20. Write the mechanism of the following SN^1 reaction: (2)

$$(CH_3)_3C\text{–}Br \xrightarrow{\text{Aq. NaOH}} (CH_3)_3\ C\text{–}OH + NaBr$$

OR

Convert: But-1-ene to 1-iodobutane

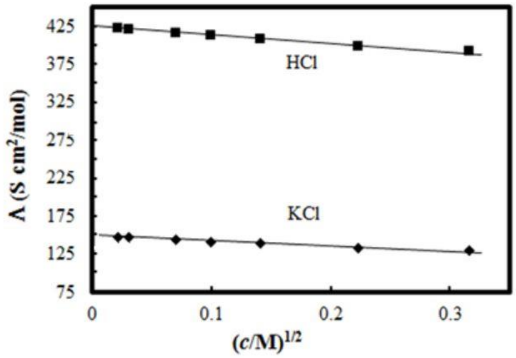
21. Differentiate between the following. (2)
(i) Amylose and Amylopectin (ii) Peptide linkage and Glycosidic linkage

SECTION C

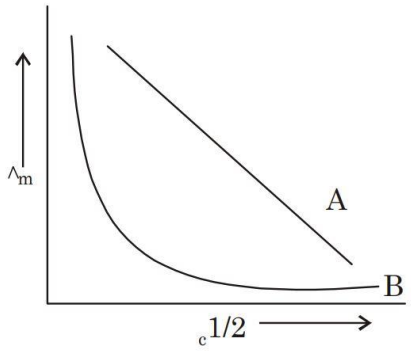
This section contains 7 questions with internal choice in one question. The following questions are short answer type and carry 3 marks each.

22. (a) Write the IUPAC name and hybridisation of the complex $[NiCl_4]^{2-}$. (3)
(b) What type of isomerism is shown by the pair $[Cr(H_2O)_6]Cl_3$ and $[Cr(H_2O)_5Cl]Cl_2 \cdot H_2O$?
(c) Draw one of the geometrical isomers of the complex $[Pt(en)_2Cl_2]^{+2}$ which is optically inactive.

23. The molar conductivity of CH_3COOH at infinite dilution is 390 S cm^2 /mol. Using the graph and given information, find out the molar conductivity of CH_3COOK. (3)



(b) In the plot of molar conductivity (Λm) vs square root of concentration (c½) following curves are obtained for two electrolytes A and B:



Predict the nature of electrolytes A and B.

24. (a) What would be the products A and B in the following reaction? (3)

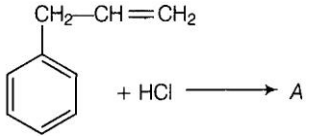
$$C_6H_5\text{-}CH_2\text{-}O\text{-}C_6H_5 + HBr \rightarrow A + B$$

(b) Give a chemical reaction of Kolbe's reaction. Also mention the reason behind converting phenol to phenoxide ion before treating with carbon dioxide.

25. (a) An organic compound with the molecular formula $C_9H_{10}O$ forms 2, 4-DNP derivative, reduces Tollens' reagent and undergoes Cannizzaro reaction. On vigorous oxidation, it gives 1, 2-benzenedicarboxylic acid. Identify the compound. (3)
(b) Give chemical tests to distinguish between the following pair of compounds:
Pentan-2-one and Pentan-3-one.
(c) Arrange the following compounds in increasing order of their acid strength:
Benzoic acid, 4- Nitrobenzoic acid, 4- Methoxybenzoic acid.

26. (a) Write the name of the vitamin whose deficiency causes bleeding of gums. (3)
(b) Give one example each for fibrous protein and globular protein.

27. (a) What is 'A' in the following reaction? (3)



(b) Among all the isomers of molecular formula C_4H_9Br, identify:
(i) the one isomer which is optically active
(ii) the one isomer which is highly reactive towards S_N2.

28. The decomposition of hydrocarbon follows the equation $k = (4.5 \times 10^{11} s^{-1}) e^{-28000K/T.}$ Calculate E_a. (3)

SECTION D

The following questions are case - based questions. Each question has an internal choice and carries 4 (1+1+2) marks each. Read the passage carefully and answer the questions that follow.

29. A Lead storage battery is the most important type of secondary cell having a lead anode and a grid of lead packed with PbO_2 as cathode. A 38% solution of sulphuric acid is used as electrolyte. (Density=1.294 g mL^{-1}) The battery holds 3.5 L of the acid. During the discharge of the battery, the density of H_2SO_4 falls to 1.139 g mL^{-1} . (20% H_2SO_4 by mass). (4)

(a) Write the reaction taking place at the cathode when the battery is in use.

OR

(a) Write the products of electrolysis, when dilute sulphuric acid is electrolysed using Platinum electrodes.
(b) What is the molarity of sulphuric acid before discharge?
(c) How much electricity in terms of Faraday is required to carry out the reduction of one mole of PbO_2?

30. Crystal field theory (CFT) describes the breaking of orbital degeneracy in transition metal complexes due to the presence of ligands. CFT qualitatively describes the strength of the metal-ligand bonds. Based on the strength of the metal-ligand bonds, the energy of the system is altered. This may lead to a change in magnetic properties as well as colour. This theory was developed by Hans Bethe and John Hasbrouck van Vleck. (4)

In Crystal Field Theory, it is assumed that the ions are **simple point charges** (a simplification). When applied to alkali metal ions containing a symmetric sphere of charge, calculations of bond energies are generally quite successful. The approach taken uses classical potential energy equations that take into account the attractive and repulsive interactions between charged particles (that is, Coulomb's Law interactions).

When examining a single transition metal ion, the five *d*-orbitals have the same energy. When ligands approach the metal ion, some experience more opposition from the *d*-orbital electrons than others based on the geometric structure of the molecule. Since ligands approach from different directions, not all *d*-orbitals interact directly. These interactions, however, create a splitting due to the electrostatic environment.

For example, consider a molecule with octahedral geometry. Ligands approach the metal ion along x, y and z axis. Therefore, the electrons in the dz^2 and $dx^2–y^2$orbitals (which lie along these axes) experience greater repulsion. For octahedral complexes, crystal field splitting the energies of the dz^2 and $dx^2–y^2$ orbitals increase due to greater interactions with the ligands. The dxy, dxz, and dyz orbitals decrease with respect to this normal energy level and become more stable. Answer the following questions:

(a) Write the electronic configuration of d^5 on the basis of crystal field theory when (i) $\Delta^0 < P$ (ii) $\Delta^0 > P$

OR

(a) Low spin configuration is rarely observed in tetrahedral coordination entity formation. Explain.

(b) Write the formula of the following coordination compound: Iron(III)hexacyanatoferrate(II)

(c) Explain the hybridization of $[CoF6]^{3-}$ as per valence bond theory.

SECTION E

The following questions are long answer type and carry 5 marks each. All questions have an internal choice

31. (a) State the reason: Even though Manganese is having +7 oxidation state, $KMnO_4$ is coloured. (5)

(b) Following ions are given: Cu^{+}(aq), Cu^{+2}(aq), Mn^{3+}, Cr^{2+}
Identify the ion which is: (i) a strong reducing agent and (ii) unstable in aqueous solution. Also give suitable reason for each.

(c) Why is E^0 (V^{+3}/V^{+2}) value for vanadium comparatively low?

32. (a) Gas (A) is more soluble in water than gas (B) at the same temperature. Which one of the two gases will have the higher value of K_H (Henry's constant) and why? (5)

(b) Mention (i) what kind of deviation from Raoult's law and (ii) what type of Azeotrope is formed for a mixture of HCl and H_2O.

(c) Calculate the boiling point of solution when 4g of $MgSO_4$(M=120gmol^{-1}) was dissolved in 100g of water, assuming $MgSO_4$ undergoes complete ionization.
[K_b for water = 0.52 K kg mol^{-1}]

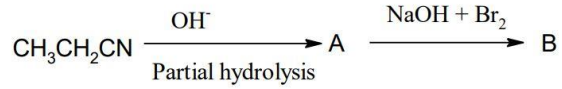
OR

(a) What is meant by negative deviation from Raoult's law? Give an example. What is the sign of $\Delta_{mix}H$ for negative deviation?

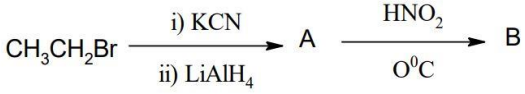
(b) Calculate the mass of NaCl (molar mass = 58·5 g mol^{-1}) to be dissolved in 37·2 g of water to lower the freezing point by 2°C, assuming that NaCl undergoes complete dissociation.
(Kf for water = 1·86 K kg mol^{-1})

33. (a) Write the structures of A and B in the following: (5)

(i)



(ii)



(b) How will you convert Aniline to fluorobenzene?

(c) Arrange the following in decreasing order of solubility in water:
$(C_2H_5)_2NH$, $C_2H_5NH_2$, $C_6H_5NH_2$

OR

An organic compound A' with molecular formula C_7H_7NO reacts with Br_2/aq. KOH to give compound B', which upon reaction with $NaNO_2$& HCl at O°C gives C'. Compound C' on heating with CH_3CH_2OH gives a hydrocarbon D'. Compound B' on further reaction with Br2 water gives white precipitate of compound E'. Identify the compound A, B, C, D & E; also justify your answer by giving relevant chemical equations.