CBSE Sample Paper 11

Class XII 2022-23

Chemistry

Time: 3 Hours **Max. Marks: 70**

General Instructions:

1. There are 35 questions in this question paper with internal choice.
2. SECTION A consists of 18 multiple-choice questions carrying 1 mark each.
3. SECTION B consists of 7 very short answer questions carrying 2 marks each.
4. SECTION C consists of 5 short answer questions carrying 3 marks each.
5. SECTION D consists of 2 case-based questions carrying 4 marks each.
6. SECTION E consists of 3 long answer questions carrying 5 marks each.
7. All questions are compulsory.
8. Use of log tables and calculators is not allowed.

SECTION - A

18 Marks

(The following questions are multiple-choice questions with one correct answer. Each question carries 1 mark. There is no internal choice in this section.)

1. Which of the following options will be the limiting molar conductivity of CH_3COOH if the limiting molar conductivity of CH_3COONa is 91 Scm^2mol^{-1}? Limiting molar conductivity for individual ions are given in the following table:

S.No	Ions	limiting molar conductivity / Scm^2mol^{-1}
1	H^+	349.6
2	Na^+	50.1
3	K^+	73.5
4	OH^-	199.1

(a) 350 Scm^2mol^{-1} (b) 375.3 Scm^2mol^{-1}
(c) 390.5 Scm^2mol^{-1} (d) 340.4 Scm^2mol^{-1} 1

2. Curdling of milk is an example of:
(a) breaking of peptide linkage
(b) hydrolysis of lactose
(c) breaking of protein into amino acids
(d) denauration of proetin 1

3. When 1 mole of benzene is mixed with 1 mole of toluene The vapour will contain: (Given: vapour of benzene = 12.8 kPa and vapour pressure of toluene = 3.85 kPa).
(a) equal amount of benzene and toluene as it forms an ideal solution
(b) unequal amount of benzene and toluene as it forms a non ideal solution
(c) higher percentage of benzene
(d) higher percentage of toluene 1

4. Which of the following is the reason for zinc not exhibiting variable oxidation state?
(a) inert pair effect
(b) completely filled 3d subshell
(c) completely filled 4s subshell
(d) common ion effect 1

5. Propanamide on reaction with bromine in aqueous NaOH gives:
(a) Propanamine
(b) Etanamine
(c) N-Methyl ethanamine
(d) Propanenitrile 1

6. The standard reduction potentials at 25°C for the follow half cell reactions are given against each:

$Zn^{2+}_{(aq)} + 2e^- \rightarrow Zn_{(s)}$, $E^\circ_{cell} = -0.762$ V
$Cr^{3+}_{(aq)} + 3e^- \rightarrow Cr_{(s)}$, $E^\circ_{cell} = -0.740$ V
$2H^+ + 2e^- \rightarrow H_{2(g)}$, $E^\circ_{cell} = -0.00$ V
$Fe^{3+} + e^- \rightarrow Fe^{2+}$, $E^\circ_{cell} = -0.770$ V

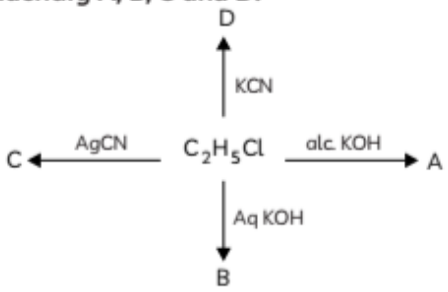
Which of the following is strong oxidizing agent?
(a) Fe^{2+} (b) Zn
(c) Cr (d) H_2 1

7. 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)

(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+} 1

8. Identify A, B, C and D:



(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 1

9. The propionic acid when treated with aqueous sodium bicarbonate, liberates CO_2. The 'C' of CO_2 comes from:

(a) methyl group

(b) carboxylic acid group

(c) methylene group

(d) bicarbonate 1

10. Reagent used in Schiff's base:

(a) Pyridine

(b) $SOCl_2$

(c) Raney Ni

(d) None of the above 1

11. The alcohol which does not react with Lucas reagent is:

(a) isobutyl alcohol

(b) n-butanol

(c) tert-butyl alcohol

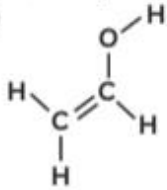
(d) sec-butyl alcohol 1

12. Identify which is the allylic:

(a) $H_2C = CH - CH_2 - CH_2OH$

(b) CH_3CH_2OH

(c) $OH-CH_2CH_2-OH$

(d)  1

13. Which among the following is a false statement?

(a) Rate of zero order reaction is independent of initial concentration of reactant.

(b) Half life of a third order reaction is inversely proportional to square of initial concentration of the reactant.

(c) Molecularity of a reaction may be zero or fraction.

(d) For a first order reaction, $t_{½}$ =0.693k 1

14. For a reaction: $H_2 + Cl_2 \rightarrow 2HCl$

Rate = k

What is the order and molecularity of this reaction?

(a) Zero-order reaction and molecularity is two.

(b) First-order reaction and molecularity is two.

(c) Second-order reaction and molecularity is one.

(d) Zero-order reaction and molecularity is one. 1

In the following questions, a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as:

(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

15. Assertion: Acylation of amines gives a monosubstituted product, whereas alkylation of amines gives polysubstituted product.

Reason: Acyl group sterically hinders the approach of further acyl groups. 1

16. Assertion: The two strands are complementary to each other.

Reason: The hydrogen bonds are formed between specific pairs of bases. 1

17. Assertion: Propan-1-ol and propan-2-ol are distinguished byb iodoform test

Reason: Propan-1-ol gives positive iodoform test. 1

18. Assertion: Aquatic species are more comfortable in cold waters rather than in warm waters.

Reason: Different gases have different K_H values at the same temperature. 1

SECTION - B

14 Marks

(The following questions are very short answer type with internal choice in two questions and carry 2 marks each.)

19. Carry out the following conversions in not more than 2 steps:

(A) Aniline to chlorobenzene

(B) 2-Bromopropane to 1- bromopropane 2

20. A glucose solution which boils at 101.04°C at 1 atm. What will be relative lowering of vapour pressure of an aqueous solution of urea which is equimolal to given glucose solution? (Given: K_b for water is 0.52 K kg mol^{-1}) 2

21. (A) Write the electronic configuration of iron ion in the following complex ion and predict its magnetic behaviour:

$[Fe(H_2O)_6]^{2+}$

(B) Write the IUPAC name of the coordination complex: $[CoCl_2(en)_2]NO_3$

OR

(A) Predict the geometry of $[NiCN_4]^{2-}$.

(B) Calculate the spin only magnetic moment of $[Cu(NH_3)_4]^{2+}$ ion. 2

22. For a reaction the rate law expression is represented as follows:

Rate = $k[A][B]^{1/2}$

(A) Interpret whether the reaction is elementary or complex. Give reason to support your answer.

(B) Write the units of rate constant for this reaction if concentration of A and B is expressed in moles/L.

OR

The following results have been obtained during the kinetic studies of the reaction:

$P + 2Q \rightarrow R + 2S$

Exp.	Initial P(mol/L)	Initial Q (mol/L)	Init. Rate of Formation of R (M min^{-1})
1	0.10	0.10	3.0×10^{-4}
2	0.30	0.30	9.0×10^{-4}
3	0.10	0.30	3.0×10^{-4}
4	0.20	0.40	6.0×10^{-4}

Determine the rate law expression for the reaction. 2

23. Name the reagents used in the following reactions:

(A) $CH_3-CO-CH_3 \xrightarrow{?} CH_3-\underset{\displaystyle OH}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}}-CH_3$

(B) $CH_3-COOH \xrightarrow{?} CH_3-COCl$ 2

24. The following haloalkanes are hydrolysed in presence of aq KOH.

(1) 1-Chlorobutane

(2) 2-Chloro-2-methylpropane

Which of the above is most likely to give (A) an inverted product (B) a racemic mixture:

Justify your answer. 2

25. Zinc / silver oxide cell is used in hearing aids, instruments and other low power devices. The Following reaction occurs :

$Zn_{(s)} + Zn^{2+}{}_{(aq)} + 2e^- ; E^0{}_{Zn/Zn2}{}^+ = -0.76$

$Ag_2O + H_2O + 2e^- \longrightarrow 2Ag + 2OH^- ;$

$E^0{}_{Ag+/Ag} = 0.344V$

Calculate:

(A) Standard potential of the cell.

(B) Standard Gibbs Energy. 2

SECTION - C

15 Marks

(The following questions are short answer type with internal choice in two questions and carry 3 marks each.)

26. Give reasons for the following:

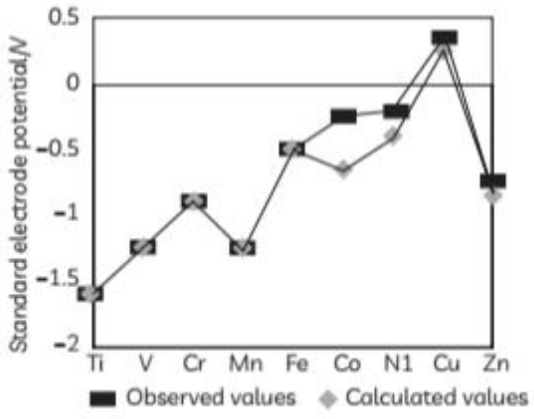
(A) Transition elements act as catalysts

(B) It is difficult to obtain oxidation state greater than two for copper.

(C) CrO is basic but Cr_2O_3 is amphoteric.

OR

Observed and calculated values for the standard electrode potentials of elements from Ti to Zn in the first reactivity series are depicted in figure given below:



Explain the following observations:

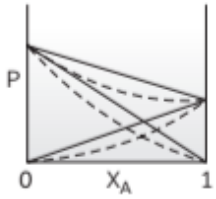
(A) The general trend towards less negative E° values across the series.

(B) The unique behaviour of copper.

(C) More negative E° values of Mn and Zn. 3

27. Give any three tests to differentiate between aldehydes and ketones. 3

28. The graph below contains dashed lines representing the measured vapor pressure, and solid lines representing the ideal vapor pressure for a mixture of volatile liquids A and B.



(A) What kind of deviation is depicted in the above graph?

(B) What would be the sign of enthalpy of mixing and volume for such a deviation ?

(C) How is Raoult's law treated as a special case of Henry's law? 3

29. When treated with NaOH, an organic substance (A) having a distinctive odour transforms into two chemicals (B) and (C). The oxidation of compound (B), which has the chemical formula C_2H_4O, results in compound (A). The sodium salt of an acid is compound (C). When (C) is heated with soda lime, an aromatic hydrocarbon results (D). Establish the structures of (A). (B). (C) and (D). 3

30. (A) Define threshold energy.

(B) What is the value of slope of graph $\log_{10}k$ and 1/t indicates?

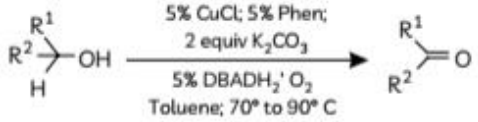
(C) What is the effect of positive catalyst in the reaction? 3

SECTION - D

8 Marks

(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.)

31. *An efficient aerobic catalytic system for the transformation of alcohols into carbonyl compounds under mild conditions, copper-based catalyst has been discovered. This copper-based catalytic system utilizes oxygen or air as the ultimate, stoichiometric oxidant, producing water as the only by-product.*



A wide range of primary, secondary, allylic, and benzylic alcohols can be smoothly oxidized to the corresponding aldehydes or ketones in good to excellent yields. Air can be conveniently used instead of oxygen without affecting the efficiency of the process. However, the use of air requires slightly longer reaction times.

This process is not only economically viable and applicable to large-scale reactions, but it is also environmentally friendly.

(Reference: Ohkuma, T., Ooka, H., Ikariya, T., & Noyori, R. (1995). Preferential hydrogenation of aldehydes and ketones. Journal of the American Chemical Society, 117(41), 10417-10418.)

(A) Name any one reaction used to convert through the copper based catalyst. 1

(B) Write the reaction of oxidation of ethanol based on copper catalyst by ozonolysis. 1

(C) Benzyl alcohol on treatment with this copper-based catalyst gives a compound 'A' which on reaction with KOH gives compounds 'B' and 'C'. Compound 'B' on oxidation with $KMnO_4$. KOH gives compound 'C'. Identity the compounds 'A', 'B' and 'C'.

OR

An organic compound 'X' with molecular formula C_3H_8O on reaction with this copper based catalyst gives compound 'Y' which reduces Tollen's reagent. 'X' on reaction with sodium metal gives 'Z'. What is the product of reaction of 'Z' with 1-chloro-2-methylpropane? 2

32. *Amines are one of the most important classes of organic compounds which can be derived when we replace one or more hydrogen atoms of ammonia molecules with an alkyl group. An amine is generally a functional group with a nitrogen atom having a lone pair.*

Compounds of nitrogen connected to a carbonyl group are called as amides; they have a structure R–CO–NR'R" and varies in properties with amines. Amines are organic compounds that contain nitrogen atoms with a lone pair. Basically, they are derived from ammonia (NH_3) in which one or more hydrogen atom is replaced by an alkyl or

aryl group, and so they are known as alkyl amines and aryl amines respectively. Anilines are the organic compounds in the class of group coming in organic chemistry which are also called as amino benzene or phenyl amine. These compounds are said to be toxic in nature and also known to be one of the classes of aromatic amines. These are used in a wide variety of industries and are known to possess all the characteristics of an aromatic compound. The aniline compounds are said to have the formula $C_6H_5NH_2$ wherein the amino group is supposed to be attached to the Phenyl group.

(A) Why salts of benzene diazonium are water soluble. 1

(B) Give one test to differentiate between cyanides and isocyanides. 1

(C) Arrange the primary, secondary and tertiary amines in descending order on the basis of the following property:

(i) Boiling point

(ii) Basic strength

OR

Complete the following conversions.

(i) Nitromethane to dimethylamine

(ii) Methylamine to ethylamine 2

SECTION - E

15 Marks

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

33. (A) How are conductance data used to determine cell constant?

(B) Differentiate between potential difference and the e.m.f. in three points.

(C) What flows in the internal circuit of a galvanic cell. 5

34. Three amino acids are given below:

Alanine $CH_3CH(COOH)(NH_2)$

Aspartic acid $HOOC–CH_2CH(COOH)(NH_2)$

Lysine $H_2N-(CH_2)_4–CH(COOH)(NH_2)$.

(A) Make two tripeptides using these amino acids and mark the peptide linkage in both cases.

(B) Represent alanine in the zwitter ionic form.

(C) Which enzyme is used in conversion of starch to maltose?

OR

(A) State any four difference between globular and fibrous proteins.

(B) Identify the name used in the following conversions:

(i) Starch to glucose

(ii) Protein to amino acids

(iii) Urea to ammonia 5

35. (A) State Kohlrausch law.

(B) Calculate the emf of the following cell at 298 K.

$Al_{(s)}|Al^{3+}$ (0.15M)$||Cu^{2+}$(0.025M)$|Cu(s)$

(Given $E°_{(Al^{3+}/Al)}$ = –1.66 V, $E°_{(Cu^{2+}/Cu)}$ = 0.34V, log 0.15 = –0.8239, log 0.025 = –1.6020)

OR

(A) On the basis of E° values identify which amongst the following is the strongest oxidising agent:

$Cl_{2(g)} + 2\,e^- \longrightarrow 2Cl^-$ $E° = +1.36$ V,

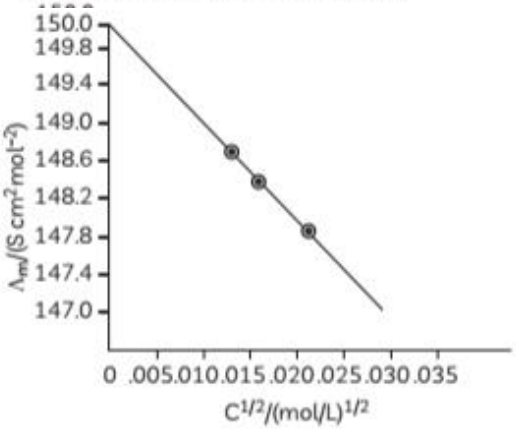
$MnO_4^- + 8H^+ + 5e^- \longrightarrow Mn^{2+} + 4H_2O$

$E° = +1.51$ V

$Cr_2O_7^{2-} + 14H^+ + 6e^- \longrightarrow 2Cr^{3+} + 7H_2O$

$E° = +1.33$ V

(B) The following figure, represents variation of (Λ_m) vs $\sqrt{c}$ for an electrolyte. Here Λ_m is the molar conductivity and c is the concentration of the electrolyte.



(i) Define molar conductivity.

(ii) Identify the nature of electrolyte on the basis of the above plot. Justify your answer.

(iii) Determine the value of $\Lambda_m°$ for the electrolyte.

(iv) Show how to calculate the value of $\Lambda_m°$ for the electrolyte using the above graph. 5

SOLUTION

SECTION - A

1. *(c) 390.5 $Scm^2\ mol^{-1}$*

Explanation: The limiting molar conductivity of CH_3COOH:

$$\lambda^{\infty}(CH_3COOH) = \lambda°(CH_3COONa) + \lambda°(H^+) - \lambda°(Na^+)$$
$$= 91 + 349.6 - 50.1$$
$$= 440.6 - 50.1$$
$$= 390.5\ S\ cm^2\ mol^{-1}$$

Related Theory

Molar conductivity is defined as the conducting power of all the ions produced by dissolving one mole of an electrolyte in solution. It is denoted by (lambda).
Molar conductivity and specific conductivity are interrelated as:
Specific conductance is given by k and molar conductance is given by Λ
The relation between the two terms is:

$\Lambda = k \times 1000/M$
Also $\Lambda = \{(1/R) \times (l/a)\} \times 1000/M$
Where Λ = *Molar conductance*
k = *Specific conductance*
R = *Resistance*
M = *Molarity of the solution*
l = *length*
a = *area of cross section*

2. *(d) denaturation of protein*

Explanation: The skin that forms on the curded milk is the phenomenon which occurs due to the denaturation of the proteins.

Related Theory

Denaturation is the process in which the proteins lose their native form on the application of the external factors such as strong acid, base, solvents (Both organic and Inorganic), radiation etc , in such cases proteins lose their native forms such as their quaternary, tertiary and secondary structures due to the breakage of the bonds and the unfolding in the molecules.

3. *(c) higher percentage of benzene*

Explanation: Liquids which are more volatile exert more vapour pressure. The volatile liquids are those which have weak intermolecular force of attraction. The vapour pressure of benzene is more than the vapour pressure of toluene, thus benzene is more volatile in nature and it will have higher percentage of vapours thus the solution will have higher percentage of benzene.

4. *(b) completely filled 3d subshell*

Explanation: The electronic configuration of Zn is [Ar] $3d^{10}\ 4s^2$, it has fully filled 3d subshell and it does not shows variable oxidation state as well since the fully filled shells are more stable and they do not react easily.

5. *(b) Ethanamine*

Explanation:

$$\underset{\text{propanamide}}{CH_3CH_2CONH_2} + Br_2 + 4NaOH \xrightarrow{\Delta} \underset{\text{Ethanamine}}{CH_3CH_2NH_2} + 2NaBr + Na_2CO_3 + 2H_2O$$

6. *(a) Fe^{2+}*

Explanation: The value of standard reduction potential is directly proportional to strong reducing agent.

7. *(c) V^{3+}, V^{2+}, Fe^{3+}*

Explanation: These set of ions V^{3+}, V^{2+}, Fe^{3+}

The electronic configuration of V^{3+} = [Ar] $3d^3\ 4s^2$

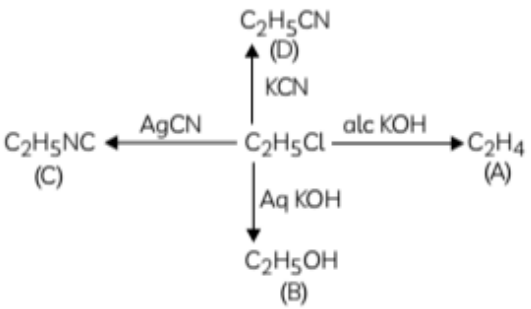
The electronic configuration of V^{2+} = $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^3$

And that of Fe^{3+} is $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^5$.

Due to the incompletely filled d-subshells these ions undergo d-d transitions and thus shows colour due to the electronic transitions.

8. *(a) A = C_2H_4, B = C_2H_5OH, C = C_2H_5NC, D = C_2H_5CN*

Explanation:



9. *(d) bicarbonate*

Explanation: $CH_3—CH_2—COOH + NaH\overset{\bullet}{C}O_3 \rightarrow CH_3CH_2COONa + H_2O + \overset{\bullet}{C}O_2$

10. *(c) Raney Ni*

Explanation: Schiff's base on reduction with hydrogen in the presence of Raney nickel gives secondary alcohol.

11. *(b) n-butanol*

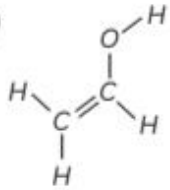
Explanation: In Lucas reagent test, turbidity is given immediately by tertiary alcohol and after 5 minutes turbidity is given by secondary alcohol while primary alcohol does not give this test.

$$RCH_2OH \xrightarrow[\text{Heat}]{ZnCl_2 + HCl} RCH_2Cl + H_2O$$

$$\begin{matrix} R \\ R \end{matrix}\!\!>\!CHOH \xrightarrow[\text{in 5 minutes}]{ZnCl_2 + HCl} \begin{matrix} R \\ R \end{matrix}\!\!>\!CHCl + H_2O$$

$$(CH_3)_3COH \xrightarrow[\text{immediately}]{ZnCl_2 + HCl} (CH_3)_3CCl + H_2O$$

12. *(d)*



Explanation: Allylic alcohol is an organic compound which has the structural formula $CH_2 = CHCH_2OH$. In other words, in these alcohols, the the-OH group is attached to sp^2 hybridized carbon next to the carbon-carbon double bond, that is to an allylic carbon.

13. *(c) Molecularity of reaction may be zero or fraction.*

Explanation: Molecularity of reaction is defined as number of reactant molecules (or atoms or ions) taking part in an elementary reaction. Minimum value of molecularity is one so cannot be fractional or zero.

Related Theory

Molecularity can be explained by the following examples:

$$N_2O_{5(g)} \rightarrow 2NO_{2(g)} + 21O_{2(g)}$$

In this reaction, only one molecule is taking part in the reaction, therefore the rate law expression for this reaction is:

$$Rate = k[N_2O_5]$$

Hence, the reaction is unimolecular and first order.

Similarly, a reaction can be bimolecular or trimolecular depending on the number or molecule taking part in the reaction.

Like $O_{3(g)} \rightarrow 2O_{2(g)}$ is a bi-molecular gaseouse reaction tri-molecular gaseous reaction and $2NO + H_2 \rightarrow N_2 + H_2O_2$ is tri-molecular gaseous reaction.

14. *(a) Zero-order reaction and molecularity is two.*

Explanation: Since Rate = k the reaction is not dependent on the concentration of any reactant hence the order is zero and two reactants are involved hence the molecularity is two.

15. *(c) (A) is true but (R) is false*

Explanation: Amines on acetylation give monosubstituted product, while on alkylation gives polysubstitution product as well. Thus, Assertion is correct statement but reason is wrong statement.

16. *(a) Both (A) and (R) are true and (R) is the correct explanation of (A).*

Explanation: The two strands of DNA are complementary to each other the nucleotides held together on the each strand are complementary , since the nitrogenous bases A, T, G and C are bonded through hydrogen bonds with each other. Adenine and Guanine are purine bases present in DNA and cytosine and guanine are the pyrimidines bases present in DNA and RNA both, but the pyrimidine base uracil is present in RNA whereas the base thymine is present in DNA. Thus, assertion and reason both are correct statements and reason is correct explanation for assertion.

Related Theory

Adenine pairs with thymine with 2 hydrogen bonds. Guanine pairs with cytosine with 3 hydrogen bonds. This creates a difference in strength between the two sets of Watson and Crick bases. Guanine and cytosine bonded base pairs are stronger than thymine and adenine bonded base pairs in DNA.

17. *(c) (A) is true but (R) is false*

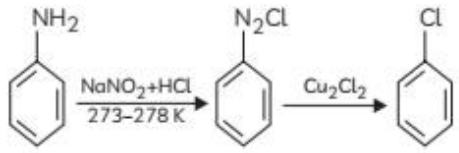
Explanation: Propan-1-ol and propan-2-ol are distinguished by iodoform test as propan-2-ol gives positive iodoform test

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

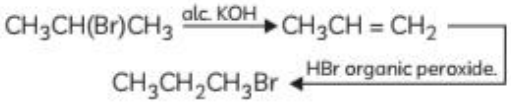
Explanation: The amount of oxygen dissolved in the water decreases with rise in the temperature of the water. The amount of oxygen dissolved in water for per unit area is more for cold water as compared for the warm water. Hence aquatic species are more comfortable in cold waters rather than in warm waters. Thus, assertion and reason both are correct statements but reason is not correct explanation for assertion because the K_H value of gases has nothing to do with these conditions needed for the survival of the aquatic species.

SECTION - B

19. (A)



(B)



20. $\Delta T_b = K_f m$

$\Delta T_b = 101.04–100 = 1.04°C$

or $m = 1.04 / 0.52 = 2$

Relative lowering of VP = x^2

Relative lowering of VP = $n_2/n_1 + n_2$

$= 2/2 + 55.5 = 2/57.5 = 0.034$ atm

Related Theory

The relative lowering in the vapour pressure is a colligative property since it depends on the number of the moles and can be calculated by using the different parameters such as molarity , mole fraction etc.

21. (A) $t_{2g}^4 e_g^2$ Paramagentic

The electronic configuration of the iron ion in the complex ion $[Fe(H_2O)_6]^{2+}$ can be written as $t_{2g}^4 e_g^2$ and it will be paramagnetic in nature due to the presence of unpaired electrons in the ion.

(B) Dichloridobis(ethane-1,2-diamine) cobalt (III) nitrate

OR

(A) Square planar

(B) $Cu^{2+} = 3d^9$, it means Cu^{2+} has 1 unpaired electron so $\sqrt{1(3)}$ = 1.73BM

The outer electronic configuration of Cu^{2+} is $3d^9$, that is it has 1 unpaired electron so magnetic moment can be calculated as $\sqrt{1(3)}$ = 1.73 BM.

Related Theory

Using the VSEPR theory, the electron bond pairs and lone pairs on the center atom the geometry of the molecule can be easily depicted whereas the shape of a molecule is determined by the location of the nuclei and its electrons.

22. (A) Reaction is a complex reaction.

Order of reaction is 1.5.

Molecularity cannot be 1.5, it has no meaning for this reaction. The reaction occurs in steps, so it is a complex reaction.

For the given rate = $k [A][B]^{1/2}$

Since the order of the reaction is ½ = 1.5 and the molecularity of the reaction cannot be equal to 1.5 thus such type of reactions are never elementary in nature they are complex in nature.

(B) Unit of k is $mol^{-1/2}L^{1/2}s^{-1}$

Related Theory

Order and Molecularity are the two closely related terms in the context of the chemical reactions to know the change in the concentrations of the reactants and products with the change in time but they are different. The molecularity of the reaction is the number of molecules that come together to react in an elementary (single-step) reaction and is equal to the sum of stoichiometric coefficients of reactants in this elementary reaction whereas order of the reaction is the sum of the concentration powers given in the rate law.

OR

Let the rate law expression be Rate = $k [P]^x [Q]^y$

from the table we know that,

Rate 1 = $3.0 \times 10^{-4} = k (0.10) \times (0.10)^y$

Rate 2 = $9.0 \times 10^{-4} = k (0.30) \times (0.30)^y$

Rate 3 = $3.0 \times 10^{-4} = k (0.10) \times (0.30)^y$

Rate 1/ Rate 3 = $(1/3)^y$ or $1 = (1/3)^y$

So y = 0

Rate 2/ Rate 3 = $(3)^x$ or $3 = (3)^x$

So x = 1

Rate = k [P]

Related Theory

The order of the reaction is given by the sum of the concentration powers given in the rate law; Let the hypothetical reaction be

$r = k [A]^x [B]^y$

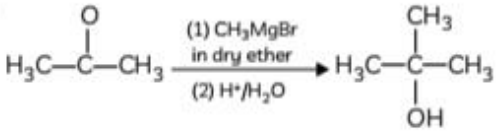
The concentration powers of A = x

And the concentration power of B = y

Therefore the sum of the powers is = {(x) + (y)}

Rate = x+ y

23. (A)



(B) $H_3C—COOH \xrightarrow{SOCl_2/PCl_5} H_3C—COCl$

24. (A) Inverted product will be given by 1 chlorobutane as it undergoes S_N^2 reaction.

(B) Racemic mixture will be given by 2 chloro-2-methylpropane as it undergoes S_N1 reaction.

25. (A) In this reaction:

Zn is oxidized and Ag_2O is reduced

$$E^0_{cell} = E^0_{cathode} - E^0_{anode}$$
$$= 0.344 - (-0.76) = 1.104V$$

(B) $$\Delta G^0 = -nFE^0_{cell}$$
$$= -2 \times 96500 \times 1.104$$
$$= -2.13 \times 10^5 \text{ J mol}^{-1}$$

Related Theory

The value of ΔG should always be negative for a reaction to be spontaneous. This is possible only when $E^0_{cell} = E^0_{cathode} - E^0_{anode}$ is positive.

SECTION - C

26. (A) Due to large surface area and ability to show variable oxidation states

Transition elements act as catalysts due to the large surface area and ability to show variable oxidation states.

(B) Due to high value of third ionisation enthalpy

It is difficult to obtain oxidation state greater than two for copper because the value of third ionisation enthalpy is very high for a copper atom.

(C) Oxidation state of Cr in Cr_2O_3 is +3 and of CrO is +2. When oxidation number of a metal increases, ionic character decreases so CrO is basic while Cr_2O_3 is amphoteric.

CrO is basic but Cr_2O_3 is amphoteric because oxidation state of Cr in Cr_2O_3 is +3 and of Cr in CrO is +2. When oxidation number of a metal increases, ionic character decreases so CrO is basic while Cr_2O_3 is amphoteric.

OR

(A) The general trend towards less negative EV values across the series is related to the general increase in the sum of the first and second ionisation enthalpies.

(B) The high energy to transform Cu(s) to $Cu^{2+}(aq)$ is not balanced by its hydration enthalpy.

(C) The stability of the half-filled d sub-shell in Mn^{2+} and the completely filled d^{10} configuration in Zn^{2+} are related to their more negative E° values

27. Three tests to differentiate between aldehydes and ketone are:

(i) Reaction with $LiAlH_4$: aldehydes gives primary alcohols and ketone gives secondary alcohols on reaction with $LiAlH_4$.

(ii) Reaction with NaOH: aldehydes gives brown resinous mass and ketone shows no action with NaOH.

(iii) Schiff's reagent test: aldehydes restores pink color andketones shows no action.

28. (A) Negative deviation occurs when the total vapour pressure is less than what it should be according to Raoult's Law.

$P_A < P_A^0 X_A$ and $P_B < P^0_B X_B$ as the total vapour pressure ($P_A^0 X_A + P^0_B X_B$) is less than what it should be with respect to Raoult's Law.

(B) The enthalpy of mixing is negative that is, $\Delta_{mix} H < 0$ because more heat is released when new molecular interactions are formed.

The volume of mixing is negative that is, $\Delta_{mix} V < 0$ as the volume decreases on the dissolution of components A and B.

(C) According to Raoult's Law : $P_A = P_A^\circ X_A$

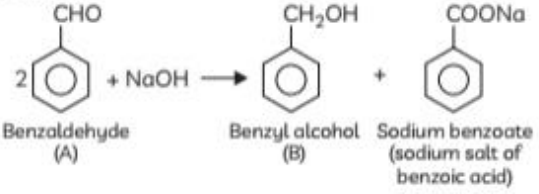
By Henry's law $P = K_H X$

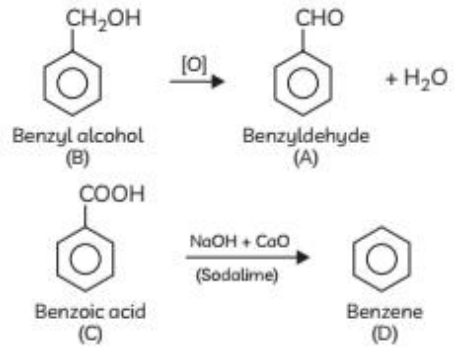
In both the above laws the partial pressure of the volatile component or gas is directly proportional to its mole fraction in solution. The only difference in the two expressions is the proportionality constant P_A° (in Raoult's law) and K_H (in Henry's law). Therefore, Raoult's law becomes a special case of Henry's law in which K_H becomes equal to vapour pressure of the pure component (P_A°).

Caution

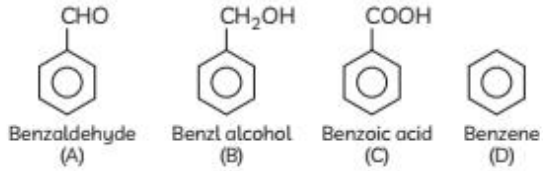
In the case of solution of a gas in a liquid, the gaseous component is volatile component. Its solubility is governed by Henry law.

29. Since, compound (A) has characteristic odour, undergoes Cannizzaro reaction when treated with NaOH, and compound (B) having formula C_7H_8O gives back compound (A) on oxidation, compound (A) should be benzaldehyde. The sequence of reactions can be written as follows.





Hence, the structure of compounds (A), (B), (C) and (D) are as follows.



30. (A) Threshold energy is the minimal amount of energy that molecules colliding must have in order for a chemical reaction to take place.

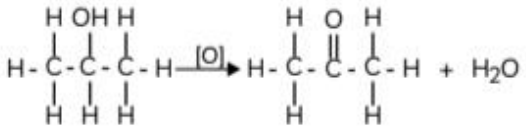
(B) Slope = $\tan\theta = E_a/2.303\ R$

(C) The function of a positive catalyst is to lower down the "activation energy". The greater the decrease in the activation energy caused by the catalyst, higher will be the reaction rate.

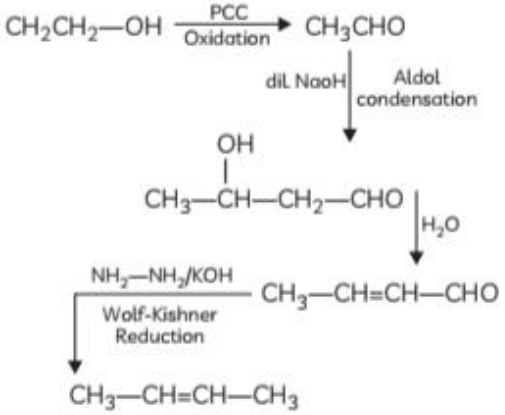
SECTION - D

31. (A) Propan-2-ol to propanone

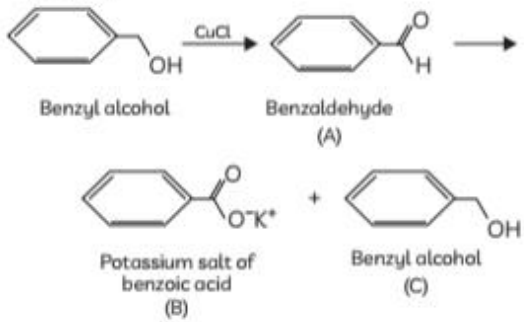
Explanation: This conversion is carried out in the presence of the copper catalyst as well.



(B) The oxidation of ethanol based on the copper catalyst is carried out by the ozonolysis and the following product is obtained:



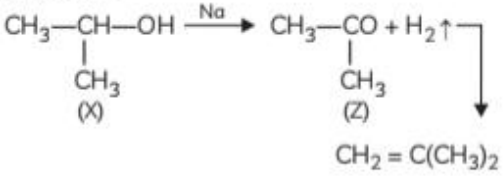
(C) The sequence of the reactions is shown below:



OR

$CH_2 = C(CH_3)_2$

Explanation: The sequence of the reactions is shown below:



32. (A) Because diazonium salts are polar by nature and water is a polar solvent, benzene diazonium salts are soluble in water. Consequently, the polar diazonium salt dissolves in the water (like dissolve like)

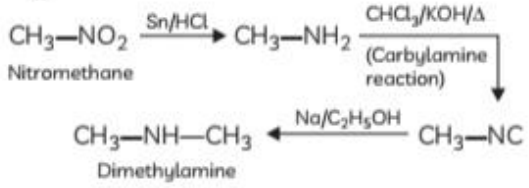
(B) On reduction, cyanides give primary amines and isocyanides give secondary amines.

(C) (i) Primary amine > secondary amine > tertiary amine

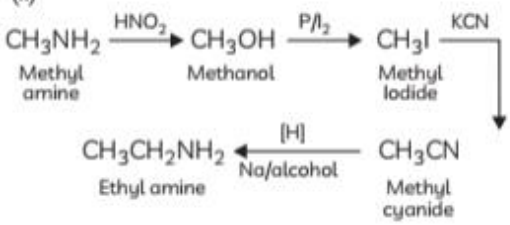
(ii) secondary amine > primary amine > tertiary amine

OR

(i)



(ii)



SECTION - E

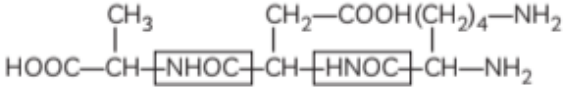
33. (A) Cell constant = $\frac{\text{specific conductance}}{\text{observed conductance}}$

(B)

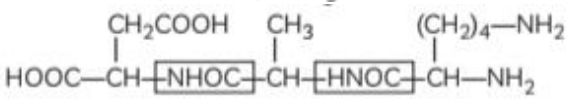
S. No.	Emf	Potential difference
1.	It is difference between electrode potential of two electrodes when no current is flowing through circuit.	It is difference of potential between electrode in a closed circuit.
2.	It is the maximum voltage obtained from a cell.	It is less than maximum voltage obtained from a cell.
3.	It is responsible for steady flow of current.	It is not responsible for steady flow of current.

(C) Ions flows is the internal circuit of a galvanic cell.

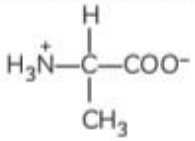
34. (A) Tripeptide 1 made up of three amino acids Alanine, Aspartic acid and lysine.



Tripeptide 2 made up of three amino acids Alanine, Alanine, and lysine.



(B) Alanine in the zwitter ionic form can be represented as follows:



(C) Diastase enzyme is used.

OR

(A)

S. No.	Fibrous proteins	Globular proteins
1.	These proteins possess thread like structures.	These proteins possess folded spheroidal structures
2.	The polypeptide chains are held together by stronger intermolecular hydrogen bonds.	The intermolecular hydrogen bonding is comparatively weaker.
3.	These proteins are insoluble in water.	These proteins are soluble in water
4.	They are stable to moderate changes in temperature and pH.	They are very sensitive to changes in temperature and pH.

(B) (i) Amylase

(ii) Trypsin

(iii) Urease

35. (A) A limiting molar conductivity of an electrolyte can be represented as the sum of the individual contributions of the anion and cation of the electrolyte.

Kohlrausch law states that limiting molar conductivity of an electrolyte can be represented as the sum of the individual contributions of the anion and cation of the electrolyte.

$$\Lambda_m^\infty = \nu_+\lambda_+^\infty + \nu_-\lambda_-^\infty$$

ν_+ and ν_- are the stoichiometric coefficients for the cation and anion in the electrolyte. λ°_+ and λ°_- are the ionic conductance of individual ions (cations and anions).

(B) $E^\circ_{cell} = E^\circ_{cathode} - E^\circ_{anode}$

$= 0.34 - (-1.66) = 2.00\ V$

$$E_{cell} = E^\circ_{cell} - \frac{0.059}{n}\log\frac{[Al^{3+}]^2}{[Cu^{2+}]^3}$$

Here $n = 6$

$$E_{cell} = 2 - \frac{0.059}{6}\log\frac{[0.15]^2}{[0.025]^3}$$

$= 2 - 0.059/6\ (2\log 0.15 - 3\log 0.025)$

$= 2 - 0.059/6\ (-1.6478 + 4.8062)$

$= 2 - 0.0311$

$= 1.9689V$

In the given electrolytic reaction:

$Al(s)|Al^{3+}\ (0.15\ M)\ ||Cu^{2+}\ (0.025\ M)\ |\ Cu(s)$

Al is undergoing oxidation hence Aluminium is anode and copper electrode is cathode. Standard EMF of the given cell can be given as follows:

$E^\circ_{cell} = E^\circ_{cathode} - E^\circ_{anode} = 0.34-(-1.66) = 2.00\ V$

Net EMF of the given cell can be calculated as follows:

$$E_{cell} = E^\circ_{cell} - \frac{0.059}{n} \log \frac{[Al^{3+}]^2}{[Cu^{2+}]^3}$$

Here, n = 6

$$E_{cell} = 2 - \frac{0.059}{6} \log \frac{[0.15]^2}{[0.025]^3}$$

$= 2 - 0.059/6 (2\log 0.15 - 3 \log 0.025)$

$= 2 - 0.059/9 (- 1.6478 + 4.8062) = 2 - 0.0311 = 1.9689V$

Hence, EMF if the given cell is 1.9689 V.

OR

(A) MnO_4^-

The given species can be arranged as follows according to their increasing oxidation potential–

$Cr_2O_7^{2-}$ (+1.33 V) < Cl_2 (+ 1.36 V) < MnO_4^- (+ 1.51 V)

Hence, MnO_4^- is the strongest oxidising agent.

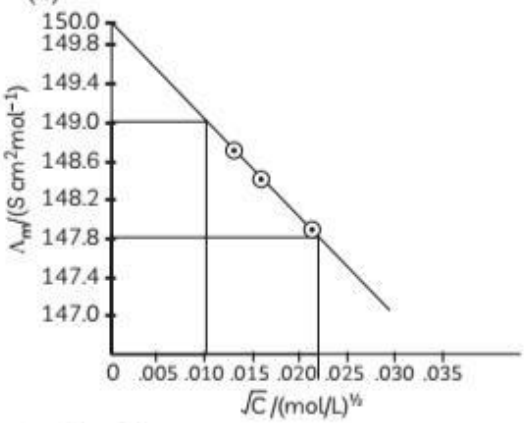
(B) (i) Molar conductivity of a solution at a given concentration is the conductance of the volume V of solution containing one mole of electrolyte kept between two electrodes with area of cross section A and distance of unit length.

(ii) Strong electrolyte, For strong electrolytes, Λ_m increases slowly with dilution

(iii) $\Lambda_m = \Lambda_m^\circ - \sqrt{c}$

Therefore $\Lambda_m^\circ = 150\ Scm^2mol^{-1}$

(iv)



Λ_m° = – Slope

$= - (149 - 147.8/ 0.010 - 0.022)$

$= 100\ Scm^2mol^{-1}/(mol/L^{-1})^{1/2}$.