Solved Paper 2023

CHEMISTRY

Time : 3 Hours **Class-XII** **Max. Marks : 70**

General Instructions :

(i) *This question paper contains **35** questions. **All** questions are **compulsory**.*

(ii) *Question paper is divided into **five** sections - Section **A, B, C, D** and **E***

(iii) ***In Section A** : Question numbers **1 to 18** are Multiple Choice (MCQ) type Questions carrying 1 mark each.*

(iv) ***In Section B** : Question numbers **19 to 25** are Very Short Answer (VSA) type questions carrying 2 marks each.*

(v) ***In Section C** : Question numbers **26 to 30** are Short Answer (SA) type questions carrying 3 marks each.*

(vi) ***In Section D** : Question numbers **31 and 32** are Case based questions carrying 4 marks each.*

(vii) ***In Section E :** Question numbers **33 to 35** are Long Answer (LA) type questions carrying **5** marks each.*

(viii) *There is no overall choice. However, an internal choice has been provided in 2 questions in **Section B,** 2 questions in **Section C**, 2 questions in **Section D** and 2 questions in **Section E**.*

(ix) *Use of Calculators is NOT allowed.*

Delhi Set-I **56/5/1**

SECTION - A

1. Which of the following molecules has a chiral centre correctly labelled with an asterisk (*) ? 1

(a) $CH_3C^*HBrCH_3$

(b) $CH_3C^*HClCH_2Br$

(c) $HOCHC^*H(OH)CH_2OH$

(d) $CH_3C^*Br_2CH_3$

Ans. Option (b) is correct

Explanation: Chiral molecules images are non-super impossible to each other.

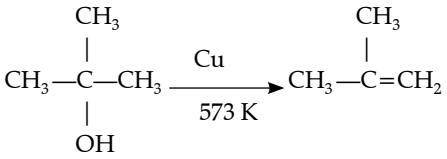
2. Which of the following alcohols will not undergo oxidation? 1

(a) Butanol **(b)** Butan-2-ol

(c) 2-Methylbutan-2-ol **(d)** 3-Methylbuta-2-ol

Ans. Option (c) is correct

Explanation: Because it is a tertiary alcohol and tertiary alcohol do not under go oxidation, it undergo dehydration and make alkene.



3. A voltaic cell is made by connecting two half cells represented by half equations below: 1

$Sn^{2+}_{(aq)} + 2e^- \rightarrow Sn_{(s)}$ $E^o = -0.14$ V

$Fe^{3+}_{(aq)} + e^- \rightarrow Fe^{2+}_{(aq)}$ $E^o = +0.77$ V

Which statement is correct about this voltaic cell?

(a) Fe^{2+} is oxidised and the voltage of the cell is –0.91 V

(b) Sn is oxidised and the voltage of the cell is 0.91 V

(c) Fe^{2+} is oxidised and the voltage of the cell is 0.91 V

(d) Sn is oxidised and the voltage of the cell is 0.63 V

Ans. Option (b) is correct

Explanation: Sn is oxidized as it is having -ve value of electrode potential.

$E^o = E_c - E_a$
$= 0.77 - (-0.14)$
$= 0.91$ V

4. Four half reactions I to IV are shown below: 1

I. $2Cl^- \rightarrow Cl_2 + 2e^-$

II. $4OH^- \rightarrow O_2 + 2H_2O + 2e^-$

III. $Na^+ + e^- \rightarrow Na$

IV. $2H^+ + 2e^- \rightarrow H_2$

Which two of these reactions are most likely to occur when concentrated brine is electrolysed?

(a) I and III **(b)** I and IV
(c) II and III **(d)** II and IV

Ans. Option (b) is correct

Explanation:

(1) At anode $2Cl^- \rightarrow Cl_2 + 2e^-$

(2) At cathode

$Na^+ + e^- \rightarrow Na = E_o = -2.71$ V

$2H^+ + 2e^- \rightarrow H_2$, $E_o = 0$V

Those have high E_o value, that reaction will take place.

5. Which property of transition metals enables them to behave as catalysts? 1

(a) High melting point
(b) High ionisation enthalpy
(c) Alloy formation
(d) Variable oxidation states

Ans. Option (d) is correct

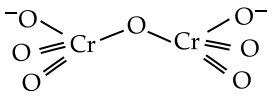
Explanation: Because of variable oxidation state they have **tendency** to form bonds with many elements.

6. In the two tetrahedral structures of dichromate ion 1

(a) 4 Cr – O bonds are equivalent in length.
(b) 6 Cr – O bonds are equivalent in length.
(c) All Cr – O bonds are equivalent in length.
(d) All Cr – O bonds are non-equivalent.

Ans. Option (a) is correct

Explanation: 4 Cr – **O** bonds are equal in length



$[Cr_2O_7]^{2-}$

7. 1 mole of liquid A and 2 moles of liquid B make a solution having a total vapour pressure 40 torr. The vapour pressure of pure A and pure B are 45 torr and 30 torr respectively. The above solution 1

(a) is an ideal solution
(b) shows positive deviation
(c) shows negative deviation
(d) is a maximum boiling azeotrope

Ans. Option (c) is correct

Explanation: Shows negative de viation.

because A – B forces of attraction are higher than A – A and B – B components.

8. Which of the following would not be a good choice for reducing nitrobenzene to aniline? 1

(a) LiA/H_4 **(b)** H_2/Ni
(c) Fe and HCl **(d)** Sn and HCl

Ans. Option (a) is correct

Explanation: Nitrobenzene gives azo product when react with $LiAlH_4$. Nitrobenzene react with highly reactive metal and conc. HCl to give Aniline.

9. If molality of a dilute solution is doubled, the value of the molal elevation constant (K_b) will be 1

(a) halved **(b)** doubled
(c) tripled **(d)** unchanged

Ans. Option (d) is correct

Explanation: K_b is molal elevation constant, when molality is double, it remains unchanged.

10. Hydrolysis of sucrose is called 1

(a) inversion **(b)** hydration
(c) esterification **(d)** saponification

Ans. Option (a) is correct

Explanation: Hydrolysis of sucrose (sugarcane) is called inversion. On undergoing hydrolysis it gives equimolar amount of glucose and fructose.

11. Which one of the following has lowest pK_a value? 1

(a) $CH_3 - COOH$ **(b)** $O_2N - CH_2 - COOH$
(c) $Cl - CH_2 - COOH$ **(d)** HCOOH

Ans. Option (b) is correct.

Explanation: $O_2N - CH_2 - COOH$ having less value of ^pk_a because its acidic strength is very high.

12. Which of the following cell was used in Apollo space programme? 1

(a) Mercury cell **(b)** Daniel cell
(c) $H_2 - O_2$ Fuel cell **(d)** Dry cell

Ans. Option (c) is correct.

Explanation: H_2O_2 fuel cell is used in apollo space programme to provide electricity power.

13. The following experimental rate data were obtained for a reaction carried out at 25º C 1

$A_{(g)} + B_{(g)} \rightarrow C_{(g)} + D_{(g)}$

Initial $[A_{(g)}]$/ mol dm^{-3}	Initial $[B_{(g)}]$mol dm^{-3}	Initial rate/mol $dm^{-3}s^{-1}$
3.0×10^{-2}	2.0×10^{-2}	1.89×10^{-4}
3.0×10^{-2}	4.0×10^{-2}	1.89×10^{-4}
6.0×10^{-2}	4.0×10^{-2}	7.56×10^{-4}

What are the orders with respect to $A_{(g)}$ and $B_{(g)}$?

	Order with respect to $A_{(g)}$	Order with respect to $B_{(g)}$
(a)	Zero	Second
(b)	First	Zero
(c)	Second	Zero
(d)	Second	First

Ans. Option (c) is correct

14. The magnetic moment of $[NiCl_4]^{2-}$ **1**

(a) 1.82 BM (b) 2.82 BM

(c) 4.42 BM (d) 5.46 BM

[Atomic number : Ni = 28]

Ans. Option (b) is correct

Explanation: Ni^{2+} = 28, $3d^8$ $4s^0$, no. of unpaired electron = 2.

$\mu = \sqrt{n(n+2)}$

$= \sqrt{2(2+2)}$

$= \sqrt{8}$ = 2.82 BM

For questions number 15 to 18, two statements are given - one labelled as Assertion (A) and the other labelled as Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below:

(a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

(b) Both Assertion (A) and Reason (R) and true, but Reason (R) is not the correct explanation of the Assertion (A).

(c) Assertion (A) is true, but Reason (R) is false.

(d) Assertion (A) is false, but Reason (R) is true.

15. Assertion (A): Proteins are polymers of α-amino acids connected by a peptide bond. **1**

Reason (R): A tetrapeptide contains 4 amino acids linked by 4 peptide bonds.

Ans. Option (c) is correct

Explanation: Assertion is true but reason is false because in tetrapeptide, four amino acid and three peptide bonds are present.

16. Assertion (A): For a zero order reaction the unit of rate constant and rate of reaction are same. **1**

Reason (R): Rate of reaction for zero order reaction is independent of concentration of reactant.

Ans. Option (a) is correct

Explanation: Assertion & Reason both are correct.

17. Assertion (A): Acetic acid but not formic acid can be halogenated in presence of red P and Cl_2. **1**

Reason (R): Acetic acid is a weaker acid than formic acid.

Ans. Option (a) is correct

Explanation: Because acetic acid have hydrogen atoms which can be replaced by halogen. But formic acid do not have.

18. Assertion (A): Trans $[Cr\ Cl_2(ox)_2]^{3-}$ shows optical isomerism. **1**

Reason (R): Optical isomerism is common in octahedral complexes involving bidentate ligands.

Ans. Option (A) is correct

Explanation: Trans $[Cr(Cl_2)CoX_2]^{3-}$ is optically inactive because of super-impossible mirror image.

SECTION - B

19. (a) (i) What should be the signs (positive/ negative) for E^0_{Cell} and ΔG^0 for a spontaneous redox reaction occurring under standard conditions? **2 × 1 = 2**

(ii) State Faraday's first law of electrolysis.

OR

(b) Calculate the emf of the following cell at 298 K:

$Fe_{(s)} \mid Fe^{2+}$ (0.01M)$\mid\mid H^+_{(1M)} \mid H_{2(g)}$ (1 bar), $Pt_{(s)}$

Given E^0_{Cen} = 0.44 V. **2**

Ans. (a) (i) $\left.\begin{matrix}\Delta G^0 = -ve \\ E^0 cell = +ve\end{matrix}\right]$ for spontaneous reaction

(ii) Faraday'+s first law of electrolysis - The amount of chemical reaction which occur at any electrode during electrolysis by a current is proportional to the quantity of electricity passed through the electrolyte (solution).

OR

(b) According to the equation

$Fe(s) + 2H^+(aq) \rightarrow Fe^{+2}(aq) + H_2(g)$

By applying nearest Equation-

$$E_{cell} = E^0_{cell} - \frac{0.0591}{n}\log\frac{Fe^{2+}}{\left[H^+\right]^2}$$

$$= 0.44 - \frac{0.0591}{2}\log\frac{0.001}{(1)}$$

$= 0.44 - 0.0295 \log 10^{-3}$

$= 0.44 - 0.0295 (-3 \log 10)$ as, $(\log 10 = 1)$

$= 0.44 + 0.089$

$E_{cell} = 0.53$ V

20. What happens to the rate constant k and activation energy E_a as the temperature of a chemical reaction is increased? Justify. **2**

Ans. Rate constant increases with the increase in temperature because rate of the reaction increases. The rate of the reaction becomes doubled after every ten degree rise in temperature.

The activation energy also increases with increase in temperature because kinetic energy of the molecules increases their colliding frequency will be very high and activation energy increases.

21. (a) Which of the following species cannot act as a ligand? Give reason.

OH^-, NH_4^+, CH_3NH_2, H_2O **2 × 1 = 2**

(b) The complex $[Co(NH_3)_5(NO_2)]$ Cl_2 is red in colour. Give IUPAC name of its linkage isomer.

Ans. (a) NH_4^+ (Ammonium ion) can not act as **ligand** Ligand donate electron to central atom or they can

have lone pair of electron to donate and form bond between ligand and central atom. But NH_4^+ do not have lone pair of electron to donate.

(b) Complex $[Co(NH_3)_5(NO_2)]Cl_2$ is Red in colour when it is present in hydrated form. It absorb moisture and turn into Red colour.

It is showing linkage isomerism-

$[CO(NH_3)_5(NO_2)]Cl_2 \rightleftharpoons [CO(NH_3)_5(ONO)]Cl_2$

Pentaamine N-nitro cobalt (III) Chloride — Penta amine o-nitro cobalt (III) Chloride

22. Why is boiling point of o-dichlorobenzene higher than p-dichlorobenzene but melting point of para isomer is higher than ortho isomer? 2

Ans. Melting point of **p**–Chlorobenzene is higher than o-Chlorobenzene because of its closed packed structure which have high intramolecular forces of attraction. That's why high amount of temperature is required to break down the bonds while boiling point of o-chlorobenzene is high because of high dipole interaction present at ortho-position. There is great dipole-dipole forces of attraction between carbon and chlorine atom which results into high boiling point as compared to p-chlorobenzene which have zero dipole moment.

23. For the pair phenol and cyclohexanol, answer the following $2 \times 1 = 2$

(a) Why is phenol more acidic than cyclohexanol ?

(b) Give one chemical test to distinguish between the two.

Ans. (a) Cyclohexanol is less acidic as compared to phenol because phenol is an aromatic compound while cyclohexanol is cyclic ring structure containing hydroxyl ion (–OH group).

In phenol benzene ring is having double bond and shows sp^2 hybridization. Because of more s-character it is more acidic.

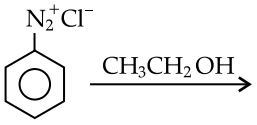
(b) When phenol react with Ferric Chloride, it gives violet colour but cyclohexanol remains colourless when react with $FeCl_3$.

24. (a) (i) Draw the zwitter ion structure for sulphanilic acid. $2 \times 1 = 2$

(ii) How can the activating effect of $-NH_2$ group in aniline be controlled?

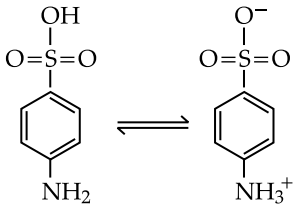
OR

(b) (i) Complete the reaction with the main product formed: $2 \times 1 = 2$



(ii) Convert Bromoethane to Propanamine.

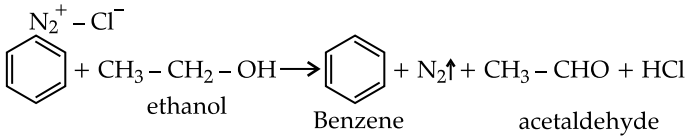
Ans. (i)



(ii) The activating effect of $-NH_2$ group can be reduce by friedal craft (Alkylation & Acetylation) process because nitrogen of aniline required positive charge and hence act as a strong deactivating group.

OR

(b) (i)



(ii) $CH_3 - CH_2 - Br \xrightarrow{Sn/KCN} CH_3 - CH_2 - CN$

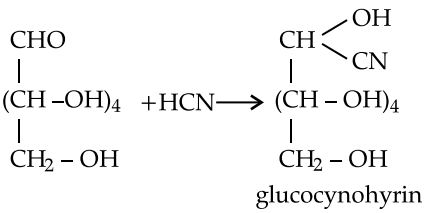
Bromoethane

$\xrightarrow[2[H]]{Na/C_2H_5-OH} CH_3 - CH_2 - CH_2 - NH_2$

Propanamine

25. Give the reaction of glucose with hydrogen cyanide. Presence of which group is confirmed by this reaction ? 2

Ans.



glucocynohyrin

→ cyno group is present in this reaction.

SECTION - C

26. (a) For the reaction $1 + 2 = 3$

$2N_2O_{5(g)} \rightarrow 4\ NO_{2(g)} + O_{2(g)}$ at 318 K

Calculate the rate of reaction if rate of disappearance of $N_2O_{5(g)}$ is 1.4×10^{-3} m s^{-1}.

(b) For a first order reaction derive the relationship $t_{99\%} = 2t_{90\%}$

Ans. (a) $2N_2O_5 \rightarrow 4\ NO_2 + O_2$

$$\frac{-\frac{1}{2}d[N_2O_5]}{dt} = +\frac{\frac{1}{4}d[NO_2]}{dt} = +\frac{d[O_2]}{dt}$$

$= 2 \times \frac{1}{4} \times 1.4 \times 10^{-3}$ [Rate of disappearance

$= 1.4 \times 10^{-3}\ ms^{-1}$

$= 0.7 \times 10^{-3}\ ms^{-1}$

(b) For a first order of reaction

$$t = \frac{2.303}{K}\log\frac{a}{a-x}$$

$$t_{99\%} = \frac{2.303}{K}\log\frac{100}{1}$$

$$= \frac{2.303}{K}\log 100$$

$$= \frac{2.303 \times 2}{K} = \frac{4.606}{K}$$

$$\text{and } t_{90\%} = \frac{2.303}{K}\log\frac{a}{a-x}$$

$$= \frac{2.303}{K}\log 10 = \frac{2.303}{K}$$

$$\frac{t_{99\%}}{t_{90\%}} = 2$$

$$t_{99\%} = 2\, t_{90\%}.$$

27. (a) On the basic of crystal field theory write the electronic configuration for d^5 ion with a strong field ligand for which $\Delta_0 > P$. 1 + 2 = 3

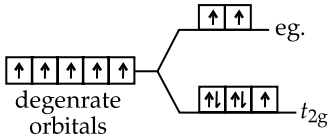
(b) $[Ni(CO)_4]$ has tetrahedral geometry while $[Ni(CN)_4]^{2-}$ has square planar yet both exhibit diamagnetism. Explain.

[Atomic number : Ni = 28]

Ans. (a) It is the magnitude difference in energy between the two sets of d-orbital i,e t_{2g} and eg. electronic configuration of d^5 if $\Delta_o > P$ is t_{2g}^5 eg

Because in a strong field ligand pairing of electrons takes place for eg $[Ni(CN)_4]^{2-}$

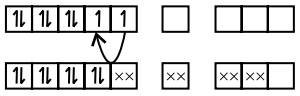
–CN is a strong field ligand



(b) Ni = 28, $3d^8\ 4s^2$

$Ni^{2+} = 3d^8\ 4s^0$

$[Ni(CN)_4]$ is a strong field ligand.



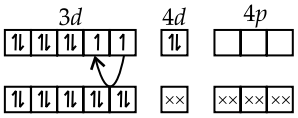
= dsp^2 hybridization showing square planar geometry

= All electrons are paired so it is diamagnetic in nature.

$[Ni(CO)_4]$

Ni = 28, $3d^8\ 4s^2$

Ni = valency is zero



= sp^3 hybridization

→ showing tetrahedral geometry

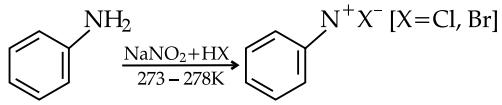
→ All electrons are paired

so it is diamagnetic in nature.

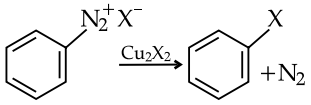
28. (a) Illustrate Sandmeyer's reaction with an equation. 1 + 2 = 3

(b) Explain, why $(CH_3)_2$ NH is more basic than $(CH_3)_3N$ in aqueous solution.

Ans. (a) Sand meyer's Reaction -



Benzene diozonium halide



Aryl halide

(b) The order of basicity is $(CH_3)_2$ –N > $(CH_3)_3$ – N because alkyl group is small, there is no steric hindrance to H-bonding, So, nature of alkyl group is responsible for basicity of 2^0 amine. Secondly, there is inductive effect which is important for salvation effect.

29. Give reasons for any 3 of the following observations: 3 × 1 = 3

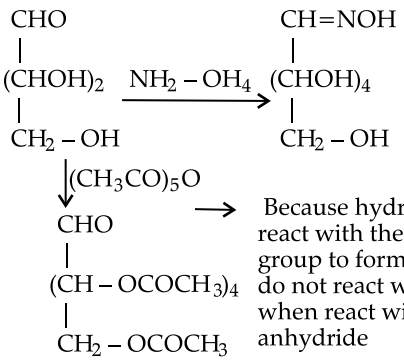
(a) Penta-acetate of glucose does not react with hydroxylamine.

(b) Amino acids behave like salts.

(c) Water soluble vitamins must be taken regularly in diet.

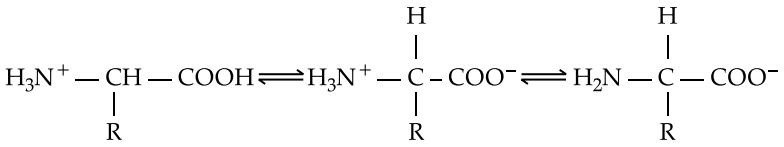
(d) The two strands in DNA are complimentary to each other.

Ans. (a)



Because hydroxyl amine react with the aldehyde group to form oxime. It do not react with acetate when react with acid anhydride

(b) In a solution, amino acids for Zwitter ions



Because of (+) and (–) charge they exist as solids and form salts.

(c) Water soluble vitamins can not retain in body for longer time. If someone take high diet of vitamin B and C they would not be harmful as they dissolve in water and excrete outside of body.

(d) Two DNA strands are complementary because they are connected with each other through base pair C,G,T by hydrogen bonding and run parallel to each other.

5′ ⟶ 3′

3′ ⟵ 5′

30. (a) (i) Why is the C – O bond length in phenols less than that in methanol?

3 × 1 = 3

(ii) Arrange the following in order of increasing boiling point:

Ethoxyethane, Butanal, Butanol, n-butane

(iii) How can phenol be prepared from anisole? Give reaction.

OR

(b) (i) Give mechanism of the following reaction:

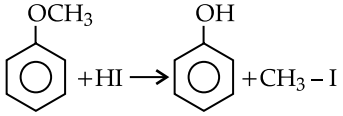
2 + 1 = 3

$$CH_3 - CH_2 - OH \xrightarrow[413K]{H_2SO_4} CH_3CH_2 - O - CH_2CH_3 + H_2O$$

(ii) Illustrate hydroboration - oxidation reaction with an example.

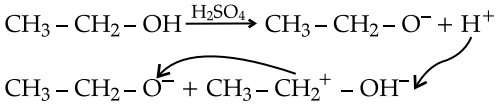
Ans. (a) (i) C – O bond length in phenol is less than methanol because of presence of benzene ring which is aromatic and consisting of double bond. The lone pair present in oxygen is shared with partial conjugation effect while in methanol the lone pair of oxygen shared with normal carbon atom.

(ii) Butanol > Butane > Butanal > Ethoxy ethane

(iii) 

OR

(b) (i) $2CH_3 - CH_2 - OH \xrightarrow[413K]{H_2SO_4} CH_3–CH_2–O–CH_2–CH_3+H_2O$



$CH_3–CH_2–O–CH_2–CH_3+H_2O$

(ii) Hydroboration -

$3CH_3–CH_2 = CH_2 + BH_3 \rightarrow (CH_3–CH_2–CH_3)_3–B$

Propane

$\downarrow 3H_2O$

$3CH_3–CH_2–OH+B(OH)_3$

SECTION - D

The following questions are case - based questions. Read the passage carefully and answer the questions that follow:

31. Nucleophilic Substitution

Nucleophilic Substitution reaction of haloalkane can be conducted according to both S_N1 and S_N2 mechanisms. S_N1 is a two step reaction while S_N2 is a single step reaction. For any haloalkane which mechanism is followed depends on factors such as structure of haloalkane, properties of leaving group, nucleophilic reagent and solvent.

Influences of solvent polarity: In S_N1 reaction, the polarity of the system increases from the reactant to the transition state, because a polar solvent has a greater effect on the transition state than the reactant, thereby reducing activation energy and accelerating the reaction. In S_N2 reaction, the polarity of the system generally does not change from the reactant to the transition state and only charge dispersion occurs. At this time, polar solvent has a great stabilizing effect on Nu than the transition state, thereby increasing activation energy and slow down the reaction rate. For example, the decomposition rate (S_N1) of tertiary chlorobutane at 25° C in water (dielectric constant 79) is 300000 times faster than in ethanol (dielectric constant 24). The reaction rate (S_N2) of 2-Bromopropane and NaOH in ethanol containing 40% water is twice slower than in absolute ethanol. Hence the level of solvent polarity has influence on both S_N1 and S_N2 reaction, but with different results. Generally speaking weak polar solvent is favourable for S_N2 reaction, while strong polar solvent is favourable for S_N1. Generally speaking the substitution reaction of tertiary haloalkane is based on S_N1 mechanism in solvents with a strong polarity (for example ethanol containing water).

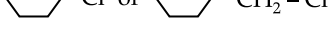
Answer the following questions:

(a) Why racemisation occurs in S_N1? **1**

(b) Why is ethanol less polar than water? **1**

(c) Which one of the following in each pair is more reactive towards S_N2 reaction?

(i) $CH_3 – CH_2 – I$ or $CH_3 CH_2 – Cl$

(ii)  **$CH_2 – Cl$** **2 × 1**

OR

(c) Arrange the following in the increasing order of their reactivity towards S_N1 reactions:

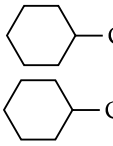
(i) 2-Bromo-2-methylbutane, 1-Bromopentane, 2-Bromopentane

(ii) 1-Bromo-3-methylbutane, 2-Bromo-2-methylbutane, 2-Bromo-3-methylbutane **2 × 1**

Ans. (a) In S_N1 **m**echanism, there is intermediate carbo cation formed. Due to which recmization of the product take place or D and L form formed.

(b) In ethanol alkyl chain is present which is responsible for non-polar nature. Water has high value of dipole moment than ethanal. That's why water is more polar than ethanal.

(c) (i) $CH_3 - CH_2 - I$ will react faster than CH_3–CH_2–Cl because I is bigger in size and more polarized atom. Its bond dissociation enthalpy is less So, it easily react with other substances.

(ii)  Cl is less reactive when compared to CH_2–Cl because in chlorocylo hexane bond length is less and it is closely attached with cyelohexane while 1-methyl 1-chloro cyclohexane is less stable one extra methyl group is attached which make it more reactive towards **S_N1** mechanism.

[OR]

(c) (i) 2-Bromo-2-methylbutane > 2-Bromopentane > 1-Bromopentane

(ii) 1-Bromo-3-methyl butane > 2-Bromo-3-methyl butane > 2-Bromo-2-methyl butane.

32. Rahul set-up an experiment to find resistance of aqueous KC*l* solution for different concentrations at 298 K using a conductivity cell connected to a Wheatstone bridge. He fed the Wheatstone bridge with a.c. power in the audio frequency range 550 to 5000 cycles per second. Once the resistance was calculated from null point he also calculated the conductivity K and molar conductivity $\wedge_m$ and recorded his readings in tabular form.

S.No.	Conc. (M)	k S cm^{-1}	$\wedge_m$ S cm^2 mol^{-1}
1.	1.00	111.3×10^{-3}	111.3
2.	0.10	12.9×10^{-3}	129.0
3.	0.01	1.41×10^{-3}	141.0

Answer the following questions:

(a) Why does conductivity decrease with dilution? **1**

(b) If $\wedge_m^0$ of KC*l* is 150.0 S cm^2 mol^{-1}, calculate the degree of dissociation of 0.01 M KC*l*. **1**

(c) If Rahul had used HC*l* instead to KC*l* then would you except the $\wedge_m$ values to be more or less than those per KC*l* for a given concentration. Justify. **2 × 1**

OR

(c) Amit, a classmate of Rahul repeated the same experiment with CH_3COOH solution instead of KC*l* solution. Give one point that would be similar and one that would be different in his observations as compared to Rahul.

Ans. (a) Conductivity decreases with dilution because it depends upon the number of ions present in the solution. When dilution increases number of available ions decreases. Hence, conductivity decreases.

(b) $\propto = \frac{i^\circ_m}{i_m}$

$i_m = 150.0$ S cm^2 mol^{-1}

$i^\circ_m = 141.0$ S cm^2 mol^{-1}

$\propto = \frac{141}{150} = 0.94$

(c) Molar conductivity of HCl will be high because when it break down into ions, it produce

$HCl \rightarrow H^+ + Cl^-$

Its H^+ (cation) size is smaller then K^+ ion. So for same concentration of HCl and K**Cl**, HCl shows high molar conductivity.

[OR]

(c) (i) KCl is strong electrolyte and completely dissociate into their respective ion while CH_3–COOH is weak electrolyte and do not completely dissociate.

(ii) Number of ions produced after dissociation are equal

$KCl \rightarrow K^+ + Cl^-$

$CH_3–COOH \rightarrow CH_3 - COO^- + H^+$

SECTION - E

33. (a) (i) Why is boiling point of 1M NaC*l* solution more than that of 1M glucose solution?

1 + 2 + 2 = 5

(ii) A nonvolatile solute 'X' (molar mass = 50 g mol^{-1}) when dissolved in 78g of benzene reduced its vapour pressure to 90%.

Calculate the mass of X dissolved in the solution.

(iii) Calculate the boiling point elevation for a solution prepared by adding 10g of $MgCl_2$ to 200g of water assuming $MgCl_2$ is completely dissociated.

(K_b for Water = 0.512 K kg mol^{-1}, Molar mass $MgCl_2$ = 95g mol^{-1})

OR

(b) (i) Why is the value of Van't Hoff factor for ethanoic acid in benzene close to 0.5 ?

1 + 2 + 2 = 5

(ii) Determine the osmotic pressure of a solution prepared by dissolving 2.32 × 10^{-2}g of K_2SO_4 in 2L of solution at 25 ºC, assuming that K_2SO_4 is completely dissociated.

(R = 0.082 L atm K^{-1} mol^{-1}, Molar mass K_2SO_4 = 174g mol^{-1})

(iii) When 25.6g of sulphur was dissolved in 1000g of benzene, the freezing point lowered by 0.512 K. Calculate the formula of sulphur (S_x).

(K_f for benzene = 5.12 K kg mol^{-1}, Atomic mass of Sulphur = 32g mol^{-1})

Ans. (a) (i) NaCl is having ionic bonding between sodium and chloride atoms which is strong bonding while glucose having covalent bonding which is weak in nature. NaCl will required high temperature to boil while glucose need low temperature to dissociate its bonding.

(ii)

$$\frac{P^\circ - P_s}{P_s} = \frac{n}{N} = \frac{w \times M}{m \times w}$$

$$\frac{100-90}{90} = \frac{w \times 78}{50 \times 78}$$

$$\frac{10}{90} = \frac{w}{50}$$

$$90 \times w = 10 \times 50$$

$$w = \frac{10 \times 50}{90} = 5.55 \text{ grams}$$

(ii) $T_b = i \times k_b \times m$ ($MgCl_2$ = 3 ions) i = 3

$$T_b = \frac{3 \times 0.512 \times 10}{95 \times 0.2} (200 \text{ gm} = 0.2 \text{ Kg})$$

$$= \frac{5.36}{19} = 0.80$$

So elevation is boiling point = 273 + 0.80

= 273.80 K

OR

(b) (i) Van't Hoff factor is used in determination of colligative property. It is also called Abnormal colligative property.

$$i = \frac{\text{actual no. of particle or cocentration}}{\text{Theoretical number of particles}}$$

∵ It is considered that degree of dissociation of ethanoic acid in benzene is 1

$$2CH_3 - COOH \longrightarrow (CH_3 - COOH)_2$$

So, $i = \frac{1}{2} = 0.5$

(ii) $K_2SO_4 \longrightarrow 2K^+ + SO_4^{2-}$

ions produced are = 3

$i = 3$

$x = iCRT$

$$= 3 \times \frac{0.0232}{174} \times 0.5 \times 0.0821 \times 298$$

$$= \frac{0.851}{174} = 0.00489$$

$= 4.89 \times 10^{-3}$ atm

(iii) $\Delta T_f = \frac{K_f \times m \times 1000}{M_B \times W_A}$ $\left[\because M_B = S_x\right]$.

$$0.512 = \frac{5.12 \times 25.6 \times 1000}{S_x \times 1000}$$

$$S_x = \frac{5.12 \times 25.6}{0.512}$$

$S_x = 256$

$x \times 32 = 256$

$$x = \frac{256}{32} = 8$$

So, the required formula (S_x)

x = 8

or S_8.

34. (a) (i) Write the reaction involved in Cannizaro's reaction. 1 + 1 + 3 = 5

(ii) Why are the boiling point of aldehydes and ketones lower than that of corresponding carboxylic acids?

(iii) An organic compound 'A' with molecular formula $C_5H_8O_2$ is reduced to n-pentane with hydrazone followed by heating with NaOH and Glycol. 'A' forms a dioxime with hydroxylamine and gives a positive Iodoform and Tollen's test. Identify 'A' and give its reaction for Iodoform and Tollen's test.

OR

(b) (i) Give a chemical test to distinguish between ethanol acid and ethanoic acid. 1 + 1 + 3 =5

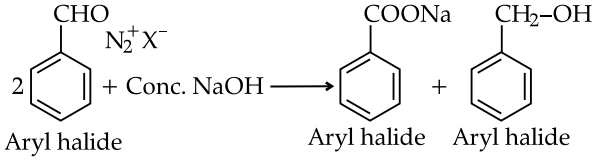
(ii) Why is the α-hydrogens of aldehydes and ketones are acidic in nature?

(iii) An organic compound 'A' with molecular formula $C_4H_8O_2$ undergoes acid hydrolysis to form two compounds 'B' and 'C'. Oxidation of 'C' with acidified potassium permanganate also produces 'B'. Sodium salt of 'B' on heating with soda lime gives methane.

(1) Identify 'A', 'B' and 'C'.

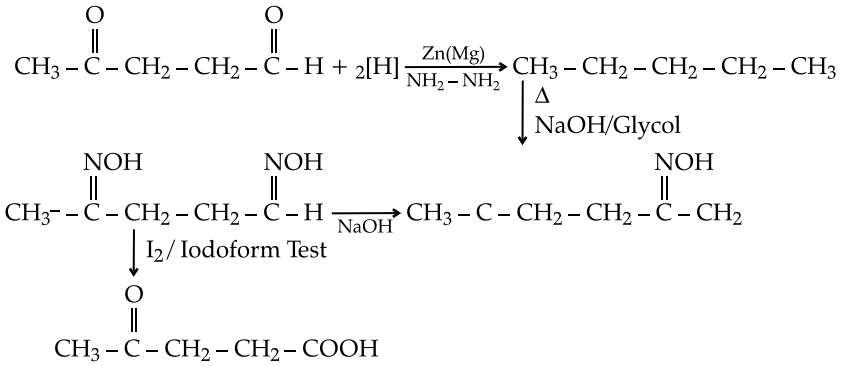
(2) Out of 'B' and 'C', which will have higher boiling point? Give reason.

Ans. Cannizaro Reaction (a) (i)



(ii) Boiling points of aldehyde and ketones are less than carboxylic acid because carboxylic acid have hydrogen bonding and associated molecules bonding which increases the boiling point of carboxylic acids.

(iii)



(b) (i) Sodium bicarbonate ($NaHCO_3$) is used to distinguish ethanol and ethanoic acid
ethanoic acid give brick Red fumes with sodium bicarbonate.
ethanol do not react with sodium bicarbonate.

(ii) α-Hydrogen is always attached with oxygen which is highly electronegative and having lone pair of electrons. Alpha hydrogen atom when donate electron it act as an acid.

(iii)

$$\underset{(A)}{CH_3-COO-C_2H_5} \xrightarrow{H_2O/H^+} \underset{(B)}{CH_3-COOH} + \underset{(C)}{C_2H_5-OH}$$

$$C_2H_5-OH+[O] \xrightarrow{KMnO_4} \underset{(B)}{CH_3-COOH}$$

$$\underset{\text{(Salt of B) sodiumacetate}}{CH_3-COONa} \xrightarrow[CaO+NaOH]{\Delta} \underset{\text{methane}}{CH_4} + \underset{\text{soda lime}}{Na_2CO_3}$$

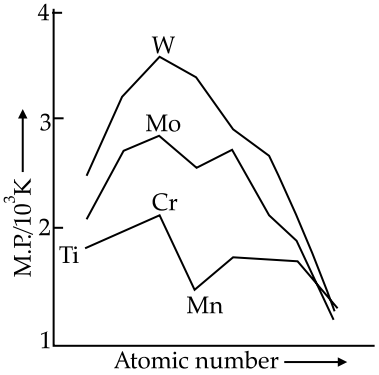
1. A - $CH_3 – COOC_2H_5$ (ethyl methanoate)
B - $CH_3 – COOH$ (ethanoic acid)
C - $CH_3 – COONa$ (sodium **a**cetate)

2. Ethanoic acid will have higher boiling point because it contain associate molecule which participate in hydrogen bonding. H-bonding is strong bonding which required high temperature to boil.

35. (a) Why is chemistry of actinoids complicated as compared to lanthanoids? 1 + 2 + 2 = 5

(b) Complete the following reaction and justify that it is a disproportionation reaction:
$3\ MnO_4^{2-} + 4H^+ \rightarrow$ _____ + _____ + 2 H_2O.

(c) The given graph shows the trends in melting points of transition metals:



Explain the reason why Cr has highest melting point and manganese (Mn) a lower melting point.

Ans. (a) Actinoids are present below the series of lanthanoid. They are **r**adio active in nature. To study them is more complicated as compared to lanthanoid. Second, they have variable oxidation state.

(b) $3\ MnO_4^- + 4H+ \rightarrow 2MnO_4^- + MnO_2 + 2H_2O$
It is disproportinoation reaction because oxidation take place in acidic medium and oxidation numbers are
$MnO_4^{2-} = 6$
$MnO_4^- = 7$
$MnO_2 = 4$

(c) Cr = 24 [Ar] $3d5\ 4s^1$ 4
Mn = 25 [Ar] $3d^5\ 4s^2$

Cr has maximum number of unpaired electrons in α-orbital. So **it** can have maximum pairing and form bond. Number of unpaired electrons are six in Cr. But Mn has five unpaired electron in d-orbital which is less than Cr. That's why boiling p**o**int of **C**r is maximum in transition metal. Mn is half filled which have extra stability and less tendency of form bonds.

Delhi Set-II 56/5/2

Note: Except these, all other questions are from Delhi Set-I.

SECTION - A

3. Consider the following standard electrode potential values: 1

$Fe^{3+}_{(aq)} + e^- \rightarrow Fe^{2+}_{(aq)}$ $E^\circ = +0.77$ V

$MnO_4^-{}_{(aq)} + 8H^+ + 5e^- \rightarrow Mn^{2+}_{(aq)} + 4H_2O_{(l)}$ $E^\circ = +1.51$ V

What is the cell potential for the redox reaction?

(a) – 2.28 V **(b)** – 0.74 V

(c) + 0.74 V **(d)** + 2.28 V

Ans. Option (c) is correct

Explanation: $E^\circ = E_C - E_a$

$= 1.51 - 0.77 = +0.74$ V

6. Which of the following ions has the electronic configuration $3d^6$? (Atomic number; Mn=25, Co=27, Ni=28)

(a) Ni^{3+} **(b)** Co^{3+}

(c) Mn^{2+} **(d)** Mn^{3+} **1**

Ans. Option (d) is correct

Explanation: Co^{3+}

Co = Electronic configuration is [Hr] $3d^7\ 4s^2$

$Co^{3+} = 3d^6$.

7. Which of the following aqueous solution will have highest boiling point? 1

(a) 1.0 M KCl **(b)** 1.0 M K_2SO_4

(c) 2.0 M KCl **(d)** 2.0 M K_2SO_4

Ans. Option (d) is correct

Explanation: The elevation in boiling point is a colligative property that is changed by adding of impurity

$K_2SO_4 \rightarrow 2K^+ + SO_4^{2-}$

i = 3 (i = vant Hoft factor)

When higher impurities are present in a solution, the boiling point of solution increases which is directly proportional to molality of the solute and vant Hoff factor of the solution.

9. Amides can be converted into amines by the reaction named 1

(a) Hoffmann degradation

(b) Ammonolysis

(c) Carbylamine

(d) Diazotisation

Ans. Option (a) is correct

Explanation: Amide can be converted into amine by the action of $NaOH/Br_2$ which is called **H**olffmann degradation.

10. Which of the following statements is not true about glucose? 1

(a) It is an aldohexose.

(b) On heating with HI it forms n-hexane.

(c) It is present in pyranose form.

(d) It gives 2, 4 DNP test.

Ans. Option (d) is correct

For questions number 15 to 18, two statements are given - one labelled as Assertion (A) and the other labelled as Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below:

(a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

(b) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).

(c) Assertion (A) is true, but Reason (R) is false.

(d) Assertion (A) is false, but Reason (R) is true.

15. Assertion (A): Vitamin C cannot be stored in our body. 1

Reason (R) : Vitamin C is fat **soluble and is excreted from the body in urine.**

Ans. Option (c) is correct

Explanations: Vitamin C is water soluble and higher amount excreted from the body in urine

16. Assertion (A): The half life of a reaction is the time in which the concentration of the reactant is reduced to one half of its initial concentration.

Reason (R): In first order kinetics when concentration of reactant is doubled, its half life is doubled.

Ans. Option (c) is correct

17. Assertion (A): Bromination of benzoic acid gives m-bromobenzoic acid. 1

Reason (R): Carboxyl group increases the electron density at the meta position.

Ans. Option (a) is correct

18. Assertion (A): EDTA is a hexadentate ligand. 1

Reason (R): EDTA has 2 nitrogen and 4 oxygen donor atoms.

Ans. Option (a) is correct

SECTION - B

22. Write equations for the following: 2 × 1 = 2

(a) Oxidation of chloroform by air and light

(b) Reaction of chlorobenzene with CH_3Cl/anhyd. $AlCl_3$

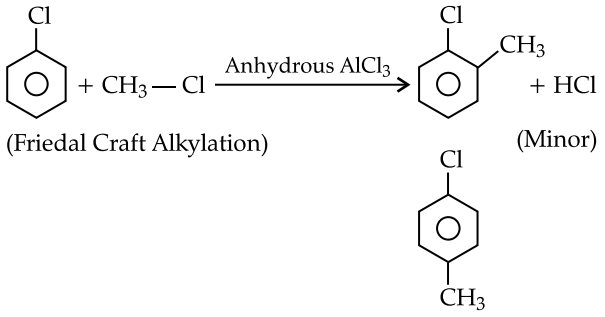
Ans. Option (a) is correct

Explanation:

(a) $CHCl_3 + [O_2] \xrightarrow{\text{sunlight}} COCl_2 + HCl$

Chloroform Phasgene

(b)



(Friedal Craft Alkylation)

SECTION - C

27. (a) On the basis of crystal field theory write the electronic configuration for d^5 ion with a weak ligand for which delta 0 < P.

(b) Explain $[Fe(CN)_6]^{3-}$ is an inner orbital complex whereas $[FeF_6]^{3-}$ is an outer orbital complex. 2

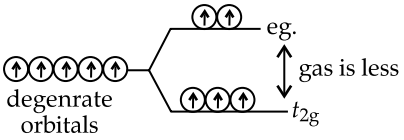
[Atomic number : Fe = 26]

Ans. It is a magnitude difference in energy between the two sets of d-orbital i.e. t_{2g} and eg electronic configuration of d^5 if $\Delta_0 < P$

then t_{2g}^3 and e_g^2

Because it follows weak field ligand phenomina when weak field ligands are present in a structure pairing of electrons do not take place.

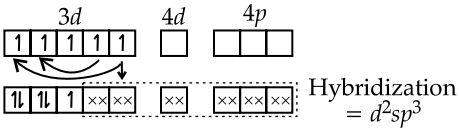
∵ so



(b) $[Fe(CN)_6]^{3-}$ = CN is strong field ligand

Fe = 26, [Ar] $3d^6\ 4s^2$

$Fe^{3+} = 3d^5$



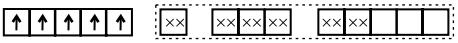
Inner d-complex

If strong field ligand is available then

$\Delta_0 > P = t_{2g}^5\ e_g$

In $[Fe(F_6)]^{3-}$, **Fe** = [Ar] $3d^6\ 4s^2$

$Fe^{3+} = 3d^5$.



Hybridization = sp^3d^2 outer *d*- complex

with a weak field ligand $\Delta_0 < P$

∵ so, there is no pairing of electrons in 3d orbitals.

SECTION - E

35. (a) A transition element X has electronic configuration |Ar| $4s^2\ 3d^3$, Predict its likely oxidation states. 1 + 1 + 3 = 5

(b) Complete the reaction mentioning all the products formed:

$2KMnO_4 \longrightarrow$

(c) Account for the following

(i) In the 3d transition series, zinc has the lowest, enthalpy of atomisation.

(ii) Cu^+ ion is unstable in aqueous solution.

(iii) Actinoids show more number of oxidation states than lanthanoids.

Ans. (a) The **X**-element is vanadium (V)
Its electronic configuration is [Ar] $3d^3\ 4s^2$
Likely oxidation state: +2, +3, +4, +5

(b) $2KMnO_4 \xrightarrow{\Delta} K_2MnO_4 + MnO_2 + O_2\uparrow$

(c) (i) Zn = 30 [Ar] $4s^2\ 3d^{10}$

The d-orbital is fully filled in zinc (**Zn**). There is no unpaired electrons are available. Inter atomic bonding is weak because of which **metallic** bond**i**ng is also weak.

(ii) Cu = [Ar] $3d^9\ 4s^2$
$= 3d^{10}\ 4s^1$

In aqueous medium it exist as Cu^+ loosing one e^- but because of high hydration enthalpy it readily converted into Cu^{2+}. It also show disproportion reaction because of which the reaction take place.

$2Cu^{2+} \longrightarrow Cu^{2+} + Cu$

(iii) Actinoids are radioactive in nature. They have almost similar enthalpy of actinides. Therefor**e**, they shows more actinoids contraction than lanthinoids contraction. They have more poor shielding of 5f orbitals than 4f orbitals.

Delhi Set-III 56/5/3

Note : Except these, all other questions are from Delhi Set-I & Set II.

SECTION - A

3. Consider the following standard electrode potential values: 1

$Sn^{2+}_{(aq)} + 2e^- \rightarrow Sn_{(s)}\ E^0 = -0.14$ V

$Fe^{3+}_{(aq)} + e^- \rightarrow Fe^{2+}_{(aq)}\ E^0 = +0.77$ V

What is the cell reaction and potential for the spontaneous reaction that occurs?

(a) $2\ Fe^{2+}_{(aq)} + Sn^{2+}_{(aq)} \rightarrow 2\ Fe^{3+}_{(aq)} + Sn_{(s)}\ E^0 = -0.91$ V

(b) $2\ Fe^{3+}_{(aq)} + Sn_{(s)} \rightarrow 2\ Fe^{2+}_{(aq)} + Sn^{2+}_{(aq)}\ E^0 = +0.94$ V

(c) $2Fe^{2+}_{(aq)} + Sn^{2+}_{(aq)} \rightarrow 2\ Fe^{3+}_{(aq)} + Sn_{(s)}$ $E^0 = +0.91$ V

(d) $2\ Fe^{3+}_{(aq)} + Sn_{(s)} \rightarrow 2\ Fe^{2+}_{(aq)} + Sn^{2+}_{(aq)}$ $E^0 = +1.68$ V

Ans. Option (b) is correct

$E° = E_C - E_a$

$= 0.77 - (-0.14) = +0.94$ V

6. The unit of molar conductivity is 1

(a) $S\ cm^{-2}\ mol^{-1}$ **(b)** $S\ cm^2\ mol^{-1}$

(c) $S^{-1}\ cm^2\ mol^{-1}$ **(d)** $S\ cm^2\ mol$

Ans. Option (d) is correct

7. Out of the following 1.0 M aqueous solutions, which one will show largest freezing point depression? 1

(a) NaCl **(b)** Na_2SO_4

(c) $C_6H_{12}O_6$ **(d)** $Al_2(SO_4)_3$

Ans. Option (d) is correct

Explanation: Because it exhibit higher number of ions after dissociation.

$$Al_2(SO_4)_3 \longrightarrow 2Al^{3+} + 3SO_4^{2-}$$

$2 + 3 = 5$

9. In the reaction 1

$C_6H_5NH_2 + CHCl_3 + 3\ KOH \rightarrow A + 3B + 3C$ the product A is

(a) C_6H_5NC **(b)** C_6H_5CN

(c) C_6H_5Cl **(d)** $C_6H_5NHCH_3$

Ans. Option (a) is correct

Explanation:

$C_6H_5NH_2 + CHCl_3 + 3KOH \rightarrow C_6H_5N \equiv C$

10. β-pleated sheet structure in proteins refers to 1

(a) primary structure **(b)** secondary structure

(c) tertiary structure **(d)** quaternary structure

Ans. Option (b) is correct

Explanation: Secondary structure of proteins consist of 2-types of parts.

(a) α-Helix **(b)** β- pleated

For questions number 15 to 18, two statements are given - one labelled as Assertion (A) and the other labelled as Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below:

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(b) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).

(c) Assertion (A) is true, but Reason (R) is false.

(d) Assertion (A) is false, but Reason (R) is true.

15. Assertion (A): The backbone of DNA and RNA molecule is a chain consisting of heterocyclic base, pentose sugar and phosphate group.

Reason (R): Nucleotides and nucleosides mainly differ from each other in presence of phosphate group.

Ans. Option (a) is correct

16. Assertion (A): Order of reaction is applicable to elementary as well as complex reactions. 1

Reason (R): For a complex reaction molecularity has no meaning.

Ans. Option (a) is correct

17. Assertion (A): The final product in Aldol condensation is always α, β- unsaturated carbonyl compound. 1

Reason (R) : α, β- unsaturated carbonyl compounds are stabilised due to conjugation.

Ans. Option (a) is correct

18. Assertion (A): $[Co(NH_3)_5\ SO_4]\ Cl$ gives a white precipitate with silver nitrate solution. 1

Reason (R): The complex dissociates to give Cl^- and SO_4^{2-} ions.

Ans. Option (c) is correct

Explanation: The complex dissociate to give Cl^-.

SECTION - B

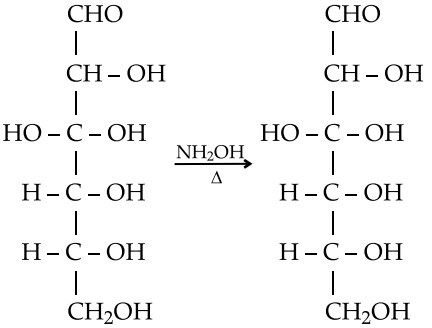
22. Why haloarenes are not reactive towards nucleophilic substitution reaction? Give two reasons. 2

Ans. 1. Halorenes are less reactive towards bonds between C – X (carbon & halogen) is shorter because benzene is sp^2 hybridized having double bond between two carbons.

2. Haloarenes shows resonating structure in which lone pair present on halogen rotates around the benzene ring and charges are delocalised which make it a stable structure and do not easily substitute the **halogen** group .

25. Give the reaction of heating glucose with hydroxylamine. Presence of which group is confirmed by this reaction? 2

Ans.



D-Glucose Oxime (aldo - oxime)

In oxime, hydroxyl group is present which is attached to nitrogen of **imine** group.

SECTION - C

27. (b) A solution of $[Ni(H_2O)_6]^{2+}$ is green but a solution of $[Ni(CO)_4]$ is colourless. Explain. 2
[Atomic number : Ni = 28]

Ans. (b) In $[Ni(H_2O)_6]^{2+}$ Ni has configuration of $3d^8$.

The two unpaired electrons do not pair up in presence of weak H_2O ligand, but in $[Ni(CO)_4]$ due to presence of strong CO ligand, it pairs up. As there is unpaired electron in $[Ni(H_2O)_6]^{2+}$ it is coloured and $[Ni(CO)_4]$ is colourless, due to absence of unpaired electrons.

SECTION - E

35. (a) Write the number of unpaired electrons in Cr^{3+}. (Atomic number of Cr = 24) 1 + 2 + 2 = 5

(b) Complete the reaction mentioning all the products formed:

$Cr_2O_7^{2-} + 3H_2S + 8H^+ \rightarrow$

(c) Account for the following:

(i) Mn^{2+} is more stable than Fe^{2+} towards oxidation to +3 state.

(ii) Copper has exceptionally positive E(M^{2+} /M) value.

(iii) Eu^{2+} with electronic configuration [Xe] $4f^7 6s^2$ is a strong reducing agent.

Ans. (a) Cr = 25, [Ar] $3d^4\ 4s^2 \rightarrow$ Ground state structure

Cr^{3+} = [Ar] $3d^4$

There are four unpaired electrons present in Cr^{3+}.

(b) $Cr_2O_7^{2-} + 3H_2S + 8H^+ \rightarrow 2Cr^{3+} + 7H_2O + 3S$
cromiumion water sulphur

(c) (i) Electronic configuration-

Mn = 25, [Ar] $3d^5\ 4s^2 \rightarrow Mn^{2+}$ = [Ar] $3d^5 \rightarrow$ donating $2e^-$

Fe = 26, [Ar] $3d^6\ 4s^2 \rightarrow Fe^{3+}$ = [Ar] $3d^5 \rightarrow$ donating $3e^-$

Mn = after loosing 2 electron 3d orbital is half filled and Mn^{2+} is stable.

Fe = After loosing three electrons 3d orbitals is half filled and more stable. That's why, Fe^{3+} is stable at +3 oxidation state and Mn^{2+} is stable in +2 oxidation state.

(ii) E° value of copper is +ve i.e, 0.34 V. This is due to presence of high enthalpy of atomization and low enthalpy of hydrogen which make it exceptionally positive.

(iii) Electronic configuration of Eu^{2+} [Xe] $4f^7\ 6s^2$

It has the tendency to loose two electron and attain a stable half filled configuration. So, it oxidized by loosing 2 electrons and reduce to other species.

Outside Delhi Set-I 56/2/1

SECTION - A

1. The conversion of an alkyl halide into an alkene by alcoholic KOH is classified as 1

(a) a substitution reaction

(b) an addition reaction

(c) a dehydrohalogenation reaction

(d) a dehydration reaction

Ans. Option (c) is correct

Explanation: dehydrohalogentation reaction: As it is accompanied by removal of one halogen molecule 1 atom.

$$CH_3 - CH_2 - X \xrightarrow[KOH]{Alc} . CH_2 = CH_2 + HX$$

2. The oxidation state of Fe in $[Fe(CO)_5]$ is 1

(a) +2 **(b)** 0

(c) +3 **(d)** +5

Ans. Option (b) is correct

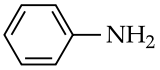
Explanation: $[Fe(CO)_5]$

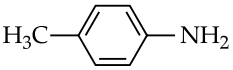
x + (0 × 6) = 0

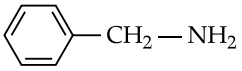
x : 0

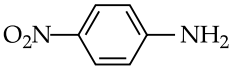
(b) 0 (Zero)

3. Among the following, which is the strongest base? 1

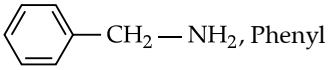
(a) 

(b) 

(c) 

(d) 

Ans. Option (c) is correct

Explanation:  , Phenyl methyl amine shows + I effect.

As lone pair of electron on N-atom is delocalised and not involved in resonance.

4. The slope in the plot of *l*n [R] vs, time for a first order reaction is 1

(a) $\frac{+k}{2.303}$ **(b)** $-k$

(c) $\frac{-k}{2.303}$ **(d)** $+k$

Ans. Option (b) is correct

Explanation: –k

$$d\frac{[R]}{dt} \propto [R] \frac{d[R]}{dt} = -K[A]\frac{d[A]}{[A]} = -Kdt$$

$$\ell n[R] = -Kt$$

5. An α-helix is a structural feature of **1**

(a) Sucrose **(b)** Polypeptides

(c) Nucleotides **(d)** Starch

Ans. Option (b) is correct

Explanation: Polypetides

6. Racemisation occurs in **1**

(a) S_N1 reaction

(b) S_N2 reaction

(c) Neither S_N1 nor S_N2 reaction

(d) S_N2 reaction as well as S_N1 reaction

Ans. Option (a) is correct

Explanation: S_N1 reaction, They are accompanied by racemization in optically active alkyl halides.

7. Value of Henry's constant K_H

(a) increases with decrease in temperature

(b) decreases with increase in temperature

(c) increases with increase in temperature

(d) remains constant

Ans. Option (c) is correct

Explanation: Increases with increase in temperature. As temperature (T) increases, the mole fraction of gas in the solution decreases and Henry's constant increases.

8. Which of the following solutions of KC*l* will have the highest value of molar conductivity? **1**

(a) 0.01 M **(b)** 1 M

(c) 0.5 M **(d)** 0.1 M

Ans. Option (a) is correct

Explanation: 0.01 M

Molar conductivity is the conductivity divided by concentration of solution expressed in molarity

$$\Lambda_m = \frac{K}{C}$$

9. Which of the following reactions are feasible? **1**

(a) $CH_3CH_2Br + Na^+ O^-C(CH_3)_3 \rightarrow CH_3CH_2–O–C(CH_3)_3$

(b) $(CH_3)_3C – Cl + Na^+ O^-CH_2CH_3 \rightarrow CH_3CH_2 – O – C(CH_3)_3$

(c) Both (a) and (b)

(d) Neither (a) nor (b)

Ans. Option (c) is correct

Explanation: In (b) Elimination will take place where, alkene and alcohol and sodium halide will be the product .So the given reaction is not feasible.

10. Which of the following is most reactive in nucleophilic addition reactions? **1**

(a) HCHO **(b)** CH_3CHO

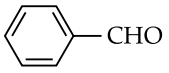
(c) CH_3COCH_3 **(d)** $CH_3COC_2H_5$

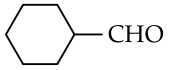
Ans. Option (a) is correct

Explanation: HCHO

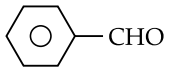
Presence of alkyl groups decrease the reactivity by decreasing the electron deficiency.

11. Which of the following does not give aldol condensation reaction? **1**

(a) $CH_3 – CHO$ **(b)** 

(c)  **(d)** CH_3COCH_3

Ans. Option (b) is correct

Explanation: 

Benzaldehyde. It does not give aldol condensation due to absence of α-H atom.

12. For the reaction $3A \rightarrow 2B$, rate of reaction $+\frac{d[B]}{dt}$ is equal to **1**

(a) $\frac{-3}{2}\frac{d[A]}{dt}$ **(b)** $\frac{-2}{3}\frac{d[A]}{dt}$

(c) $\frac{-1}{3}\frac{d[A]}{dt}$ **(d)** $+\frac{2d[A]}{dt}$

Ans. Option (b) is correct

Explanation: $3A \rightarrow 2B$

$$-\frac{1}{3}\frac{d[A]}{dt} = \frac{1}{2}\frac{d[B]}{dt}$$

(b) $-\frac{2}{3}\frac{d[A]}{dt}$

$$\Rightarrow \frac{+d[B]}{dt} = -\frac{2}{3}\frac{d[A]}{dt}$$

13. Which of the following characteristics of transition metals is associated with their catalytic activity? **1**

(a) Paramagnetic nature

(b) Colour of hydrated ions

(c) High enthalpy of atomisation

(d) Variable oxidation states

Ans. Option (d) is correct

Explanation: Variable oxidation state.

The transition elements, on account of their variable valency, are able to form unstable intermediate compounds very readily and hence show catalytic behaviour.

14. The formula of the complex dichlorobis (ethane –1, 2-diamine) platinum (IV) nitrate is **1**

(a) $[Pt\,Cl_2\,(en)_2\,(NO_3)_2]$

(b) $[Pt\,Cl_2(en)_2]\,(NO_3)_2$

(c) $[PtCl(en)_2(NO_3)]NO_3$

(d) $[Pt\ Cl_2(en)_2(NO_3)_2]Cl_2$

Ans. Option (b) is correct

Explanation: $[Pt\ Cl_2(en)_2](NO_3)_2$.

Given below are two statements labelled as Assertion (A) and Reason (R).

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.

15. Assertion (A): Osmotic pressure is a colligative property. 1

Reason (R): Osmotic pressure is proportional to the molality.

Ans. Option (c) is correct

Explanation: (A) is true, but (R) is false

Because osmotic pressure is proportional to the molarity.

16. Assertion (A): Conductivity decreases with decrease in concentration of electrolyte.

Reason (R): Number of ions per unit volume that carry the current in a solution decreases on dilution.

Ans. Option (a) is correct

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

Conductivity decreases with a decrease in concentration as the number of ions per unit volume that carries the current in a solution decrease on dilution.

17. Assertion (A): Copper is a non-transition element. 1

Reason (R): Copper has completely filled d-orbitals in its ground state.

Ans. Option (d) is correct

Explanation: (A) & (R) are true and (R) is the correct explanation of (A)

Due to high electronegativity of Cl-atom.

Because copper is a transition element.

18. Assertion (A): Nucleophilic substitution of iodoethane is easier than chloroethane.

Reason (R): Bond enthalpy of C-I bond is less than that of C-Cl bond.

Ans. Option (a) is correct

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

SECTION - B

19. The vapour pressure of pure liquid X and pure liquid Y at 25^0C are 120 mm Hg and 160 mm Hg respectively. If equal moles of X and Y are mixed to form an ideal solution, calculate the vapour pressure of the solution. 2

Ans. X = 120mm Hg, $P_A = P^0_A \cdot x_A$

Y = 160 mm Hg, $P_B = P^0_B \cdot x_B$

$\because$ When equal amount of X and Y are mixed

$x_A + x_B = 1$

Acc. to Raoutt's law

$P_{total} = P_A + P_B$

$P^0_A, x_A + P^0_B, x_B$

$= (1-x_B) P^0_A + x_B P^0_B$

$P_{Total} = P^0_A + (P^0_B - P^0_A) x_B$

$= 120 + (160 - 120) \times 1$

$P_{Total} = 120 + 40$

$= 160$ mmHg

20. (a) Give reasons: 2 × 1

(i) Mercury cell delivers a constant potential during its life time.

(ii) In the experimental determination of electrolytic conductance, Direct Current (DC) is not used.

OR

(b) Define fuel cell with an example. What advantages do the fuel cells have over primary and secondary batteries? 2

Ans. (a) (i) as the overall reaction does not involve any ion in the solution whose concentration changes during its life period.

(ii) If we apply DC current through the conductivity cell, it will lead to the electrolysis of the solution taken in the cell, So, AC current is used for this measurement to prevent its electrolysis.

[OR]

(b) Fuel cell : A fuel cell is an electrochemical cell that generates electricity/electrical energy from fuel via an electrochemical reaction. It offers high efficiency and zero emissions. eg. The polymer electrolyte fuel cells etc.

Advantages:

Good reliability – quality of power does not degrade over time

Environmentally beneficial – greatly reduces CO_2 & harmful pollutant emission.

21. (a) The conversion of molecule A to B followed second order kinetics. If concentration of A increased to three times, how will it affect the rate of formation of B? 2 × 1

(b) Define Pseudo first order reaction with an example

Ans. (a) Reaction is $A \rightarrow B$ for second order kinetics

$(Rate)_1 = K[A]^2$

$(Rate)_2 = K[3A]^2 = 9K[A]^2$

$(Rate)_2 = 9 \times (Rate)_1$

So the rate of formation of B will increase by 9 times.

(b) The reaction that have higher order true rate law but are found to behave as first order are known as pseudo first order reactions.
Example : Consider the acid hydrolysis of methyl acetate.
$CH_3COOCH_{3(ag)} + H_2O_{(e)} \rightarrow CH_3COOH_{(ag)} + CH_3OH_{(ag)}$

22. (a) Write the IUPAC names of the following: 2 × 1
(i) $[CO(NH_3)_5(ONO)]^{2+}$
(ii) $K_2[NiCl_4]$

OR

(b) (i) What is a chelate complex? Give one example.
(ii) What are heteroleptic complexes? Give one example. 2 × 1

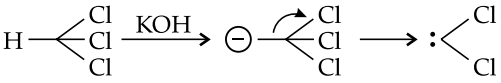
Ans. (a) (i) $[Co(NH_3)_5(ONO]^{2+}$
IUPAC : Pentaammine **o**nitrito cobalt (III) ion
(ii) K_2 $[NiCl_4]$
potassiumtetra chlornickelate (II)

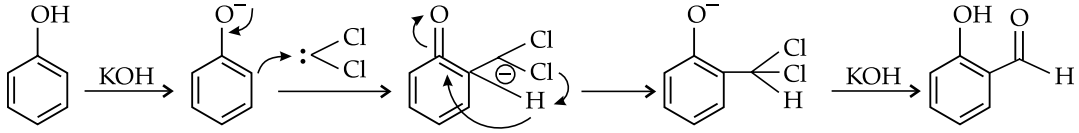
[OR]

(b) (i) Chelate complex: A class of coordination or complex compounds consisting of a central metal atom attached through two or more co-ordinate bonds with ligands in a cyclic or sing structure. example : EDIA
(ii) Heteroleptic complex: Coordination complexes which contain more than one type of ligands Example: $[Fe(NH_3)_4Cl_2]^+$

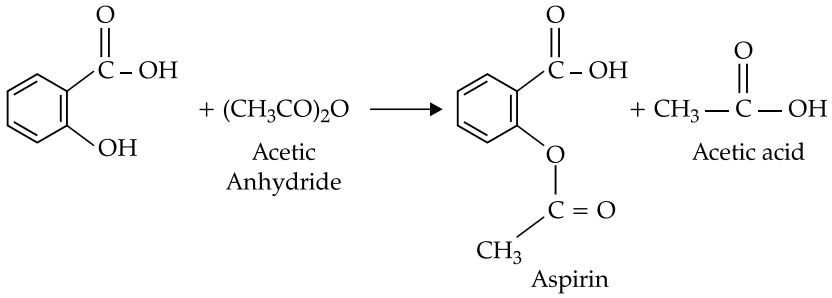
23. Write the chemical equation involved in the following reactions: 2 × 1
(a) Reimer-Tiemann reaction
(b) Acetylation of Salicylic acid

Ans. (a) Reimer- Tiemann Reaction.
It is used for ortho-formylation of phenole





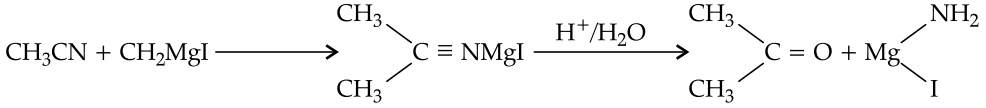
(b) Acetylation of salicylic Acid



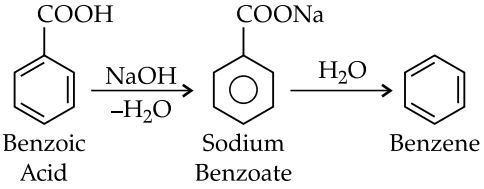
24. Do the following conversions in not more than two steps: 2 × 1
(a) CH_3 CN to $CH_3 — C(=O) — CH_3$
(b)  **to**

Ans. CH_3CN to $CH_3 — C(=O) — CH_3$

$CH_3CN + CH_3MgI \rightarrow (CH_3)_2$ CN Mg I $\xrightarrow[-NH_3]{H_2O/H^+}$ CH_3COCH_3



(b) Benzoic Acid to benzene



25. Write two differences between DNA and RNA. **1 × 2**

Ans.

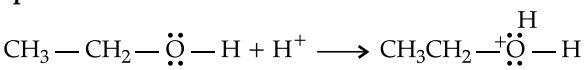
DNA	RNA
1) Sugar moiety is deoxy ribose.	1) Sugar moiety is ribose.
2) It is polymer of long chain of **n**ucleotide	2) It is polymer of nucleo-side
3) Base pairs are A, I, G, C	3) Base pairs are A, U, G, C

SECTION - C

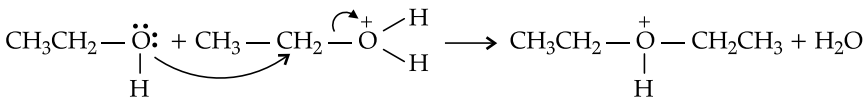
26. (a) (i) Write the mechanism of the following reaction: **2 + 1**

$$2CH_3CH_2OH \xrightarrow[413K]{H} CH_3 - CH_2 - O - CH_2 - CH_3 + H_2O$$

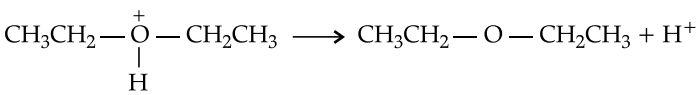
Step I :



Step II



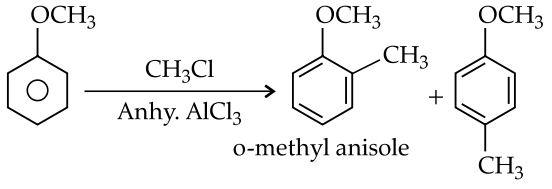
Step III:

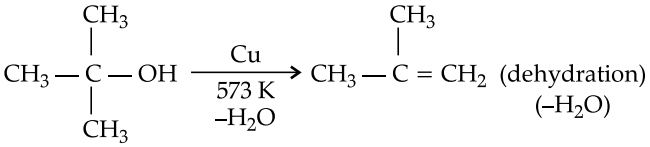


(ii) Para-nitro phenol has higher boiling point than ortho-nitrophenol due to intermolecular hydrogen bonding present in para-nitrophenol, which require more energy to break these bonds during boiling. In o-nitrophenol intramolecular hydrogen bonding is present to greater extent. Thus o-nitrophenol is stream volatile due to low boiling point.

[OR]

b(i) Friedel craft Alkylation reaction will **take place.**





(ii) Why ortho-nitrophenol is steam volatile while para-nitrophenol is not?

OR

(b) What happens when **3 × 1**

(i) Anisole is treated with CH_3Cl anhydrous $AlCl_3$?

(ii) Phenol is oxidised with $Na_2Cr_2O_7/H^+$?

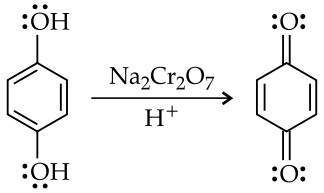
(iii) $(CH_3)_3$ C – OH is heated with Cu/573 K?

Write chemical equation in support of your answer.

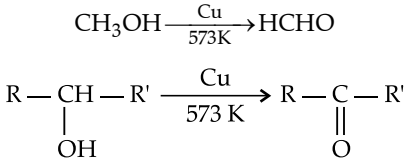
Ans. Option (a) is correct

Explanation: (i) Mechanism : Follows S_N2 Mechanism

(ii) A conjugated diketone is produced Benzoquinone,



(iii) Dehydration takes place and alkene is formed.



27. Answer any three of the following: **3 × 1**

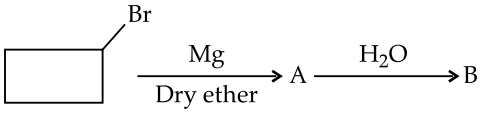
(a) Which isomer of C_5H_{10} gives a single monochloro compound C_5H_9Cl in bright sunlight?

(b) Arrange the following compounds in increasing order of reactivity towards S_N2 reaction:

2-Bromopentane, 1-Bromopentane, 2-Bromo-2-methylbutane

(c) Why p-dichlorobenzene has higher melting point than those of ortho and meta-isomers?

(d) Identify A and B in the following:

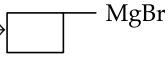


Ans. (a) The hydrocarbon is either alkene or cycloalkane. It does not react with chlorine in dark. Hence it cannot be alkene. Hence, it is cycloalkene. The compound is cyclopentane.

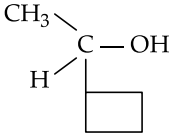
Cyclopentane (C_5H_{10})

(b) 2-Bromo-2-methylbutane <2-Bromopentane <1-Bromopentane.

(c) It is due to greater symmetry of para-isomer that fits in the crystal better as compared to o- & m-isomers.

(d) A →  MgBr

Cyclobutyl magnesium bromide.

B → 

1-cyclobutyl ethanol

28. A first order reaction is 50% complete in 30 minutes at 300 K and in 10 minutes at 320 K. Calculate activation energy (E_a) for the reaction.
[R = 8.314 J K^{-1} mol^{-1}] **3**
[Given : log 2 = 0.3010, log 3 = 0.4771, log 4 = 0.6021]

Ans. K_1 at 27 ^{0}C or 300K = $\frac{0.693}{30\,\text{min}} = 0.0231\,\text{min}^{-1}$

K_2 at 47 ^{0}C or 320K_1 = $\frac{0.693}{10\,\text{min}} = 0.0693\,\text{min}^{-1}$

Using Arrhenius equation:

$$\log\left(\frac{K_2}{K_1}\right) = \frac{Ea}{2.303\,R}\left(\frac{T_2 - T_1}{T_1T_2}\right)$$

$$\log\left(\frac{0.0693}{0.0231}\right) = \frac{Ea}{2.303 \times 8.314 \times 10^{-3}\,\text{kj mol}^{-1}\text{K}^{-1}}\left(\frac{20}{300 \times 320}\right)$$

E_a = 43.85 kj/mol.

29. When 19.5 g of F – CH_2 – COOH (Molar mass = 78 g mol^{-1}), is dissolved in 500 g of water, the depression in freezing point is observed to be 1 ^{0}C. Calculate the degree of dissociation of F – CH_2 – COOH.
[Given : K_f for water = 1.86 K kg mol^{-1}] **3**

Ans. Molecular mass of 78g/mol
(F – CH_2COOH)

No. of moles of fluoroacetic acid is $\frac{19.5}{78} = 0.25$

Molality is the number of moles of solute in 1kg of solvent

Molality = $\frac{0.25}{\frac{500}{1000}} = 0.50$ m

$\Delta T_f = K_f \times m = 1.86 \times 0.50 = 0.93$ K

$i = \frac{1.0}{0.93} = 1.0753$

$CH_2FCOOH \rightarrow CH_3FCOO^- + H^+$

$C(1-\alpha)$ $C\alpha$ $C\alpha$

Total number of moles = $C(1-\alpha) + C\alpha + C\alpha = C(1+\alpha)$

$i = \frac{C(1+\alpha)}{C} = 1 + \alpha = 1.0753$

$\alpha = 0.0753$

(ii) ($\alpha = 0.50 \times 0.0753 = 0.03765$

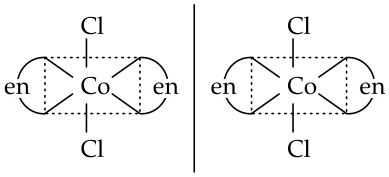
$C(1-\alpha) = 0.50\,(1 - 0.0753) = 0.462$

30. (a) Draw the geometrical isomers of $[Co(en)_2Cl_2]^{2+}$. Which geometrical isomer of $[Co(en)_2Cl_2]^{2+}$ is not optically active and why? **2 + 1**

(b) Write the hybridisation and magnetic behaviour of $[CoF_6]^{3-}$.
[Given: Atomic number of Co = 27]

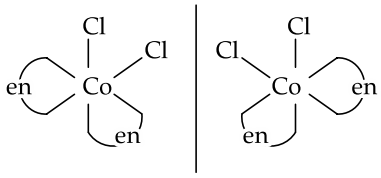
Ans. (a) Geometrical isomers of $[Co\,(en)_2\,Cl_2]^{2+}$

Trans-isomer



Optically inactive due to (super impossible mirror images)

Cis-isomer



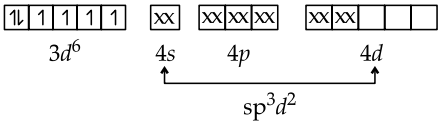
Optically active due to (non-super-impossible mirror images)

(b) $[CoF_6]^{3-}$

Co (g.s.).. (Z=27) ⇅⇅111 ⇅ ☐☐☐ ☐☐☐☐☐

$3d^7$ $4s^2$ $4p$ $4d$

$5p^3d^2$ hydridsed orbital in Co^{3+}



$\because$ it contains unpaired electrons

it is paramagnetic in nature

SECTION - D

The following questions are case based questions. Read the passage carefully and answer the questions that follow:

31. The carbon - oxygen double bond is polarised in aldehydes and ketones due to higher electronegativity of oxygen relative to carbon. Therefore they undergo nucleophilic addition reactions with a number of nucleophiles such as HCN, $NaHSO_3$, alcohols, ammonia derivatives and **Grignard** reagents. Aldehydes are easily oxidised by mild oxidising agents as compared to ketones. The carbonyl group of carboxylic acid does not give reactions of aldehydes and ketones. Carboxylic acids are considerably more acidic than alcohols and most of simple phenols.

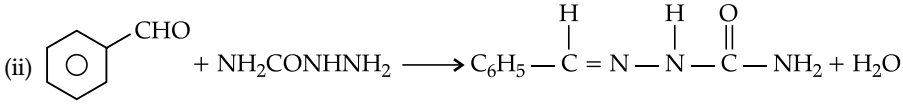
Answer the following:

(a) Write the name of the product when an aldehyde reacts with excess alcohol in presence of dry HCl. 1

(b) Why carboxylic acid is a stronger acid than phenol? 1

(c) (i) Arrange the following compounds in increasing order of their reactivity towards CH_3MgBr:

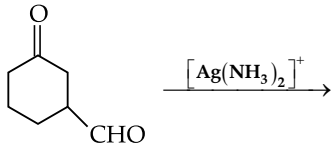
CH_3CHO, $(CH_3)_3C-\overset{\overset{O}{\|}}{C}-CH_3$, $CH_3-\overset{\overset{O}{\|}}{C}-CH_3$

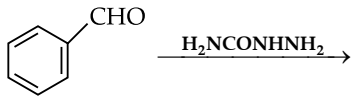


(ii) Write a chemical test to distinguish between propanal and propanone. 2 × 1

OR

(c) Write the main product in the following: 2 × 1

(i) 

(ii) 

Ans. (a) It yield alkoxyalcohol intermediate, known as hemiacetals which further reacts to give gem-dialkoxy compound known as acetal.

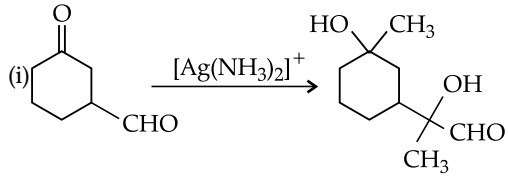
(b) Due to the resonance in carboxylic acids, the negative atom (oxygen atom), whereas, in alcohol or phenols, the negative charge is on the less electronegative atom.

(c) (i)

$(CH_3)C-\overset{\overset{O}{\|}}{C}-CH_3 < CH_3-\overset{\overset{O}{\|}}{C}-CH_3 < CH_3CHO$

(iii) We can use iodoform test to distinguish between propanol and propanone as aldehyde group shows this test where as ketones does not.

OR

(c) (i) 

32. Carbohydrates are optically active polyhydroxy aldehydes and ketones. They are also called saccharides. All those carbohydrates which reduce Fehling's solution and Tollen's reagent are referred to as reducing sugars. Glucose, the most important source of energy for mammals, is obtained by thy hydrolysis of starch. Vitamins are accessory food factors required in the diet. Proteins are the polymers of α-amino acids and perform various structural and dynamic functions in the organisms. Deficiency of vitamins leads to many diseases.

Answer the following:

(a) The penta-acetate of glucose does not react with Hydroxylamine. What does it indicate? 1

(b) Why cannot vitamin C be stored in our body? 1

(c) Define the following as related to proteins:

(i) Peptide linkage

(ii) Denaturation 2 × 1

OR

(c) Define the following as related to carbohydrates:

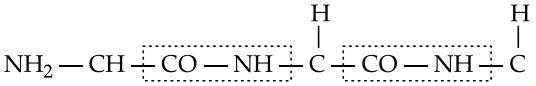
(i) Anomers

(ii) Glycosidic linkage 2 × 1

Ans. (a) It indicate the absence of free-CHO group.

(b) As it is water-soluble. It is hard to be stored in our body. It is usually secreted via urine.

(c) (i) Peptide linkage is an amide formed between two amino acid known as peptide bond.



(iii) Denaturation: The unfolding or breaking up of a protein converted into primary structure in which linear chairs of amino acids are attached.

OR

(c) (i) Anomers are cyclic monosaccharides or glycosides that are epimers, differing from each other in the configuration of C-2 of they are ketoses.

(ii) The two monosaccharides joined together by a glycosidic linkage formed by the loss of a water molecule for eg C_1 of α-D-glucose and C_2 of β-D-fructose are held together by glycosidic linkage.

SECTION - E

33. (a) (I) Account for the following: 3 + 2

(i) Eº value for Mn^{3+}/Mn^{2+} couple is much more positive than that for Cr^{3+}/Cr^{2+}.

(ii) Sc^{3+} is colourless whereas Ti^{3+} is coloured in an aqueous solution.

(iii) Actinoids show wide range of oxidation states.

(II) Write the chemical equations for the preparation of $KMnO_4$ from MnO_2.

OR

(b) (I) Account for the following : 2 + 2 + 1

(i) Transition metals form alloys.

(ii) Ce^{4+} is a strong oxidising agent.

(II) Write one similarity and one difference between chemistry of Lanthanoids and Actinoids.

(III) Complete the following ionic equation:

$$Cr_2O_7^{2-} + 2OH^- \rightarrow$$

Ans. (a) (I) (i) Because Mn^{3+} has the outer electronic configuration of $3d^4$ & Mn^{2+} has the outer electron configuration of $3d^5$. Thus the conversion is favourable.

However in case of Cr^{3+}/Cr^{2+} undergoes a change in outer configuration from $3d^3$ to $3d^4$ which is not stable.

(ii) Due to absence of unpaired electron Sc^{3+} is colourless and due to presence of one unpaired electron d-d transition takes place making Ti^{3+} coloured in nature.

(iii) It is due to comparable energies of 5f, 6d and 7s orbitals.

(II)

$$2MnO_2 + 4KOH + O_2 \xrightarrow{\Delta} 2K_2MnO_4 + 2H_2O$$

$$3K_2MnO_4 \xrightarrow{4HCl} 2KMnO_4 + MnO_2 + 2H_2O + 4KCl$$

OR

(b) (I) (i) The atomic radii of the transition elements in any series are not much different from each other. As a result they can very easily replace each other in the lattice and form alloys.

(ii) Ce^{4+} has the tendency to accept one electron to get the +3 oxidation state, hence Ce^{+4} is a good oxidising agent.

(II) In case of lanthonoids, differentiating electron enters in 4f orbital whereas in case of Actinoids it enters in 5f orbital.

They both have (3+) as their most common oxidation state.

(III) $Cr_2O_7^{2-} + 2OH^- \longrightarrow 2CrO_4^{2-} + H_2O$

34. (a) (I) Give reasons: 3 + 2

(i) Aniline on nitration gives good amount of m-nitroaniline, though - NH_2 group is o/p directing in electrophilic substitution reactions.

(ii) $(CH_3)_2$ NH is more basic than $(CH_3)_3$ N in an aqueous solution.

(iii) Ammonolysis of alkyl halides is not a good method to prepare pure primary amines.

(II) Write the reaction involved in the following:

(i) Carbyl amine test

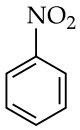
(ii) Gabriel phthalimide synthesis

OR

(b) (I) Write the structures of A, B and C in the following reactions: 3 + 1 + 1

(i) 

$$\xrightarrow{CuCN} A \xrightarrow{H_2O/H^+} B \xrightarrow[\Delta]{NH_3} C$$

(ii) 

$$\xrightarrow{Fe/HCl} A \xrightarrow[273\ K]{NaNO_2+HCl} B \xrightarrow{C_2H_5OH} C$$

(II) Why aniline does not undergo Friedal-Crafts reaction?

(III) Arrange the following in increasing order of their boiling point:

C_2H_5OH, $C_2H_5NH_2$, $(C_2H_5)_3N$

Ans. (a) (I) (i) Nitration is carried out in an acidic medium. In a strongly acidic medium, aniline is protonated to give anilinium ion which is meta-directing. Therefore, aniline on nitration gives a substantial amount of m-nitroaniline.

(ii) $(CH_3)_2$ NH is more basic than $(CH_3)_3N$ in an aquous solution. As the number of methyl groups increases, the extent of hydration decreases due to steric hindrance. Greater is the extent of hydration,

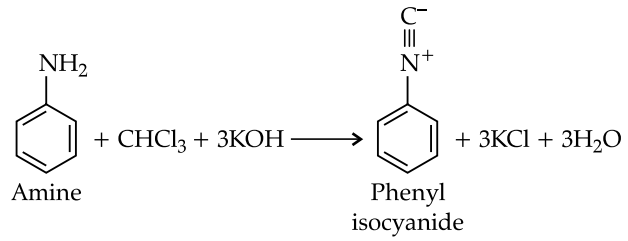
greater is the stability of ion and greater is the basic strength of amine.

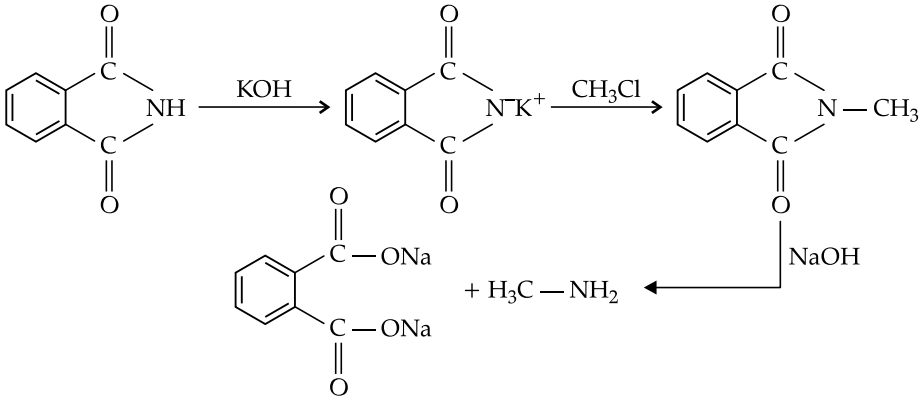
(iii) Ammonolysis of alkyl halides leads to the formation of a mixture of primary, secondary, tertiary amines and quaternary salts which is very difficult to separate and obtain pure amine.

(II) (i) Carbyl Amine Test

$$CH_3CH_3NH_3 + CHCl_3 + 3KOH \rightarrow CH_3CH_2NC + 3KCl + 3H_2$$

Ethyl amine — Alcoholic — Ethyl isocyanide



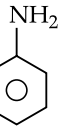


OR

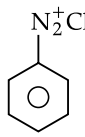
(b) (I) (i)

$$C_6H_5N_2Cl \xrightarrow{CuCN} \underset{(A)}{C_6H_5CN} \xrightarrow[H^+]{H_2O} \underset{(B)}{C_6H_5COOH}$$

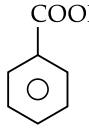
$$\xrightarrow{NH_3} (C_6H_5COONH_4) \xrightarrow[-H_2O]{\Delta} \underset{(C)}{C_6H_5CONH_2}$$

(ii) A → 

Aniline

B → 

Benzene Diazonium chloride

C → 

Benzoic acid

(II) It is due to the fact that $AlCl_3$ being electron deficient acts as a Lewis base and attacks on the lone pair of nitrogen present in aniline to form insoluble complex which precipitates out and does not proceed.

(III) Increasing order of boiling points:

$$(CH_3)_3N < C_2H_5NH_2 < C_2H_5OH$$

35. (a) Conductivity of 2×10^{-3} M methanoic acid is 8×10^{-5} S cm^{-1}. Calculate its molar conductivity and degree of dissociation if $\wedge_m^o$ for methanoic acid is 404 S cm^2 mol^{-1}.
3 + 2

(b) Calculate the Δ_rG^0 and log K_c for the given reaction at 298 K:

$Ni_{(s)} + 2Ag^+_{(aq)} \rightleftharpoons Ni^{2+}_{(aq)} + 2Ag_{(s)}$

Given : $E^0_{N_i\,2+/N_i} = -0.25V, E^0_{Ag+/Ag} = +0.80$ V

1F = 96500 C mol^{-1}.

Ans. (a) Molar conductivity

$$\Lambda_m = \frac{\kappa \times 1000}{C} = \frac{8 \times 10^{-5} S\ cm^{-1} \times 1000}{2 \times 10^{-3} mol\ L^{-1}}$$

$$= \frac{8 \times 10^{-2}}{2 \times 10^{-3}} = 40\ S\ cm^2\ mol^{-1}$$

Degree of dissociation

$$\frac{\Lambda_m}{\Lambda^\circ_m} == \frac{40}{404} = 0.099$$

(b) $Ni \longrightarrow Ni^{2+}\ (E_0 = -0.25V)$(Oxidation half)

$2Ag^+ \longrightarrow 2Ag\ (E_0 = 0.80V)$(Reduction half)

$E^\circ = E_c - E_a = 0.80 - (-0.25) = 1.05\ V$

$\Delta G = nFE^\circ$

$= 2 \times 96500 \times 10.5$

$= 202.650\ J\ mol^{-1}$

$= 202.650\ kJ\ mol^{-1}$

$$E^\circ_{cell} = \frac{0.0591}{n} \log K_c$$

$$\log K_c = \frac{1.05 \times 2}{0.0591} = 35.53$$

By taking Antilog

Antilog 35.35

$= 10^{53} \times 3.38$

$\because$ So $K_c = 3.38 \times 10^{53}$

Outside Delhi Set-II 56/2/2

Note : Except these, all other questions are from Outside Delhi Set-I.

SECTION - A

1. Which of the following belongs to the class of Vinyl halides?

(a) $CH_2 = CHCH_2CH_2Cl$

(b) $CH_2 = C(Br) - CH_3$

(c) $CH_2 = CH-CH_2-Br$

(d) $CH \equiv C-Br$

Ans. **(b)** $CH_2 = C(Br) - CH_3$

(Because vinyl halides are alkenyl group with formula RCHCHX)

2. What is the secondary valency of Cobalt in $[Co(en_2)Cl_2]^+$? 1

(a) 6 **(b)** 4

(c) 2 **(d)** 8

Ans. (a) 6 (Because it has six legands surrounding it)

3. When Benzene diazonium chloride reacts with phenol, it forms a dye. This reaction is called 1

(a) Diazotisation reaction

(b) Condensation reaction

(c) Coupling reaction

(d) Acetylation reaction

Ans. (c) coupling reaction

(It is joining of two chemical species with acid of metal catalyst)

5. Proteins are polymers of 1

(a) Nucleic acids **(b)** Amino acids

(c) Monosaccharides **(d)** Amines

Ans. (b) Amino acids (Because amino acids are linked by amide bonds)

6. Retention of configuration is observed in

(a) S_N1 reaction

(b) S_N2 reaction

(c) Neither S_N1 nor S_N2 reaction

(d) S_N2 reaction as well as S_N1 reaction

Ans. (a) S_N1 reaction (Because symmetry is same before and after the reaction

7. An azeotropic mixture of two liquids will have a boiling point lower than either of the two liquids when it 1

(a) shows a negative deviation from Raoult's law

(b) forms an ideal solution

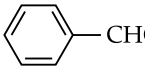
(c) shows a positive deviation from Raoult's law

(d) is saturated

Ans. (c) Shows a positive deviation from raoult's law

9. Which of the following does not give Cannizaro reaction? 1

(a) $(CH_3)_3C - CHO$ **(b)** $(CH_3)_2CH - CHO$

(c)  **(d)** HCHO

Ans. (b) $(CH_3)_2CH - CHO$ (Because it is not generating primary alcohol and carboxylic acid)

11. Aldehydes and ketones react with hydroxylamine to form 1

(a) hydrazones **(b)** cyanohydrins

(c) semicarbazones **(d)** Oxime

Ans. (d) Oxime

14. Which one among the following metals of 3d series has the lowest melting point? 1

(a) Fe **(b)** Mn

(c) Zn **(d)** Cu

Ans. (c) Zn (Zinc) (Because of fully filled configuration)

Given below are two statements labelled as Assertion (A) and Reason (R).

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.

15. Assertion (A): Elevation in boiling point is a colligative property. 1

Reason (R): The lowering of vapour pressure of solution causes elevation in boiling point.

Ans. (c) (A) is true, but (R) is false

Osmotic pressure depends upon the number of solute dissolve in per litre of solution.

16. Assertion (A): Chlorobenzene is resistant to electrophilic substitution reaction. 1

Reason (R): C-C*l* bond in chlorobenzene acquires partial double bond characters due to resonance.

Ans. (d) (A) is false but (R) is true.

18. Assertion (A): Transition metals have high enthalpy of atomisation. 1

Reason (R): Greater number of unpaired electrons in transition metals results in weak metallic bonding.

Ans. (c) (A) is true but (R) is false.

SECTION - B

23. (a) What is the difference between a nucleoside and nucleotide? 2 × 1

(b) What products would be formed when a nucleotide from DNA containing thymine is hydrolysed?

Ans. (a) Nucleotide is composed of a nitrogenous base, sugar and a phosphate group where as Nucleoside is composed of only a nitrogenous base and a phosphate group

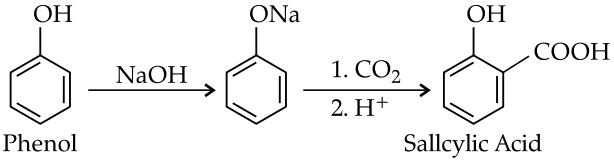
(b) Thymine β-D-2- de oxyribose and phosphoric acid are obtained as products.

24. Write the chemical equation involved in the following: 2 × 1

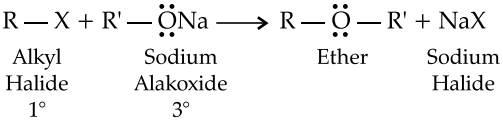
(a) Kolbe's reaction

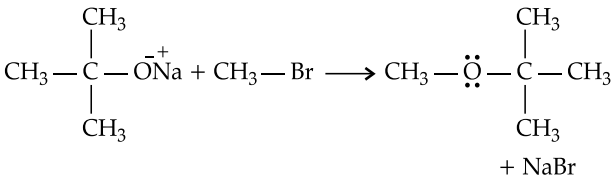
(b) Williamson synthesis

Ans. (a) Kolbe's Reaction



(b) Williamson synthesis





Outside Delhi Set-III 56/2/3

Note : Except these, all other questions are from Outside Delhi Set-I & Set-II.

SECTION - A

1. Auto oxidation of chloroform in air and sunlight produces a poisonous gas known as 1

(a) Tear gas **(b)** Mustard gas

(c) Phosgene gas **(d)** Chlorine gas

Ans. (c) Phosgene gas

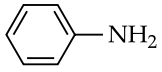
2. Which of the following ligands is an ambidentate ligand? 1

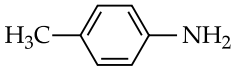
(a) CO **(b)** NO_2

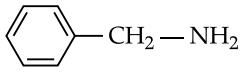
(c) NH_3 **(d)** H_2O

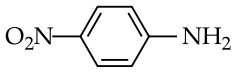
Ans. (b) NO_2 (Because it has two donor atoms)

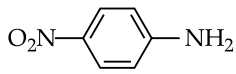
3. Among the following, which has the highest value of p^Kb? 1

(a) 

(b) 

(c) 

(d) 

Ans. (d)  (Large value of PK_b indicates a weak base)

5. When D-glucose reacts with HI, it forms 1

(a) Gluconic acid **(b)** n-hexane

(c) Saccharic acid **(d)** Iodohexane

Ans. (b) n-hexane (Because HI is reducing agent)

6. Inversion of configuration occurs in 1

(a) S_N2 reaction

(b) S_N1 reaction

(c) Neither S_N2 nor S_N1 reaction

(d) S_N1 as well as S_N2 reaction

Ans. (b) S_N1 reaction (Because it is a unimolicular reaction)

7. Solubility of gas in liquid decreases with increase in **1**

(a) Pressure

(b) Temperature

(c) Volume

(d) Number of solute molecules

Ans. (b) Temperature. (Because they will have more kinetic energy)

8. Which of the following relations is incorrect? **1**

(a) $R = \frac{1}{k}\left(\frac{l}{a}\right)$ **(b)** $G = k\left(\frac{a}{l}\right)$

(c) $G = k\left(\frac{l}{a}\right)$ **(d)** $\wedge_m = \frac{k}{c}$

Ans. (b) $G = K\left(\frac{a}{\ell}\right)$

9. The reagent that can be used to distinguish acetophenone and benzophenone is **1**

(a) 2, 4-dinitrophenyl hydrazine

(b) aqueous $NaHSO_3$

(c) Fehling solution

(d) I_2 and NaOH

Ans. (d) I_2 and NaOH

11. Which of the following compounds will undergo self-condensation in the presence of dilute NaOH solution? **1**

(a) C_6H_5CHO **(b)** CH_3CH_2CHO

(c) $(CH_3)_3$ C–CHO **(d)** H–CHO

Ans. (b) CH_3CH_2CHO (Because it contains α-Hydrogen)

13. Which of the following transition metals shows +1 and +2 oxidation states? **1**

(a) Mn **(b)** Zn

(c) Sc **(d)** Cu

Ans. (d) Cu (due to its electronic configuration)

14. The formula of the complex Iron (III) hexacyanidoferrate (II) is: **1**

(a) $Fe_2\,[Fe(CN)_6]_3$ **(b)** $Fe_4\,[Fe(CN)_6]_3$

(c) $Fe\,[Fe(CN)_6]$ **(d)** $Fe_3\,[Fe(CN)_6]_2$

Ans. (b) $Fe_4[Fe(CN)_6]_2$

Given below are two statements labelled as Assertion (A) and Reason (R).

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.

15. Assertion (A): The enthalpy of mixing Δ_{mix} H is equal to zero for an ideal solution. **1**

Reason (R): For an ideal solution the interaction between solute and solvent molecules is stronger than the interactions between solute-solute or solvent-solvent molecules.

Ans. (c) (A) is true but (R) is false.

(For ideal solution all interaction are equal)

16. Assertion (A): Molar conductivity decreases with increase in concentration. **1**

Reason (R): When concentration approaches zero, the molar conductivity is known as limiting molar conductivity.

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

17. Assertion (A): Transition metals show their highest oxidation state with oxygen. **1**

Reason (R): The ability of oxygen to form multiple bonds to metals.

Ans. (c) (A) is true but (R) is false

(It is because of its small size and elctronegativity)

18. Assertion (A): Chlorobenzene is resistant to nucleophilic substitution reaction at room temperature. **1**

Reason (R): C-C*l* bond gets weaker due to resonance.

Ans. (c) (A) is true but (R) is false.

SECTION - B

19. What are nucleic acids? Why two strands in DNA are not identical but are complementary? **1 × 2**

Ans. Nucleic Acids: They are naturally occurring chemical compounds that serve as the primary information-carrying molecules in cells. Two main classes are DNA and RNA.

Two main strands are held together by hydrogen bonds between specific pair of bases. Cytosine forms hydrogen bond with guanine while adenine forms hydrogen bonds with thymine. As a result they are complementary to each other.

❑❑