Class: XII
SESSION : 2022-2023
SUBJECT: Chemistry
SAMPLE QUESTION PAPER - 16
with SOLUTION

MM: 70 **Time: 3 hours**

General Instructions:

Read the following instructions carefully.

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

Section A

1. Use the data given in and find out the most stable ion in its reduced form. **[1]**

$E^{\ominus}_{Cr_2O_7^{2-}/Cr^{3+}} = 1.33$ V $E^{\ominus}_{Cl_2/Cl^-} = 1.36$ V

$E^{\ominus}_{MnO_4^-/Mn^{2+}} = 1.51$ V $E^{\ominus}_{Cr^{3+}/Cr} = -0.74$ V

a) Cl^- b) Cr^{3+}

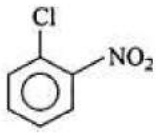
c) Mn^{2+} d) Cr

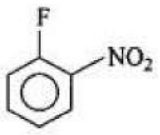
2. The minimum number of carbon atoms that should be present in carbohydrate is: **[1]**

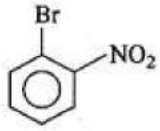
a) 6 b) 2

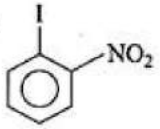
c) 4 d) 3

3. Which of the following compounds will undergo substitution of the halogen atom most readily with CH_3ONa in CH_3OH? **[1]**

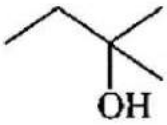
a) 

b) 

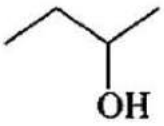
c) 

d) 

4. Which of the following has maximum pK_a value? [1]

a) 

b) 

c) 

d) 

5. For decolourization of 1 mole of $KMnO_4$, the moles of H_2O_2 required is (in acidic medium) [1]

a) 7/2 b) 5/2

c) 3/2 d) 1/2

6. Colligative properties are: [1]

a) none of these b) intensive

c) extensive d) additive

7. $CH_3COCl + C_2H_5OH \xrightarrow{Pyridine} CH_3COOC_2H_5 + HCl$ [1]

The function of pyridine in the above reaction is:

a) none of these b) to catalyse the reaction

c) both to absorb liberated HCl and catalyse the reaction d) to absorb liberated HCl

8. On dissolving sugar in water at room temperature solution feels cool to touch. Under which of the following cases dissolution of sugar will be most rapid? [1]

a) Powdered sugar in hot water b) Sugar crystals in hot water

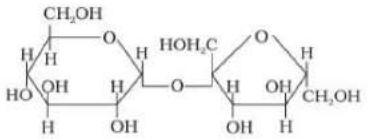
c) Powdered sugar in cold water d) Sugar crystals in cold water

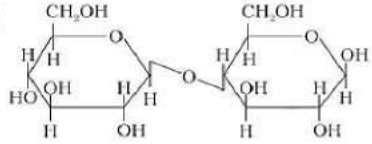
9. Rust is a mixture of: [1]

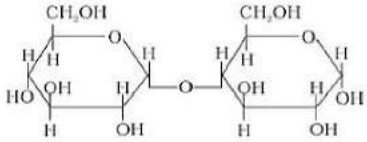
a) Fe_2O_3 and $Fe(OH)_3$ b) FeO and $Fe(OH)_2$

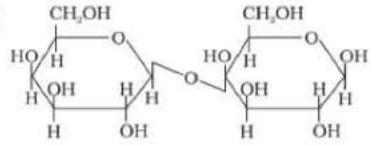
c) FeO and $Fe(OH)_3$ d) Fe_3O_4 and $Fe(OH)_3$

10. In disaccharides, if the reducing groups of monosaccharides i.e. aldehydic or ketonic groups are bonded, these are non-reducing sugars. Which of the following disaccharide is a non-reducing sugar? **[1]**

a) 

b) 

c) 

d) 

11. Which of the following alcohols will yield the corresponding alkyl chloride on reaction with concentrated HCl at room temperature? **[1]**

a) $CH_3CH_2—CH_2—OH$

b) $CH_3CH_2-\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}}-OH$

c) $CH_3CH_2-\underset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}-OH$

d) $CH_3CH_2-\underset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}-CH_2OH$

12. A reduction in atomic size with increase in atomic number is a characteristic of elements of: **[1]**

a) f-block b) radioactive series

c) d-block d) high atomic masses

13. During the passage of some charge through acidified water using Pt electrode, total 168 mL of H_2 (g) and O_2 (g) were evolved at STP. The total charge passed during electrolysis is: **[1]**

a) 965 C b) 1443 C

c) 350 C d) 482.5 C

14. The reaction obeys I order with respect to H_2 and ICl both: **[1]**

$H_2(g) + 2ICl(g) \rightarrow 2HCl(g) + I_2(g)$

Which of the following mechanism is in consistent with the given fact?

Mechanism A: $H_2(g) + 2ICl \rightarrow 2HCl(g) + I_2(g)$

Mechanism B:

i. $H_2(g) + ICl(g) \xrightarrow{\text{slow}} HCl(g) + HI(g)$

ii. $HI(g) + ICl(g) \rightarrow HCl(g) + I_2$

a) A only
b) A and B both
c) Neither A nor B
d) B only

15. **Assertion:** Phenol is a weak acid than ethanol. **[1]**
Reason: Groups with +M effect and -I affect decrease acidity at m-position.

a) If both Assertion & Reason are true and the reason is the correct explanation of the assertion.
b) If both Assertion & Reason are true but the reason is not the correct explanation of the assertion.
c) If Assertion is true statement but Reason is false.
d) If both Assertion and Reason are false statements.

16. **Assertion (A):** The nucleophilic substitution of vinyl chloride is difficult than ethyl chloride. **[1]**
Reason (R): Vinyl group is an electron-donating group.

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.

17. **Assertion (A):** The molecular weight of acetic acid determined by depression in freezing point method in benzene and water was found to be different. **[1]**
Reason (R): Water is polar and benzene is non-polar.

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.

18. **Assertion (A):** Mercury cell does not give steady potential. **[1]**
Reason (R): In the cell reaction, ions are not involved in the solution.

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.

Section B

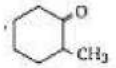
19. Mention applications of coordination compounds in following areas giving an example of each. **[2]**
(a) Analytical chemistry (b) Extraction of metals.

20. Using the valence bond approach, deduce the shape and magnetic character of $[Co(NH_3)_6]^{3+}$.[Atomic number of Co = 27] **[2]**

OR

Write the formula of the following complexes: (i) Pentaamminechlorocobalt (III) ion (ii) Lithium tetrahydro aluminate (III)

21. Write IUPAC name of the following : **[2]**



OR

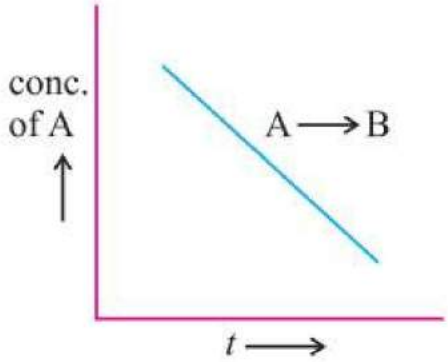
Arrange the following compounds in increasing order of their reactivity in nucleophilic addition reactions.

i. Ethanol, Propanal, Propanone, Butanone

ii. Benzaldehyde, p-Tolualdehyde, p-Nitrobenzaldehyde, Acetophenone.

Hint: Consider steric effect and electronic effect.

22. **[2]**



i. What is the order of the reaction?

ii. What is the slope of the curve?

23. Using the valence bond approach, deduce the shape and magnetic character of $[Cr(CO)_6]$. [Atomic number of Cr = 24] **[2]**

24. Write the disease caused by deficiency of vitamins A, B_2, B_6, B_{12}, C, D E and K. **[2]**

25. Mention an industrial product manufactured from methanal. **[2]**

Section C

26. An organic compound A on heating with NH_3 and cuprous oxide at high pressure gives compound B. The compound B on treatment with ice-cold solution of $NaNO_2$ and HCl gives C, which on heating with copper turning and HCl gives A again. Identify A, B & C. compound. **[3]**

27. The thermal decomposition of HCOOH is a first order reaction with a rate constant of 2.4×10^{-3} s^{-1} at a certain temperature. How long will it take for three fourth of initial quantity of HCOOH to decompose? (log 0.25 = -0.6021) **[3]**

28. Write the equation of the reaction of hydrogen iodide with: **[3]**

i. 1-propoxypropane

ii. Methoxybenzene

iii. Benzyl ethyl ether

29. Carbohydrates are essential for life in both plants and animals. Name the carbohydrates that are used as storage molecules in plants and animals, also name the carbohydrate which is present in wood or in the fibre of cotton cloth. **[3]**

OR

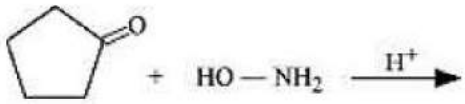
30. Explain what is meant by:

i. a peptide linkage

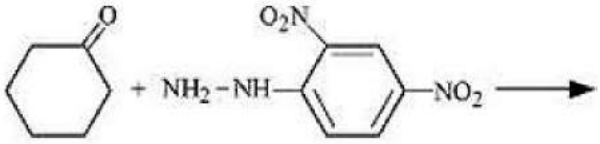
ii. a glycosidic linkage

Predict the products of the following reactions: **[3]**

i.

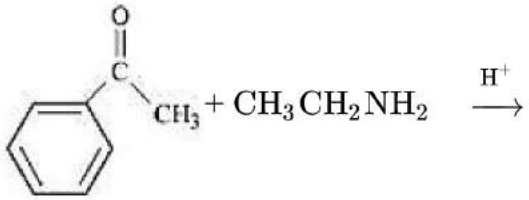


ii.



iii. $R - CH = CH - CHO + NH_2 - \overset{O}{\overset{\|}{C}} - NH_2 - NH_2 \xrightarrow{H^+}$

iv.



Section D

31. **Read the text carefully and answer the questions:** **[4]**

The boiling point elevation and the freezing point depression of solutions have a number of practical applications. Ethylene glycol ($CH_2OH{\cdot}CH_2OH$) is used in automobile radiators as an antifreeze because it lowers the freezing point of the coolant. The same substance also helps to prevent the radiator coolant from boiling away by elevating the boiling point. Ethylene glycol has a low vapour pressure. We can also use glycerol as an antifreeze. In order for boiling point elevation to occur, the solute must be non-volatile, but no such restriction applies to freezing point depression. For example, methanol (CH_3OH), a fairly volatile liquid that boils only at 65^oC is sometimes used as antifreeze in automobile radiators.

(i) Out of the CH_3OH and $C_6H_{12}O_6$, which is a better reagent for depression in freezing point but not for elevation in boiling point?

(ii) Will the depression in freezing point be same or different, if 0.1 moles of sugar or 0.1 moles of glucose is dissolved in 1 L of water?

(iii) 124 g each of the two reagents glycerol and glycol are added in 5 kg water of the radiators in the two cars. Which one is better for a car? Justify your answer.

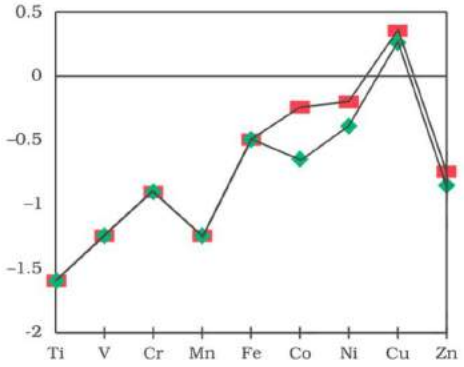
OR

If the cost of glycerol, glycol and methanol are the same, then what would be the sequence of the economy to use these compounds as antifreeze?

32. **Read the text carefully and answer the questions:** **[4]**

The unique behaviour of Cu, having a positive E° accounts for its inability to liberate H_2 from acids. Only oxidising acids (nitric and hot concentrated

sulphuric) react with Cu, the acids being reduced. 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 E° values, whereas E° for Ni is related to the highest negative $\Delta_{hyd}H°$. An examination of the $E^o_{(M^{3+}/M^{2+})}$ values the low value for Sc reflects the stability of Sc^{3+} which has a noble gas configuration. The comparatively high value for Mn shows that $Mn^{2+}(d^5)$ is particularly stable, whereas a comparatively low value for Fe shows the extra stability of Fe^{3+} (d^5). The comparatively low value for V is related to the stability of V^{2+} (half-filled t_{2g} level).



(i) Why Zn has high value for M^{3+}/M^{2+} Standard Electrode Potentials?

(ii) Transition metals, despite high E° oxidation, are poor reducing agents. Justify.

(iii) Why is Cr^{2+} reducing and Mn^{3+} oxidising when both Cr and Mn have d^4 configuration?

OR

Why Cu^{2+} is more stable than Cu^{+}?

Section E

33. i. Calculate ΔG^o for the reaction **[5]**

$Zn(s) + Cu^{2+}(aq) \rightarrow Zn^{2+}(aq) + Cu(s)$

Given: E^o for Zn^{2+}/Zn = -7.6 V and E^o for Cu^{2+}/Cu = +0.34 V

$R = 8.314\ JK^{-1}\ mol^{-1}$

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

ii. Given two advantages fo fuel cells.

OR

The resistance of a conductivity cell when filled with 0.05 M solution of an electrolytes X is 100 ohms at 40°C. The same conductivity cell filled with 0.01 M solution of electrolyte Y has a resistance of 50 ohms. The conductivity of 0.05 M solution of electrolyte X is $1.0 \times 10^{-4} S\,cm^{-1}$ calculate.

i. Cell constant

ii. Conductivity of 0.01 MY solution

iii. Molar conductivity of 0.01 MY solution.

34. Answer the following questions: **[5]**

(i) Decomposition of a substance with initial concentration 'a' follows zero order kinetics with the rate constant 'k' $mol\ L^{-1}s^{-1}$. How much time it will take for completion of the reaction?

(ii) What type of isomerism is shown by the complex $[Co(NH_3)_5\ NO_2]Cl_2$?

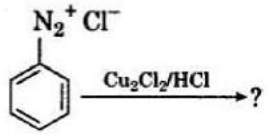
(iii) How will you convert bromobenzene to 1-phenylethanol?

(iv) Why is benzene diazonium chloride not stored and is used immediately after its preparation?

(v) Why first ionisation enthalpy of Cr is lower than that of Zn?

35. Write major product(s) in the following reactions: **[5]**

i. $C_6H_5\text{-}NO_2 \xrightarrow{Sn/HCl} ?$

ii. 

iii. $CH_3CONH_2 \xrightarrow{Br_2/KOH} ?$

OR

i. Write the structures of A and B in the following reactions:

a. $C_6H_5N_2^+Cl^- \xrightarrow{CuCN} A \xrightarrow{H_2O/H^+} B$

b. $CH_3COOH \xrightarrow[\Delta]{NH_3} A \xrightarrow{NaOBr} B$

ii. Write the chemical reaction of methyl amine with benzoyl chloride and write the IUPAC name of the product obtained.

iii. Arrange the following in the increasing order of their pK_b values: $C_6H_5NH_2$, NH_3, $C_2H_5NH_2$, $(C_2H_5)_2$ NH

SOLUTION

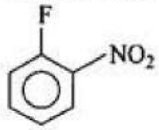
Section A

1. **(c)** Mn^{2+}

   Explanation: MnO_4^- + 5e $\longrightarrow$ Mn^{2+}; E^o_{RP} is maximum and thus reduction will predominate.

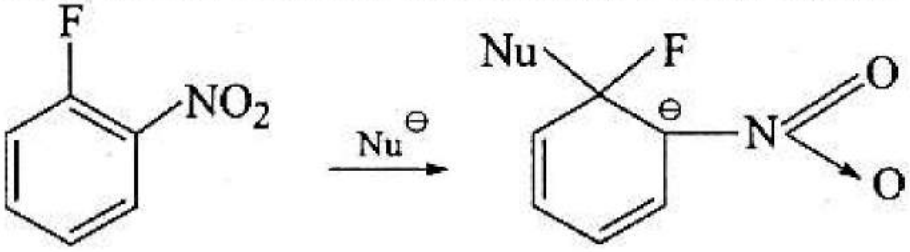
2. **(d)** 3

   Explanation: A monosaccharide is a single polyhydroxy aldehyde (aldose) or ketone (ketose) unit. Glucose is a single polyhydroxy aldehyde, while fructose is a single polyhydroxy ketone. A monosaccharide contains a skeleton, of carbon atoms. The minimum number of carbon atoms is three and it can go up to seven.

3. **(b)** 

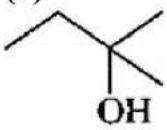
   Explanation:

   Fluoro derivative form more stable anion due to strong - I power.



(Most stable)

4. **(a)**



   Explanation: $pK_a \propto \frac{1}{\text{Acidity}}$

5. **(b)** 5/2

   Explanation: $\underset{(n=5)}{Eq.\ of\ MnO_4^-} = \underset{(n=2)}{Eq.\ of\ H_2O_2}$

   $\frac{1}{5} mol = \frac{1}{2} mol$

   $1 mol\ of\ MnO_4^- = \frac{5}{2} mol\ of\ H_2O_2$

6. **(c)** extensive

   Explanation: $\underset{1}{A_x}\underset{1-\alpha}{B_y} \rightleftharpoons \underset{0}{x}\underset{x\alpha}{A^+} + \underset{0}{y}\underset{y\alpha}{B^-}$

For dissociation:

Colligative properties $(\Delta P, \Delta T_b, \Delta T_f) \propto \frac{w}{m} \times \frac{1}{V} \times (1 - \alpha + x\alpha + y\alpha)$

For association:

$$\underset{1-\alpha}{\overset{1}{nA}} \rightleftharpoons \underset{\frac{\alpha}{n}}{\overset{0}{(A)_n}}$$

$$CP \propto \frac{w}{m} \times \frac{1}{V} \times \left(1 - \alpha + \frac{\alpha}{n}\right)$$

7. **(d)** to absorb liberated HCl

   Explanation: to absorb liberated HCl

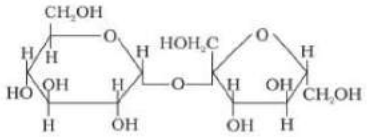
8. **(a)** Powdered sugar in hot water

   Explanation: Dissolution of sugar in water is endothermic and thus favoured by heat. Also surface area of powdered sugar is more which favours dissolution.

9. **(a)** Fe_2O_3 and $Fe(OH)_3$

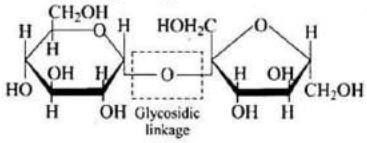
   Explanation: Rust is $Fe_2O_3 \cdot xH_2O$ or a mixture of Fe_2O_3 + $Fe(OH)_3$

10. **(a)**



   Explanation:

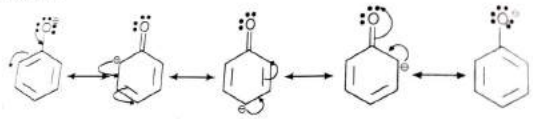
   This structure represents sucrose(diasaccharides) in which α-D glucose and β-D-fructose is attached to each other by C_1-C_2 glycosidic linkage. Since reducing groups of glucose and fructose are involved in glycosidic bond formation, this is considered as a non-reducing sugar.



11. **(b)** $CH_3CH_2 - \underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}} - OH$

   Explanation: Alkyl halides can be obtained by treating alcohol with haloacids. The reactivity of tertiary alcohols with the haloacids is the highest and primary alcohols are the lowest. Formation of alkyl chloride using primary and secondary alcohols requires the usage of a catalyst $ZnCl_2$, where dry hydrogen chloride gas is passed through a solution of alcohol or by heating a mixture of alcohol and concentrated aqueous halogen acid. Reaction with tertiary alcohols does not require a catalyst and can be carried out by using tertiary alcohols. the reaction is conducted by simply shaking with concentrated HCl at room temperature

12. **(a)** f-block
Explanation: f-block
13. **(a)** 965 C
Explanation: $2H^+ + 2e \rightarrow H_2$
$2OH^- \rightarrow \frac{1}{2}O_2 + H_2O + 2e$
eq. formed of H_2 and O_2 are in the ratio 2 : 1
Total eq. formed = $\frac{168}{11200}$ = 0.015 (n-actor for H_2 and O_2 is 2)
$\therefore$ Eq. of H_2 = 0.010
$\therefore$ Eq. of O_2 = 0.005
$\therefore$ Total charge passed = $0.010 \times 96500 = 965$ C
14. **(d)** B only
Explanation: I step of mechanism B shows I order in both reactants.
15. **(d)** If both Assertion and Reason are false statements.
Explanation: The given assertion and its reason both are incorrect.
EtOH is a weaker acid than phenol because it is tough to remove H^+ ion
from EtOH whereas phenol readily gives H^+ to form phenoxide ion (highly stable due to resonance).
The correct reason is that phenoxide ion is stabilized by resonance but ethoxide ion is not stabilized by resonance.



16. **(c)** A is true but R is false.
Explanation: A is true but R is false.
17. **(b)** Both A and R are true but R is not the correct explanation of A.
Explanation: Depression in freezing point is a colligative property which depends upon the number of the particles.
The number of particles is different in the case of benzene and water because acetic acid undergoes association in benzene and dissociation in water. That is why the molecular weight of acetic acid determined by depression in freezing point method is also different.
18. **(d)** A is false but R is true.
Explanation: Mercury cell gives a steady potential because in the cell reaction ions are not involved in the solution.

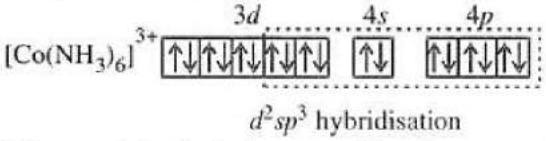
Section B

19. a. **Analytical chemistry:** (i) EDTA is used for the estimation of Ca^{2+} and Mg^{2+} in hard water.
b. **Extraction of metals :** (i) Silver and gold are extracted by treating zinc with their cyanide complexes.

20. Electronic configuration of Co : $[Ar]4s^2 3d^7$

Electronic configuration of Co^{3+} : $[Ar]^4s^0 3d^6$

NH_3 is strong field ligand, it will cause pairing of electrons. Hence,



d^2sp^3 hybridisation

It has octahedral shape and is diamagnetic due to the absence of unpaired electrons.

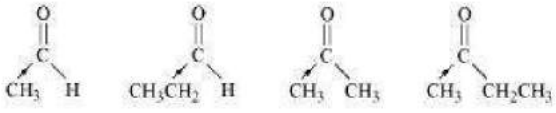
OR

i. $[Co(NH_3)_5Cl]^{2+}$

ii. Li $[AlH_4]$

21. The IUPAC name is 2-Methylcyclohexanone

i. OR



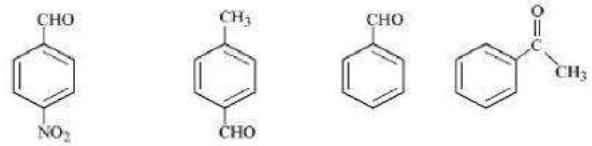
Ethanal Propanal Propanone Butanone

The +I effect of the alkyl group increases in the order: Ethanal < Propanal < Propanone < Butanone

The electron density at the carbonyl carbon increases with the increase in the +I effect of the alkyl group. As a result, the chances of attack by a nucleophile decrease. Hence, the increasing order is:

Butanone < Propanone < Propanal < Ethanol

ii.



p – Nitrobenzaldehyde *p* – Tolualdehyde Benzaldehyde Acetophenone

The + I effect is more in ketone than in aldehyde. Hence, acetophenone is the least reactive in nucleophilic addition reactions.

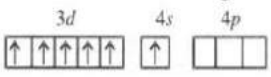
Among aldehydes, the +I effect is the highest in *p*-tolualdehyde because of the presence of the electron-donating $-CH_3$ group and the lowest in *p*-nitrobenzaldehyde because of the presence of the electron-withdrawing $-NO_2$ group. Hence, the increasing order is:

Acetophenone < p-Tolualdehyde < Benzaldehyde < p-Nitrobenzaldehyde

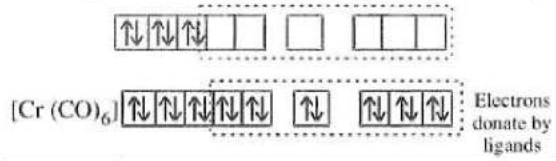
22. i. Zero order reaction.

ii. $[R] = [R_0] - kt \therefore$ Slope = -k

23. Electronic configuration of Cr



Cr (O) in $[Cr(CO)_6]$ has electronic configuration [Ar] $4s^0 3d^6$ This is because CO will cause pairing of electrons as it is strong field ligand.



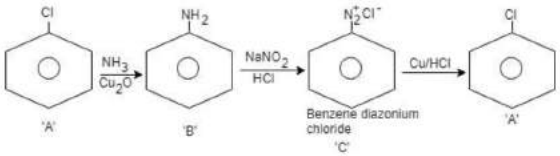
24.

Vitamin	Deficiency disease
B	Xerophthalmia, Night blindness
B_2	digestive disorders
B_6	Convulsions
B_{12}	Pernicious anaemia
C	Scurvy
D	Rickets
E	Muscular weakness
K	Increased blood clotting time.

25. Bakelite. (from phenol and formaldehyde)

Section C

26. $A \xrightarrow[Cu_2O]{NH_3} B \xrightarrow[0-5^\circ C]{NaNo_2 \; HCl} C \xrightarrow{Cu/HCl} A$



27. Three fourth of initial quantity of HCOOH is decomposed means that (where, initial concentration =$(R]_0$) concentration after t time,

$t = \frac{[R]_0}{4}$

k = 24 $\times 10^{-3} s^{-1}$

Thus, for the first order reaction,

rate constant,

$k = \frac{2.303}{t} \log \frac{[R]_0}{[R]}$

$2.4 \times 10^{-3} s^{-1} = \frac{2.303}{t} \log \frac{[R]_0}{[R]_0/4}$

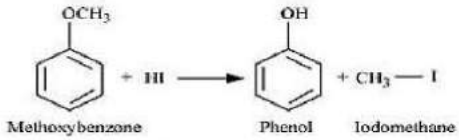
$t = \frac{2.303}{2.4 \times 10^{-3}} \times \log 4$

or $t = \frac{2.303}{2.4 \times 10^{-3}} \times 0.6021$

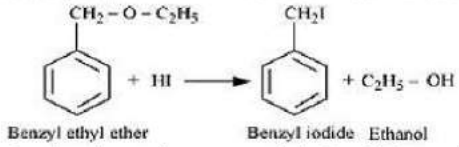
$= 5.77 \times 10^2 s$

28. i. $\underset{\text{1- Proproxypropane}}{C_2H_2CH_2 - O - CH_2C_2H_5} + HI \xrightarrow{373K} \underset{\text{Propan - 1- ol}}{CH_3CH_2CH_2 - OH} + \underset{\text{1- Iodopropane}}{CH_3CH_2CH_2 - I}$

ii.



iii.

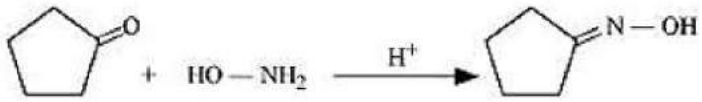


29. Carbohydrate is essential for life and also used as storage molecules in plants and animals are as follows:
    i. The plant contains mainly starch, cellulose, sucrose, etc.
    ii. Animal contains glycogen in their body. So, glycogen is also known as animal starch. Glycogen is present in the liver, muscles, and brain when the body needs glucose, the enzyme breaks glycogen down to glucose.
    iii. Cellulose is present in the wood, and the fibre of clothes. Cell wall of bacteria is made up of cellulose.

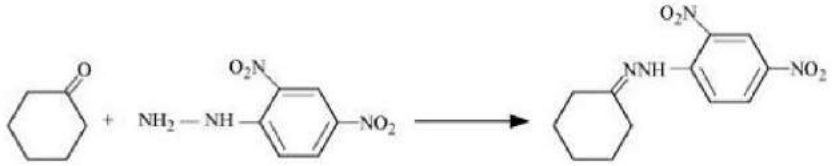
OR

    i. **Peptide linkage.** Polymers of α -amino acids are connected to each other by peptide bond or peptide linkage.
    Chemically peptide linkage is an amide formed between - COOH group and -NH_2 group.
    ii. **Glycosidic linkage.** The two monosaccharides are joined together by an oxide linkage formed by the loss of a water molecule. Such a linkage between two monosaccharide units through oxygen atom is called glycosidic linkage.

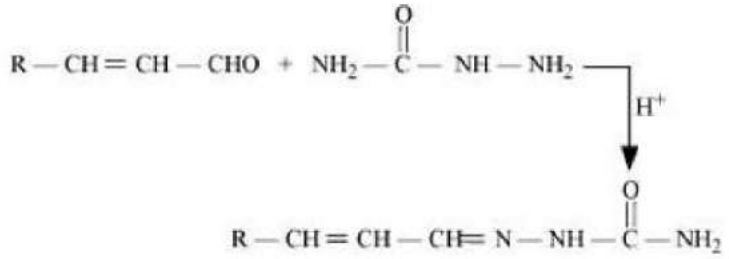
30. i.



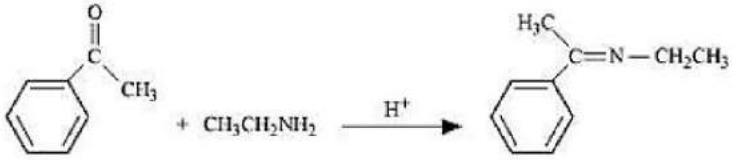
ii.



iii.



iv.



Section D

31. **Read the text carefully and answer the questions:**

The boiling point elevation and the freezing point depression of solutions have a number of practical applications. Ethylene glycol ($CH_2OH{\cdot}CH_2OH$) is used in automobile radiators as an antifreeze because it lowers the freezing point of the coolant. The same substance also helps to prevent the radiator coolant from boiling away by elevating the boiling point. Ethylene glycol has a low vapour pressure. We can also use glycerol as an antifreeze. In order for boiling point elevation to occur, the solute must be non-volatile, but no such restriction applies to freezing point depression. For example, methanol (CH_3OH), a fairly volatile liquid that boils only at 65^oC is sometimes used as antifreeze in automobile radiators.

(i) CH_3OH is a better reagent for depression in freezing point but not for elevation in boiling point.

(ii) The depression in freezing point will be the same in both the solutions because both are non-electrolytes and gives the same number of solutes.

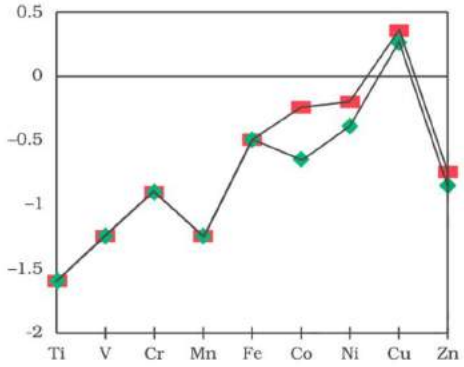
(iii) Glycol will be better than glycerol because it is more volatile than glycerol.

OR

The sequence of the economy to use these compounds as antifreeze is Methanol > Glycol > Glycerol.

32. **Read the text carefully and answer the questions:**

The unique behaviour of Cu, having a positive E° accounts for its inability to liberate H_2 from acids. Only oxidising acids (nitric and hot concentrated sulphuric) react with Cu, the acids being reduced. 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 E° values, whereas E° for Ni is related to the highest negative $\Delta_{hyd}H°$. An examination of the $E^o_{(M^{3+}/M^{2+})}$ values the low value for Sc reflects the stability of Sc^{3+} which has a noble gas configuration. The comparatively high value for Mn shows that $Mn^{2+}(d^5)$ is particularly stable, whereas a comparatively low value for Fe shows the extra stability of Fe^{3+} (d^5). The comparatively low value for V is related to the stability of V^{2+} (half-filled t_{2g} level).



(i) Due to the removal of an electron from the stable d^{10} configuration of Zn^{2+}.

(ii) Transition metals despite having high E° oxidation, are poor reducing agents because of their high heat of vaporization, high ionisation energies and low heats of hydration.

(iii) Cr^{2+} is reducing as its configuration changes from d_4 to d_3, the having a half-filled t_{2g} level. On the other hand, the change from Mn^{3+} to Mn^{2+} results in the half-filled (d_5) configuration which has extra stability.

OR

The Stability of Cu^{2+} is more than Cu^+ as stability depends on the hydration energy of the ions when they bond to the water molecules. The Cu^{2+} ion has a greater charge density than Cu^+ ion and thus forms much stronger bonds releasing more energy.

Section E

33. i. $Zn(s) + Cu^{2+}(aq) \rightarrow Zn^{2+}(aq) + Cu(s)$

$E^0_{Zn^{2+}/Zn} = -0.076$ V

$E^0_{Cu^{2+}/Cu} = +0.034$ V

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

from the reaction $n = 2$

$E^0_{cell} = E^0_{Cu^{2+}/Cu} - E^0_{Zn^{2+}/Zn}$

$E^0_{cell} = 0.34 - (-0.076) = 1.10$ V

The value of ΔG^o for the reaction $= nFE^o$

$= -2 \times 96500 \times 1.10$

$= -212300$ KJmol^{-1} $= -212.3$ kJmol^{-1}

ii. Two advantages of fuel cells.

a. Fuel cells have a higher efficiency than diesel or gas engines and are pollution-free.

b. Most fuel cells operate silently, compared to internal combustion engines. They are therefore ideally suited for use within buildings such as hospitals.

OR

For electrolyte X

Molarity = 0.05 M

Resistance = 100Ω

Conductivity = $1.0 \times 10^{-4} S\,cm^{-1}$

For electrolyte Y

Molarity = 0.01 M

Resistance = 50Ω

Conductivity = ?

i. Cell constant = Conductivity (K) × Resistance (R)

$G^* = 1.0 \times 10^{-4} \times 100$

$= 10^{-2}$cm^{-1}

ii. Conductivity of solution Y is

$K = \frac{G^*}{R} = \frac{10^{-2}}{50}$

$= 0.02 \times 10^{-2}$

$= 2 \times 10^{-4} S\,cm^{-1}$

iii. Concentration C = 0.01 M

$= 0.01\,mol\,L^{-1}$

$= 0.01 \times 1000\,mol\,ml^{-3}$

$= 10$mol cm^{-3}

∴ Molar concentration

$\lambda_m = \frac{K}{C} = \frac{2 \times 10^{-4}}{10}$

$= 0.2 \times 10^{-4} S\,cm^2 mol^{-1}$

34. Answer the following questions:

(i) For the reaction

A → products

The reaction follows zero order kinetics and the concentration of A=a mol/L

Integrating both sides, $\int d[a] = -k \int dt \implies$ [a] = – k t + C.....(i)

where, C is the constant of integration

At t = 0, the concentration of the reactant = a_0, where a_0 is initial concentration of the reactant.

Substituting in equation (i)

$a_0 = -k \times 0 + C$

$a_0 = C$

Substituting the value of C in the equation (i)

$a = -kt + a_0$ ..... (ii)

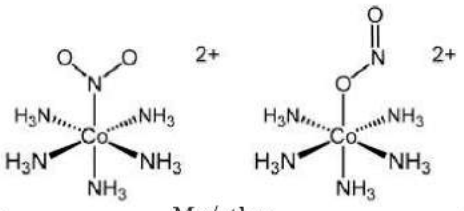
$-kt = a - a_0 \implies kt = a_0 - a$

∴The time required for the reactant concentration to reach a is $t = \frac{a_0 - a}{k}$s

The reaction gets completed when [A]=a=0

The time required for the completion of the reaction is $t = \frac{a_0 - 0}{k} = \frac{a_0}{k}$ s

(ii) Linkage isomerism is shown by the complex $[Co(NH_3)_5\ NO_2]Cl_2$.



(iii) $\underset{\text{Bromobenzene}}{C_6H_5Br} \xrightarrow{Mg/ether} C_6H_5MgBr \xrightarrow[H_3O^+]{CH_3CHO} C_6H_5 - \underset{\underset{OH}{|}}{C}H - CH_3$

1−phenylethanol

(iv)Benzene diazonium chloride is very unstable. Therefore, it cannot be generally stored and is used immediately after its preparation.

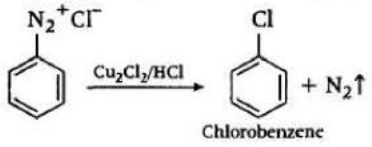
(v) The electronic configuration of chromium and zinc are respectively:

$Cr(24) = [Ar]\ 3d^5 4s^2$

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

It is easy to remove electron from 4 s^1 -orbital (unpaired) rather than from $4s^2$ -orbital (paired). Therefore, first ionisation enthalpy of Cr is less than Zn.

35. i. $C_6H_5\text{-}NO_2 \xrightarrow{Sn/HCl} C_6H_5.NH_2$ (Aniline)

ii. 

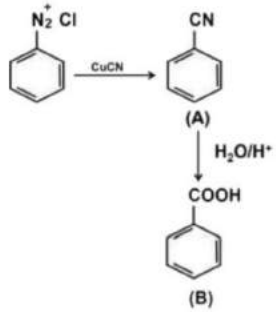
Chlorobenzene

iii. $CH_3CONH_2 \xrightarrow[\text{Hofmann bromamide degradation}]{Br_2/KOH} CH_3NH_2 + K_2CO_3 + 2KBr + 2H_2O$

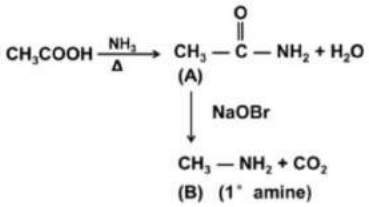
OR

i. The structure of A and B on following reaction is:

a.

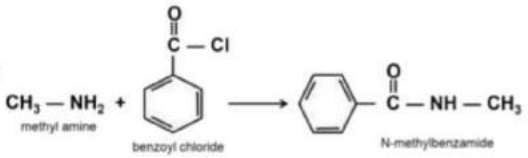


b.



ii. The chemical reaction of methyl amine with benzoyl chloride and IUPAC name of the

product form is as follows:



iii. Increasing order of pK_b values

$(C_2H_5)_2\ddot{N}H < C_2H_5NH_2 < \ddot{N}H_3 < C_6H_5\ddot{N}H_2$