

# CBSE Sample Paper 9

Class XII 2022-23

## Chemistry

Time: 3 Hours

Max. Marks: 70

### General Instructions:

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

### SECTION - A

18 Marks

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

1. Henry's law constant for oxygen dissolved in water is  $4.34 \times 10^4$  atm at  $25^\circ\text{C}$ . If the partial pressure of oxygen in air is 0.4 atm at  $25^\circ\text{C}$ , the concentration (in moles per liter) of the dissolved oxygen in water in equilibrium with air at  $25^\circ\text{C}$  is:

- (a)  $1.3 \times 10^{-3}$  M      (b)  $0.13 \times 10^{-3}$  M  
(c)  $0.28 \times 10^{-4}$  M      (d)  $5.11 \times 10^{-4}$  M      1

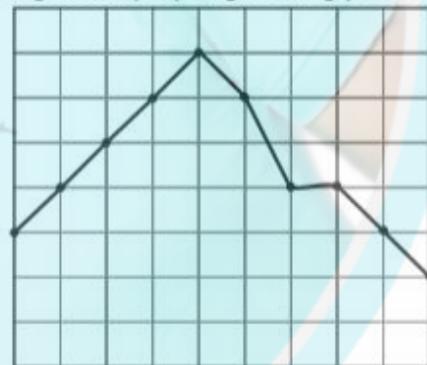
2. Which of the following option will be the limiting molar conductivity of  $\text{CH}_3\text{COOH}$  if the limiting molar conductivity of  $\text{CH}_3\text{COONa}$  is  $91 \text{ Scm}^2\text{mol}^{-1}$ ? Limiting molar conductivity for individual ions are given in the following table:

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

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

3. The three graphs below show the variation in radius, effective nuclear charge and maximum oxidation state for the transition

metals of period 4. In each part below identify which property is being plotted.



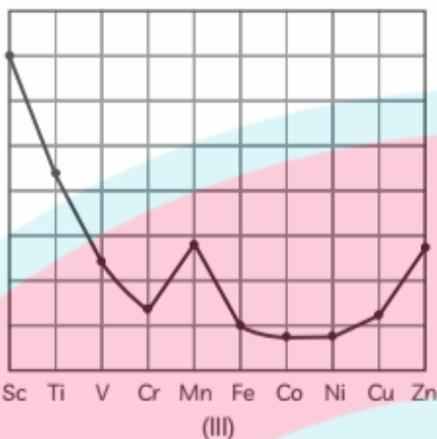
Sc Ti V Cr Mn Fe Co Ni Cu Zn

(I)



Sc Ti V Cr Mn Fe Co Ni Cu Zn

(II)



Choose the correct option:

	I	II	III
(a)	Maximum oxidation state	Effective nuclear charge	Radius
(b)	Effective nuclear charge	Maximum oxidation state	Radius
(c)	Maximum oxidation state	Radius	Effective nuclear charge
(d)	Radius	Effective nuclear charge	Maximum oxidation state

4. The number of unpaired electrons in gaseous species of  $Mn^{3+}$ ,  $Cr^{3+}$  and  $V^{3+}$  respectively are ..... and the most stable species is .....

- (a) 4, 3 and 2;  $V^{3+}$     (b) 3, 3 and 2;  $Cr^{3+}$   
 (c) 4, 3 and 2;  $Cr^{3+}$     (d) 3, 3 and 3;  $Mn^{3+}$     1

5. Identify 'X':



- (a) N, N-Dimethylbenzamide  
 (b) N, N-Dimethylbenzene  
 (c) N-Methyl-N-phenylamine  
 (d) N, N-Diphenylmethanamine    1

6. When converting a disaccharide to monosaccharides, which bond is hydrolyzed?

- (a) Disulfide bond  
 (b) Glycosidic bond  
 (c) Phosphodiester bond  
 (d) Hydrogen bond    1

7. Equilibrium constant K is related to  $E_{cell}^0$  and not  $E_{cell}$  because:

- (a)  $E_{cell}^0$  is easier to measure than  $E_{cell}$   
 (b)  $E_{cell}$  becomes zero at equilibrium point but  $E_{cell}^0$  remains constant under all conditions

(c) at a given temperature,  $E_{cell}$  changes hence value of K can't be measured

(d) any of the terms  $E_{cell}$  or  $E_{cell}^0$  can be used    1

8. Which of the following statements about  $[Ni(CO)_4]$  is correct?

- (a) Tetrahedral, diamagnetic  
 (b) Square planar, diamagnetic  
 (c) tetrahedral, paramagnetic  
 (d) Square planar, paramagnetic    1

9. The existence of two different coloured complexes with the composition  $[Co(NH_3)_4Cl_2]^+$  is due to:

- (a) Coordination isomerism  
 (b) Ionization isomerism  
 (c) Linkage isomerism  
 (d) Geometrical isomerism    1

10. Sugar that is non-reducing in nature is:

- (a) maltose                      (b) sucrose  
 (c) lactose                      (d) glucose    1

11. The catalytic activity of transition metals and their compounds is ascribed mainly due to:

- (a) their chemical behavior  
 (b) their chemical reactivity  
 (c) their ability to adopt variable oxidation states  
 (d) their unfilled d-orbitals    1

12. Magnetic moment is used to determine the magnetic character of a species. Which of the following has magnetic moment value of 5.9 B.M.?

- (a)  $Fe^{2+}$                       (b)  $Fe^{3+}$   
 (c)  $Ni^{2+}$                       (d)  $Cu^{2+}$     1

13. The voltage ..... if the salt bridge is removed from the two half cells.

- (a) drops to zero    (b) increases  
 (c) decreases    (d) remains same    1

14. Which of the following is the correct relation between conductance and resistance?

- (a)  $CR = 1$                       (b)  $C = R$   
 (c)  $C = -R$                       (d)  $CR = \text{constant}$     1

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

- (a) Both (A) and (R) are true and (R) is the correct explanation of (A).  
 (b) Both (A) and (R) are true but (R) is not the correct explanation of (A).  
 (c) (A) is true but (R) is false  
 (d) (A) is false but (R) is true

15. Assertion: When a solution is separated from the pure solvent by a semi-permeable membrane, the solvent molecules pass through it from pure solvent side to the solution side.

Reason: Diffusion of solvent occurs from a region of high concentration solution to a region of low concentration solution. 1

16. Assertion: Transition metals are good catalysts.

Reason:  $V_2O_5$  or Pt is used in the preparation of  $H_2SO_4$  by contact process. 1

17. Assertion: In optically active halides,  $S_N^1$  reactions proceed through racemisation.

Reason: The nucleophile can attack from either side of the carbocation formed to give the mixture of products. 1

18. Assertion: Methoxy ethane reacts with HI to give ethanol and iodomethane

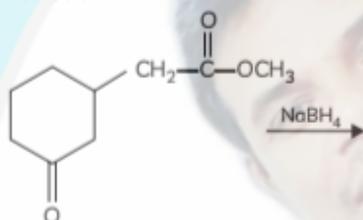
Reason: Reaction of ether with HI follows  $S_N^2$  mechanism 1

## SECTION - B

14 Marks

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

19. (A) Give the product for the following reaction.



(B) Which among the following will undergo Cannizzaro reaction?

Benzaldehyde, acetone, formaldehyde 2

20. For  $M^{2+}/M$  and  $M^{3+}/M^{2+}$  systems, the  $E^\circ$  values for some metals are as follows:

$$Cr^{2+}/Cr = -0.9 \text{ V}$$

$$Cr^{3+}/Cr^{2+} = -0.4 \text{ V}$$

$$Mn^{2+}/Mn = -1.2 \text{ V}$$

$$Mn^{3+}/Mn^{2+} = +1.5 \text{ V}$$

$$Fe^{2+}/Fe = -0.4 \text{ V}$$

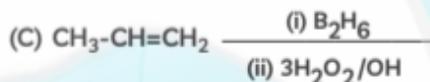
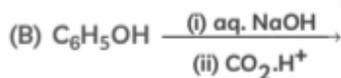
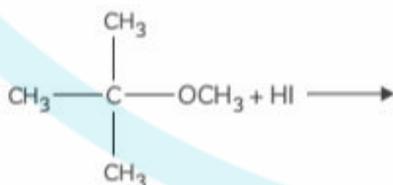
$$Fe^{3+}/Fe^{2+} = +0.8 \text{ V}$$

Use this data to comment upon:

(A) the stability of  $Fe^{3+}$  in acid solution as compared to that of  $Cr^{3+}$  or  $Mn^{3+}$  and

(B) the ease with which iron can be oxidised as compared to a similar process for either chromium or manganese metal. 2

21. (A) Write the product for the following reaction;



22. (A) Of 0.1 M solution of glucose and sodium chloride respectively, which one will have a higher boiling point and why?

(B) Why is an increase in temperature observed on mixing chloroform with acetone?

OR

Calculate the molality of ethanol solution in which the mole fraction of water is 0.88. 2

23. (A) Amino acids may be acidic, alkaline or neutral, how does this happen?

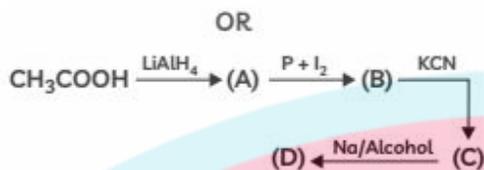
(B) What are essential and non-essential amino acids? Name one of each type.

OR

Nucleosides and Nucleotides are important units of nucleic acids. State what are known as nucleosides and nucleotides. 2

24. (A) How are amines prepared from amides?

(B) Acylation of amines with acid chloride is carried out in presence of stronger base. Why?



Identify A, B, C and D in the above reaction. 2

25. Account for the following:

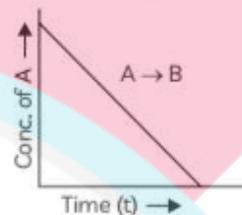
- (A)  $\text{Cl}-\text{CH}_2\text{COOH}$  is a stronger acid than  $\text{CH}_3\text{COOH}$ .  
 (B) Carboxylic acids do not give reactions of the carbonyl group. 2

## SECTION - C

15 Marks

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

26. (A) Write the main structural difference between DNA and RNA. Of the two bases, thymine and uracil, which one is present in DNA?  
 (B) What are the hydrolysis products of sucrose? 3
27. Calculate the freezing point of a solution containing 8.1 g of HBr in 100 g of water, assuming the acid to be 90 % ionized. [Given: Molar mass Br = 80 g/mol,  $K_f$  water = 1.86 K kg/mol]. 3
28. Answer any three questions:  
 (A) State the reaction involved when sodium methoxide reacts with tert-Butylbromide.  
 (B) Why a weak electrolyte like carbon dioxide can be used to carry out Kolbe's reaction?  
 (C) State two chemicals which produce denatured alcohol.  
 (D) Indicate the products for the conversion of white ppt. when phenol reacts with bromine water. 3
29. The graphical representation of concentration of A Vs time is given for a general  $\text{A} \rightarrow \text{B}$ ,



Answer the following questions:

- (A) What is the order of the reaction?  
 (B) What is the slope of the curve?  
 (C) State the units for the rate constant.

OR

The decomposition of  $\text{N}_2\text{O}_5$  (g) is a first order reaction with rate constant of  $5 \times 10^{-4} \text{ s}^{-1}$  at  $45^\circ\text{C}$ . If initial concentration of  $\text{N}_2\text{O}_5$  is 0.25 M, calculate its concentration after 2 minutes. 3

30. A colourless substance 'A'  $\text{C}_6\text{H}_7\text{N}$  is sparingly soluble in water and gives a water soluble compound 'B' on treating with mineral acid. On reacting with  $\text{CHCl}_3$  and alcoholic potash 'A' produces an obnoxious smell due to the formation of compound 'C'. Reaction of 'A' with benzenesulphonyl chloride gives compound 'D' which is soluble in alkali. With  $\text{NaNO}_2$  and HCl, 'A' forms compound 'E' which reacts with phenol in alkaline medium to give an orange dye 'F'. Identify compounds 'A' to 'F'. 3

## SECTION - D

8 Marks

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

31. Aldehydes and ketones are amphoteric. Thus they can react both as acids and bases. Under acidic conditions, the carbon of the protonated carbonyl group is much more electrophilic, reacting even with weak nucleophile. Carbonyl compounds give nucleophilic addition reaction. In this reaction the nucleophilic attack precedes the electrophilic attack.  
 (A) Why aromatic aldehyde and formaldehyde undergo Cannizaro reaction? 1
- (B) Arrange the acids given below in the decreasing order of acidity  
 $\text{C}_6\text{H}_5\text{CH}_2\text{COOH}$ ,  $\text{C}_6\text{H}_5\text{COOH}$ ,  $\text{CH}_3\text{COOH}$ ,  $\text{CH}_3\text{CH}_2\text{COOH}$  1
- (C) How will you convert:  
 (i) Toluene to Benzaldehyde.  
 (ii) Acetone to Iodoform.

OR

Give simple chemical tests to distinguish between the following pairs of compounds:

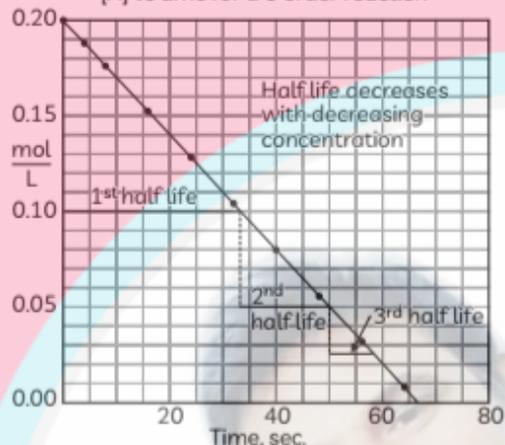
(i) Benzaldehyde and Acetophenone

(ii) Benzoic acid and phenol

2

32. A reaction in which rate of reaction is independent of concentration of the reactants is called zero order reaction. Photochemical combination of hydrogen and chlorine to give hydrogen chloride is an example of zero order reaction. The rate constant of a zero order reaction is equal to the rate of reaction.

[A] vs time for a 0 order reaction



The half life period of a zero order reaction is directly proportional to initial concentration of the reactant. For a zero order reaction,  $k = 1/t \{[A]_0 - [A]\}$ .

(A) For a reaction  $\frac{1}{2}A \rightarrow 2B$  rate of

disappearance of A is 2 related to the rate of appearance of B by what expression? 1

(B) On what factors value of rate constant depends? 1

(C) (i) What does the slope determines in graph of rate vs concentration in first order reaction?

(ii) What does the slope determines in graph between  $\log_{10}[A]$  and time?

OR

The decomposition of nitrogen pentoxide in  $CCl_4$  can be represented as given below:



In an experiment, the progress of the reaction was followed by measuring the volume of evolved oxygen. Following data were obtained.

Time (sec)	0	300	600	900	$\infty$
Vol. of $N_2$ evolved (cm <sup>3</sup> )	0	3.42	6.30	8.95	34.75

Determine the rate law, rate constant and the order of reaction. 2

## SECTION - E

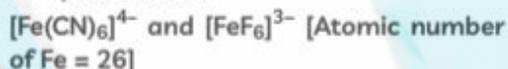
15 Marks

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

33. (A) Give the IUPAC name of:



(B) Compare the magnetic behaviour of the complex entities.



(C) Tetrahedral complexes are always of high spin. Explain.

(D) What is the relationship between observed colour of the complex and the wavelength of the light absorbed by the complex?

OR

(A) Why is  $[Co(NH_3)_6]^{3+}$  an inner orbital complex whereas  $[Ni(NH_3)_6]^{2+}$  is an outer orbital complex?

(B) What is spectrochemical series? Explain the difference between a weak field ligand and a strong field ligand as well as significance of splitting energy and pairing energy.

(C)  $FeSO_4$  solution mixed with  $(NH_4)_2SO_4$  solution in 1:1 molar ratio gives the test of  $Fe^{2+}$  ion but  $CuSO_4$  solution mixed with aqueous ammonia in 1:4 molar ratio does not give the test of  $Cu^{2+}$  ion. Explain why?

(D) What is the hybrid state and electronic configuration of coordination compound  $K_3[CoF_6]$ . 5

34. (A) (i) Compound A with molecular formula  $C_4H_9Br$  is treated with aq. KOH solution.

The rate of this reaction depends upon the concentration of the compound A only. When another optically active isomer B of this compound was treated with aq. KOH solution, the rate of reaction was found to be dependent on concentration of compound and KOH both.

Write down the structural formula of both compounds A and B.

(ii) Out of these two compounds, which

one will be converted to the product with inverted configuration? Give mechanism for the reaction

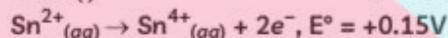
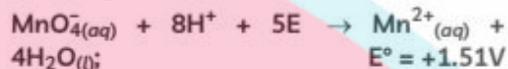
- (B) Why is it necessary to avoid even traces of moisture during the use of a Grignard reagent?
- (C) No effect on reactivity of haloarene is observed by the presence of electron withdrawing group at meta position. Explain why?

OR

- (A) An alkyl halide, X, of formula  $C_6H_{13}Cl$  on treatment with potassium tertiary butoxide gives two isomeric alkenes Y and Z ( $C_6H_{12}$ ). Both alkenes on hydrogenation give 2,3-dimethylbutane. Predict the structures of X, Y and Z. Also write the reactions involved.
- (B) Vinyl halides are less reactive than alkyl halides, but allyl halides are more reactive than alkyl halides. Explain.
- (C)  $S_N^1$  reaction of optically active compounds undergo racemisation whereas  $S_N^2$  reaction led to inversion. Explain.

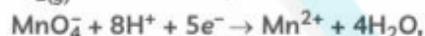
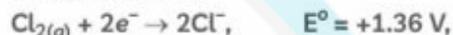
35. (A) Draw the plot of  $\Lambda_m$  v/s  $\sqrt{c}$ , for weak electrolyte. Why the limiting molar conductivity value cannot be determined for such electrolytes?

(B) Two half-reaction of an electrochemical cell are given below:



Construct the redox equation from the standard potential of the cell and predict if the reaction is reactant favoured or product favoured.

(C) On the basis of  $E^\circ$  values identify which amongst the following is the strongest oxidising agent:



# SOLUTION

## SECTION - A

1. (d)  $5.11 \times 10^{-4} M$

**Explanation:** According to Henry's law

Given:

$$P = K_H X$$

$$K_H = 4.34 \times 10^4 \text{ atm}$$

$$P_{O_2} = 0.4 \text{ atm}$$

$$P_{O_2} = K_H X_{O_2}$$

$\therefore$

$$X_{O_2} = \frac{P_{O_2}}{K_H}$$

$\Rightarrow$

$$X_{O_2} = \frac{0.4}{4.34 \times 10^4}$$

$\Rightarrow$

$$X_{O_2} = 9.21 \times 10^{-6}$$

Changing mole fraction into molarity

$$\text{Moles of water} = \frac{1000}{18}$$

$\Rightarrow$

$$= 55.5 \text{ mol}$$

Now,

$$X_{O_2} = \frac{n_{O_2}}{n_{H_2O} + n_{O_2}}$$

$\Rightarrow$

$$n_{O_2} = X_{O_2} \times (n_{H_2O} + n_{O_2})$$

$(\because n_{O_2} \ll n_{H_2O})$

$$= X_{O_2} \times n_{H_2O}$$

$$= 9.21 \times 10^{-6} \times 55.5$$

$$n_{O_2} = 5.11 \times 10^{-4} \text{ mol}$$

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

**Explanation:** The limiting molar conductivity ( $\Lambda_m^0$ ) for strong and weak electrolyte can be determined by using Kohlrausch's law which states that "the limiting molar conductivity of an electrolyte can be represented as the sum of the individual contributions of the anion and cation of the electrolyte."

$$\begin{aligned} \Lambda_{CH_3COONa}^0 &= \Lambda_{CH_3COO^-}^0 + \Lambda_{Na^+}^0 \\ 91 &= \Lambda_{CH_3COO^-}^0 + 50.1 \end{aligned}$$

$$\Rightarrow \Lambda_{CH_3COO^-}^0 = 40.9$$

$$\Rightarrow \Delta H_{\text{CH}_3\text{COO}^-} = 40.9 \text{Scm}^2\text{mol}^{-1}$$

For acetic acid

$$\begin{aligned} \Delta H_{\text{CH}_3\text{COOH}} &= \Delta H_{\text{CH}_3\text{COO}^-} + \Delta H_{\text{H}^+} \\ &= 40.9 + 349.6 \\ &= 390.5 \text{Scm}^2\text{mol}^{-1} \end{aligned}$$

3. (a) I: Maximum oxidation state; II: Effective nuclear charge; III: Radius

**Explanation:** The atomic and ionic radii of the transition elements decrease from group 3 to group 6 due to the poor shielding offered by the small number of d-electrons. The effective nuclear charge ( $Z_{\text{eff}}$ ) increases slightly along a transition series. This is because more protons are added in the nucleus, whereas the same number of electrons is added in the (n-1)d-subshell. The transition metals exhibit a variable number of oxidation states in their compounds. This is one of the notable features of the transition elements.

4. (c) 4, 3 and 2;  $\text{Cr}^{3+}$

**Explanation:**

$$\text{Mn}^{3+} = 3d^4 = 4 \text{ unpaired electrons,}$$

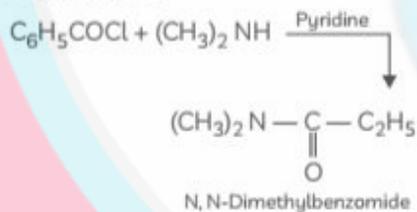
$$\text{Cr}^{3+} = 3d^3 = 3 \text{ unpaired electrons,}$$

$$\text{V}^{3+} = 3d^2 = 2 \text{ unpaired electrons.}$$

$\text{Cr}^{3+}$  is most stable out of these in aqueous solution because it has half-filled  $t_{2g}$  level (i.e.,  $t_{2g}^3$ ).

5. (a) N, N-Dimethylbenzamide

**Explanation:**



6. (b) Glycosidic bond

**Explanation:** A disaccharide is a molecule that consists of two monosaccharides joined by a glycosidic bond. The disaccharide's glycosidic bond is hydrolyzed to release the constituent monosaccharides.

7. (b)  $E_{\text{cell}}$  becomes zero at equilibrium point but  $E_{\text{cell}}^{\circ}$  remains constant under all conditions

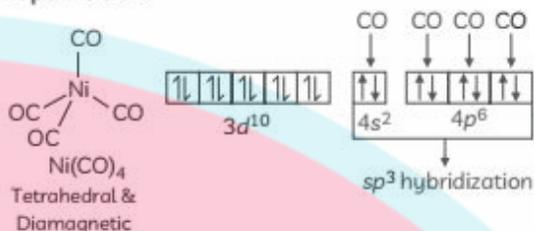
**Explanation:** At the equilibrium point,

$E_{\text{cell}} = \text{zero}$ . Therefore, K is related to  $E_{\text{cell}}^{\circ}$  as,

$$\log K_c = \frac{n \times E_{\text{cell}}^{\circ}}{(0.0591)} V$$

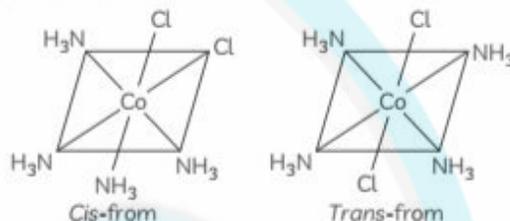
8. (a) Tetrahedral, diamagnetic

**Explanation:**



9. (d) Geometrical isomerism

**Explanation:** The complex  $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]^+$  is a  $[\text{MA}_4\text{B}_2]$  type complex and thus, fulfills the conditions that are necessary to exhibit geometrical isomerism. Hence, it has two geometrical isomers of different colours as: The structure of the geometrical isomers are as follows:



10. (b) sucrose

**Explanation:** Sucrose is a glucose carbon connected at the anomeric carbon to an anomeric carbon on a fructose. Since, both anomeric carbons are involved in the bond, neither one has an OH group, so it is not a reducing sugar.

11. (c) their ability to adopt variable oxidation states

**Explanation:** Transition metals show catalytic behavior mainly due to partially filled d-orbitals, ability to exhibit variable valences and tendency to form complex compounds.

12. (b)  $\text{Fe}^{3+}$

**Explanation:** The magnetic moment 5.92 BM shows that there are five unpaired electrons present in the d-orbitals of  $\text{Fe}^{3+}$  ion. As a result, the hybridization involved is  $sp^3$  rather than  $dsp^2$  and shows 5.9 BM magnetic moment value.

13. (a) drops to zero

**Explanation:** Salt bridge completes the circuit, allowing current to flow. If the salt bridge is taken away, no current will flow and the voltage will fall to zero.

14. (a)  $CR = 1$

**Explanation:** Conductance is the measure of the ease of flow of current through conductor. It is the reciprocal of the resistance of the conductor.

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

**Explanation:** Because a semipermeable membrane permits solvent molecules to pass through a solution of lower concentration to that of higher concentration. Flow of solvent molecule from solvent side to solution side through semipermeable membrane is called osmosis.

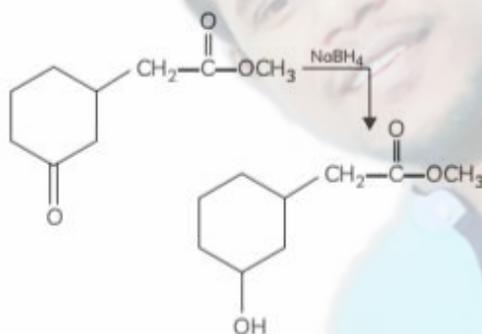
16. (a) Both (A) and (R) are true and (R) is the correct explanation of (A).

**Explanation:**  $V_2O_5$ , vanadium oxide is used in contact process as the as a catalyst as transitional metals are good catalysts.

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

## SECTION - B

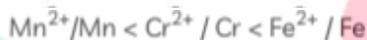
19. (A)  $NaBH_4$  does not reduce ester group. It is mild reducing reagent which reduces aldehyde and ketone into their respective alcohols.



- (B) Benzaldehyde and formaldehyde undergo cannizzaro reaction as these compounds do not contain alpha hydrogen.

20. (A) The  $E^0$  value of  $Fe^{3+}/Fe^{2+}$  is higher than that for  $Cr^{3+}/Cr^{2+}$  and lower than that for  $Mn^{3+}/Mn^{2+}$ . So, the reduction of  $Fe^{3+}$  to  $Fe^{2+}$  is easier than the reduction of  $Mn^{3+}$  to  $Mn^{2+}$ , but not as easy as the reduction of  $Cr^{3+}$  to  $Cr^{2+}$ . Hence,  $Fe^{3+}$  is more stable than  $Mn^{3+}$ , but less stable than  $Cr^{3+}$ . These metal ions can be arranged in the increasing order of their stability as:  $Mn^{3+} < Fe^{3+} < Cr^{3+}$

- (B) The reduction potentials for the given pairs increase in the following order.



So, the oxidation of Fe to  $Fe^{2+}$  is not an easy as the oxidation of Cr to  $Cr^{2+}$  and the oxidation of Mn to  $Mn^{2+}$ . Thus, these

**Explanation:** In  $S_N1$  reaction carbocation intermediate formed is a planar molecule which will lead to form d- and l- products. Hence racemization occurs. And nucleophile can attack from either side of the carbocation formed to give the mixture of products.

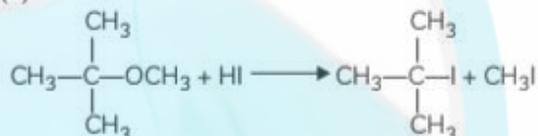
18. (a) Both (A) and (R) are true and (R) is the correct explanation of (A).

**Explanation:** Ethers can undergo nucleophilic substitution reactions with HI. Ethers having primary alkyl group undergo  $S_N2$  reaction whereas tertiary alkyl ether undergo  $S_N1$  reaction. Protonation of ether is followed by the attack of halide ion. The halide ion preferentially attacks the less sterically hindered of the two alkyl groups which are attached etherial oxygen.

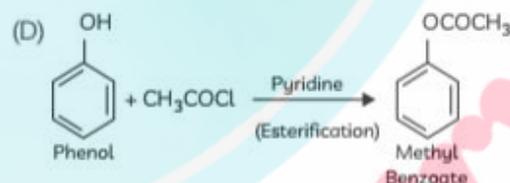
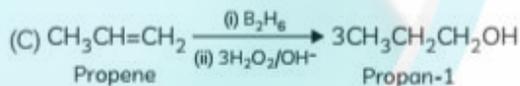
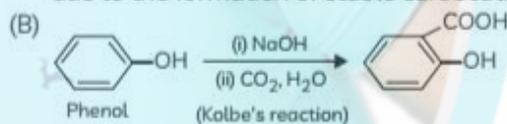
metals can be arranged in the increasing order of their ability to get oxidised as:



21. (A)



**Explanation:**  $3^0$  alkyl halide will be formed due to the formation of stable carbocation.



22. (A) 0.1 molal solution of sodium chloride will have higher  $\Delta T_b$  and higher boiling point as well because it dissociates into ions. At the same time, 0.1 molal glucose solution being a molecular

23. solid will not dissociate into ions.

(B) The bonds between chloroform molecules and molecules of acetone are dipole-dipole interactions but on mixing, the chloroform

and acetone molecules, they start forming hydrogen bonds which are stronger bonds resulting in the release of energy. This gives rise to an increase in temperature.

OR

Mole fraction of water = 0.88

Mole fraction of ethanol =  $1 - 0.88 = 0.12$

Therefore 0.12 moles of ethanol are present in 0.88 moles of water.

Mass of water =  $0.88 \times 18 = 15.84$  g of water.

Molality = number of moles of solute (ethanol) present in 1000 g of solvent (water)

$$= 12 \times \frac{1000}{15.84}$$

$$= 7.57 \text{ m}$$

Molality of ethanol ( $\text{C}_2\text{H}_5\text{OH}$ ) = 7.57 m

24. (A) Equal number of amino and carboxyl groups makes it neutral, more number of amino than carboxyl groups makes it basic and more carboxyl as compared to amino groups makes it acidic.

(i) Amino acids which contain two group and one  $-\text{NH}_2$  group are called acidic amino acid, e.g., aspartic acid.

(ii) Amino acids which contain two  $-\text{NH}_2$  group and one group are called basic amino acids, e.g., lysine.

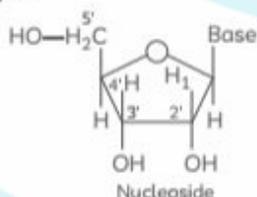
(iii) Amino acids which contain one and one  $-\text{NH}_2$  group are called neutral amino acids, e.g., glycine.

(B) (i) Amino acids that cannot be synthesized by the body and must be supplied in the diet are called essential amino acids, e.g., lysine, valine, leucine, etc.

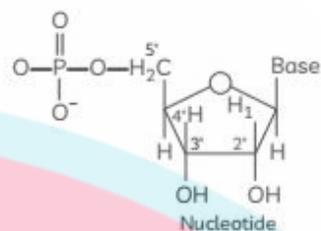
(ii) The amino acids which are synthesized by our body are called non-essential amino acids, e.g., alanine, glycine, etc.

OR

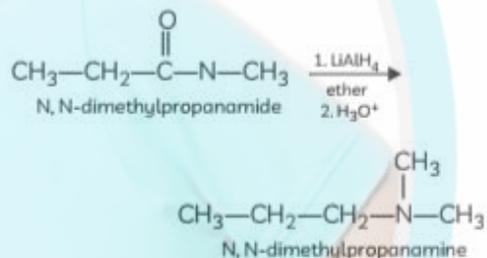
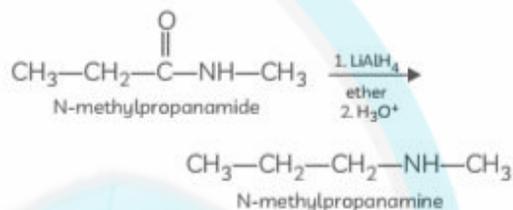
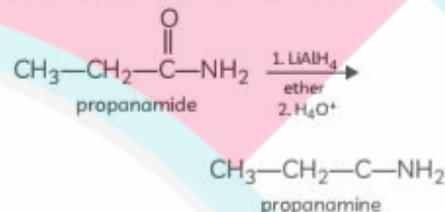
**Nucleosides:** A nucleoside is the condensation product of purine or pyrimidine base with pentose sugar.



**Nucleotides:** The monomeric unit of nucleic acid is called nucleotide. When a nucleoside is linked to phosphoric acid at 5' position of sugar moiety we get nucleotide.

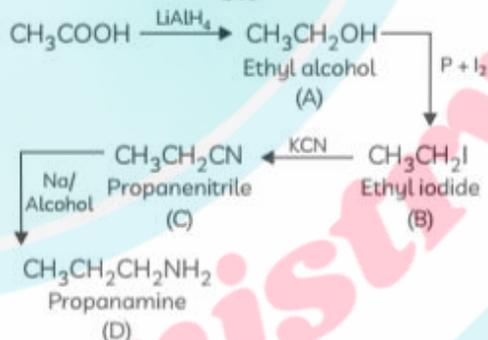


25. (A) Amides are reduced to their corresponding amines by lithium aluminium hydride. It is possible to synthesise secondary amines by substituting N and N, N amides.



(B) Pyridine is a stronger base than the amine, pyridine removes HCl formed in acylation reaction of amines and shifts the equilibrium to the right hand side.

OR



26. (A)  $\text{Cl}-\text{CH}_2\text{COOH}$  has lower  $\text{P}k_a$  value than acetic acid. Also Cl group is an electron withdrawing creating less electron density on oxygen of carboxylic acid making the release of proton easier than acetate ion. Hence,  $\text{Cl}_2-\text{CH}_2\text{COOH}$  is a stronger acid than  $\text{CH}_3\text{COOH}$ .

(B) This is due to the lone pairs on oxygen atom attached to hydrogen atom in the  $-\text{COOH}$  group are involved in resonance

and hence making the carbon atom less electrophilic. Hence, carboxylic acids do not give the reaction of carbonyl groups.

## SECTION - C

27. (A) Difference between DNA and RNA :

S.No.	DNA	RNA
(1)	The sugar present in DNA is 2-deoxy(-) ribose.	The sugar present in RNA is D(-) ribose.
(2)	DNA contains cytosine and thymine as pyrimidine bases.	RNA contains cytosine and uracil as pyrimidine bases.
(3)	DNA has double standard $\alpha$ -helix structure.	RNA has single stranded $\alpha$ -helix structure.

The base which are common to both DNA and RNA are :

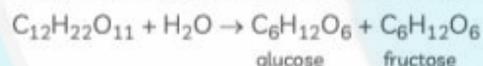
Adenine (A)

Guanine (G)

Cytosine (C)

Thymine is present in DNA.

(B) Sucrose on hydrolysis gives equimolar mixture of D(+)-glucose and D(-) fructose



28. Given: Weight of solute HBr ( $W_2$ ) = 8.1g

$$\text{Molecular weight of HBr } (M_2) = 80 + 1 = 81 \text{ g mol}^{-1}$$

Weight of solvent ( $W_1$ ) = 100 g

Molecular weight of solvent ( $M_1$ ) = 18 g mol<sup>-1</sup>

Percentage of dissociation ( $\alpha \times 100$ ) = 90%

$$\therefore \alpha = 0.90$$

To find: Freezing point of solution  $T_f$

$$\text{Formula: } \Delta T_f = K_f \times m$$

( $m$  is molality)

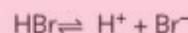
$$\Delta T_f = k_f \times m$$

$$= k_f \times \frac{W_2}{M_2} \times \frac{1}{W_1} \times 1000$$

$$= 1.86 \times \frac{8.1}{81} \times \frac{1}{100} \times 1000$$

$$\Delta T_{f(\text{theor})} = 1.86 \text{ K} \quad \dots(2)$$

$$i \text{ (van't Hoff factor)} = \frac{\Delta T_f(\text{observed})}{\Delta T_f(\text{theoretical})} \quad \dots(3)$$



$$\text{Initial} \quad 1 \quad 0 \quad 0$$

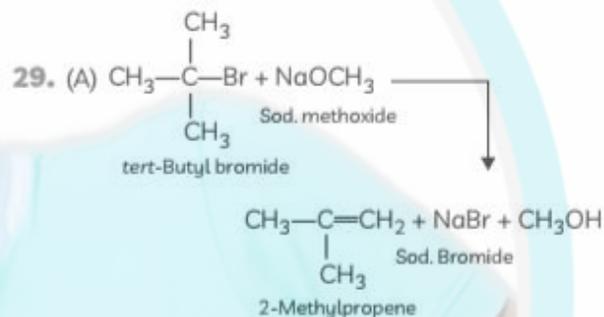
$$\text{Final} \quad 1 - \alpha \quad \alpha \quad \alpha$$

$$i = 1 - \alpha + \alpha + \alpha = 1 + \alpha = 1 + 0.90 = 1.9$$

Substituting in equation (3)

$$\Delta T_{f(\text{observed})} = 1.9 \times 1.86 = 3.534$$

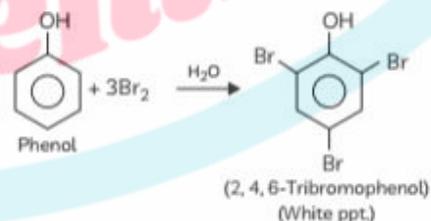
$$\Delta T_{f(\text{observed})} = T_0 - T_f = 0 - 3.534 = -3.53 \text{ }^\circ\text{C}$$



(B) Phenoxide ion is more reactive than phenol towards electrophilic aromatic substitution and hence undergo electrophilic substitution with carbon dioxide which is a weak electrophile.

(C) Denatured ethanol is the ethanol with some impurity which is called denaturing agents. Denatured alcohol is not suitable for drinking purposes and adulterated with toxic and/or bad tasting additives (e.g., methanol, benzene, pyridine, castor oil, gasoline, isopropyl alcohol, and acetone), making it unsuitable for human consumption.

(D) When phenol is treated with bromine water, white precipitate of 2, 4, 6-tribromophenol is obtained.



30. (A) Zero order reaction

(B) Slope =  $-k$

(C) Unit of  $k = \text{mol L}^{-1} \text{s}^{-1}$

**Explanation:** In case of a zero-order reaction, the rate of reaction is independent of the concentration of the reactant. The concentration  $[A]_t$  of the reactant at a time  $t$  is given by:

$$[A]_t = -kt + [A]_0 \quad (y = -mx + c)$$

Where,  $[A]_0$  is the initial concentration of the reactant and  $k$  is a rate constant.

When the concentration of the reactant is plotted against time, a straight line with the slope equal to  $-k$  is obtained.

OR

For first order reaction:

$$k = \frac{2.303}{t} \log \frac{[R_0]}{[R]}$$

Given

$$k = 5 \times 10^{-4} \text{ s}^{-1}$$

$$[R_0] = 0.25 \text{ M}, t = 2 \text{ min} = 120 \text{ s}$$

After putting the value in formula

$$5 \times 10^{-4} = \frac{2.303}{120} \log \frac{[0.25]}{[R]}$$

$$\Rightarrow \log \frac{[0.25]}{[R]} = \frac{5 \times 120 \times 10^{-4}}{2.303}$$

$$\Rightarrow \log(0.25) - \log[R] = 2.6 \times 10^{-2}$$

$$\Rightarrow -0.602 - \log[R] = 0.026$$

$$\Rightarrow -\log[R] = 0.602 + 0.026$$

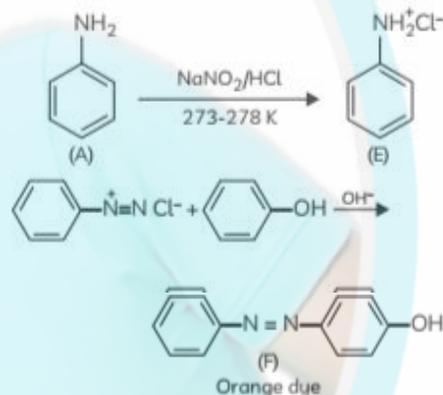
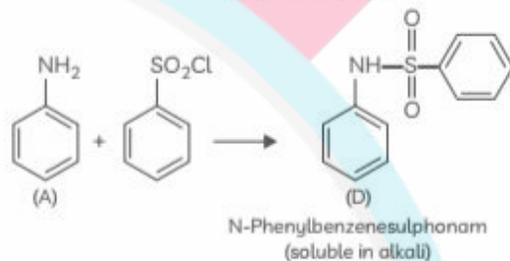
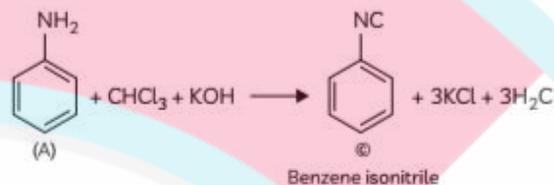
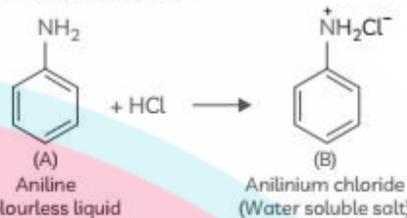
$$\Rightarrow \log[R] = 0.628$$

$$\Rightarrow [R] = \text{antilog}(-0.628)$$

$$\Rightarrow [R] = .235 \text{ M}$$

So, remaining concentration of  $\text{N}_2\text{O}_5 = 0.235 \text{ M}$ .

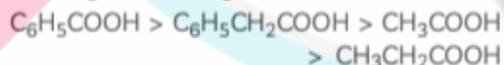
31. Compounds are as follows:



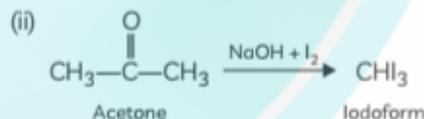
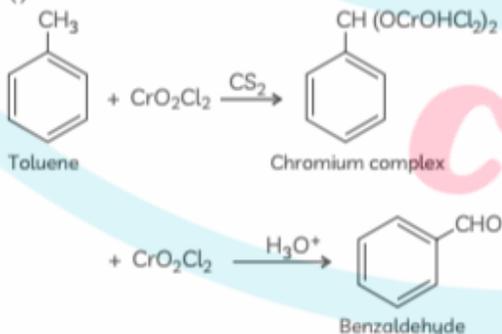
## SECTION - D

32. (A) Aromatic aldehyde and formaldehyde undergo Cannizzaro reaction because formaldehyde is more reactive than aromatic aldehyde

(B) The decreasing order of acidity of a few carboxylic acids is given below:

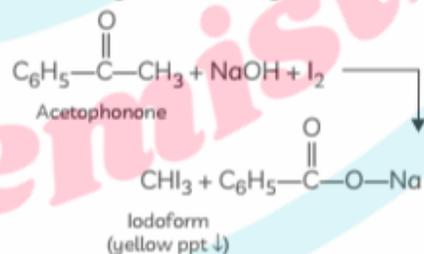


(C) (i)



OR

(i) Acetophenone is a methyl ketone. Thus it gives Iodoform test with  $\text{NaOH}$  and  $\text{I}_2$ . Benzaldehyde does not give Iodoform test.



(ii) (1) Phenol reacts with  $\text{FeCl}_3$  solution to give a violet complex whereas benzoic acid does not give this reaction.



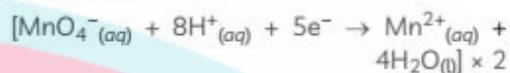


For weak electrolytes, the graph plotted between molar conductivity and  $c^{1/2}$  (where  $c$  is the concentration) is not a straight line. Weak electrolytes have lower molar conductivities and lower degree of dissociation at higher concentrations which increases steeply at lower concentrations. Therefore, limiting molar conductivity,  $\Lambda_m^\circ$  cannot be obtained by

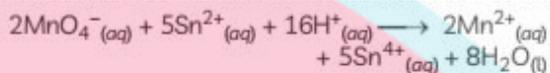
extrapolation of molar conductivity to zero concentration. Hence, we use Kohlrausch's law of independent migration of ions for determining to limit molar conductivity,  $\Lambda_m^\circ$  of weak electrolytes.



At cathode :



Cell reaction :



$$\begin{aligned} E^\circ_{\text{cell}} &= E_{\text{cathode}} - E_{\text{anode}} \\ &= 1.51\text{V} - 0.15\text{V} \\ &= 1.36\text{V} \end{aligned}$$

As cell potential is positive, therefore the reaction is product favoured.

(C)  $\text{MnO}_4^-$  because it has highest reduction potential.



**Chemistry for all**