

# Sample Paper 6 Solutions

Class XII 2023-24

Chemistry

Time: 3 Hours

Max. Marks: 70

## General Instructions:

1. There are 33 questions in this question paper with internal choice.
2. SECTION A consists of 16 multiple-choice questions carrying 1 mark each.
3. SECTION B consists of 5 very short answer questions carrying 2 marks each.
4. SECTION C consists of 7 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

$x = 0$

**Directions (Q. Nos. 1-16) :** 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. Enzyme is:

- (a) Carbohydrate                      (b) Lipid  
(c) Proteins                              (d) None of these

**Ans :** (c) Proteins

Enzymes are soluble protein molecules that can speed up chemical reactions in cells. These reactions include respiration, photosynthesis and making new proteins. For this reason enzymes are sometimes called biological catalysts.

2. A compound on hydrolysis gives 1°-amine. The compound is

- (a) anilide                              (b) amide  
(c) cyanide                              (d) none of these

**Ans :** (d) none of these

Isocyanides are hydrolyzed by dilute mineral acids to give secondary amine and formic acid (Isocyanides are not hydrolyzed by bases).

Isocyanides are named as Alkyl isocyanides. Anilide also not give 1° amine.

3. The oxidation state of nickel in  $[\text{Ni}(\text{CO})_4]$  is :

- (a) 4                                      (b) 0  
(c) 2                                      (d) 3

**Ans :** (b) 0

The oxidation state for nickel is assigned as zero. The formula conforms by 18-electron rule. The molecule is tetrahedral, with four carbonyl ligands attached to nickel.

$[\text{Ni}(\text{CO})_4]$

$$x + 0 \times 4 = 0$$

4. Formula of copper pyrite is :

- (a)  $\text{Cu}_2\text{S}$                               (b)  $\text{CuFeS}$   
(c)  $\text{CuFeS}_2$                           (d)  $\text{Cu}_2\text{Fe}_2\text{S}_2$

**Ans :** (c)  $\text{CuFeS}_2$

Copper-pyrites is the ore of copper (Cu). Its formula is  $\text{CuFeS}_2$ .

5. Which one of the following will produce maximum depression of freezing point?

- (a)  $\text{K}_2\text{SO}_4$                               (b)  $\text{NaCl}$   
(c) Urea                                  (d) Glucose

**Ans :** (a)  $\text{K}_2\text{SO}_4$

Depression in freezing point is a colligative property. It depends on the number of solute particles in the solution. Number of solution particles the solution  $\propto$  colligative property.

(a) For,  $\text{K}_2\text{SO}_4 \longrightarrow 2\text{K}^+ + \text{SO}_4^{2-}$

$$\text{Number of particles} = 2 + 1 = 3$$

(b) For,  $\text{NaCl} \longrightarrow \text{Na} + \text{Cl}^-$

$$\text{Number of particles} = 1 + 1 = 2$$

(c) For, Urea  $\longrightarrow$  No, dissociation

$$\text{Number of particles} = 1$$

(d) For, Glucose  $\longrightarrow$  No, dissociation

$$\text{Number of particles} = 1$$

Hence, (a) is the correct option.

**Important MCQ Question  
Class 12 Chemistry**

6. Which of the following statement for order of reaction is not correct?
- Order can be determined experimentally
  - Order of reaction is equal to sum of the powers of concentration terms in differential rate law
  - It is not affected with the stoichiometric coefficient of the reactants
  - Order cannot be fractional

**Ans :** (d) Order cannot be fractional

Order of a reaction can be fractional. Rest of all are true.  
Order of a reaction can be determined experimentally.

7. Carbon atom in the carbonyl group is:
- $sp$ -hybridised
  - $sp^2$ -hybridised
  - $sp^3$ -hybridised
  - $dsp^2$ -hybridised

**Ans :** (b)  $sp^2$ -hybridised

The oxygen atom must have either  $Sp^2$  or  $Sp$  hybridization because it needs a  $p$  orbital to participate in the C–O bond. In carbonyl compounds, oxygen atom has three attachments (the carbon and two lone pairs). So we use  $Sp^2$  hybridization.

8. Fused NaCl on electrolysis gives ..... on cathode.
- chlorine
  - sodium
  - sodium amalgam
  - hydrogen

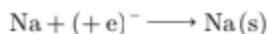
**Ans :** (b) sodium

Fused NaCl contain  $Na^+$  and  $Cl^-$  ions. On electrolysis  $Na^+$  ions move towards negatively charged electrode and changed as sodium  $[Na(s)]$  while  $Cl^-$  ions move towards positively charged electrode and librate  $Cl_2(g)$ . Thus, Reduction occurs at cathode and oxidation at anode are as follows :

**At Anode**



**At Cathode**



Hence, (b) is the correct option.

9. Which of the following aqueous solution should have the highest boiling point?
- 1.0 M NaOH
  - 1.0 M  $Na_2SO_4$
  - 1.0 M  $NH_4NO_3$
  - 1.0 M  $KNO_3$

**Ans :** (b) 1.0 M  $Na_2SO_4$

As we know greater value of Van't Hoff factor higher will be the elevation in boiling point and hence higher will be the boiling point of solution Since value of  $i$  for  $Na_2SO_4$  is highest.

Solution	Vant't off factor (i)
1.0M $Na_2SO_4$	3
1.0M $NH_4NO_3$	2
1.0M $KNO_3$	2

Hence, 1.0M  $Na_2SO_4$  has highest boiling point.

10. What are the products formed by the chlorination of methane in diffused sunlight?
- $CCl_4$
  - $CH_2Cl_2$
  - $CHCl_3$
  - All of these

**Ans :** (d) All of these

Chlorination of methane ( $CH_4$ ) will takes place via free-radical mechanism. All the four hydrogen atoms of the  $CH_4$  can be replaced by the chlorine (Cl) during chlorination of methane:



Hence, (a), (b) and (c) are the correct options.

## Important MCQ Question Class 12 Chemistry

11. Which one of the following is diamagnetic ion?
- $Co^{2+}$
  - $Ni^{2+}$
  - $Cu^{2+}$
  - $Zn^{2+}$

**Ans :** (d)  $Zn^{2+}$

In transition metals, the species contain unpaired electrons in d-subshell are paramagnetic while those have no unpaired electrons are diamagnetic in nature.

The metals (ions/atoms) with  $d^1$  to  $d^9$  electrons are paramagnetic while metals with  $d^0$  or  $d^{10}$ -outermost electronic configuration are diamagnetic.

- $Co^{2+} \rightarrow$  has  $d^7$  electrons, thus is paramagnetic.
  - $Ni^{2+} \rightarrow$  has  $d^8$  electrons, thus is paramagnetic.
  - $Cu^{2+} \rightarrow$  has  $d^9$  electrons, thus is paramagnetic.
  - $Zn^{2+} \rightarrow$  has  $d^{10}$  electrons, thus is diamagnetic.
- Hence, (d) is the correct option.

12. The rate of the reaction  $2N_2O_5 \longrightarrow 4NO_2 + O_2$  can be written in three ways:

$$-\frac{d[N_2O_5]}{dt} = k[N_2O_5]$$

$$\frac{d[NO_2]}{dt} = k'[N_2O_5]$$

$$\frac{d[O_2]}{dt} = k''[N_2O_5]$$

The relationship between  $k$  and  $k'$  and between  $k$  and  $k''$  are

- $k' = 2k; k'' = k$
- $k' = 2k; k'' = \frac{k}{7}$
- $k' = 2k; k'' = 2k$
- $k' = k; k'' = k$

**Ans :** (b)  $k' = 2k; k'' = \frac{k}{2}$

Rate of disappearance of reactants = Rate of appearance of products

$$-\frac{1}{2} \frac{d[\text{N}_2\text{O}_5]}{dt} = \frac{1}{4} \frac{d[\text{NO}_2]}{dt} = \frac{d[\text{O}_2]}{dt}$$

$$\frac{1}{2} k[\text{N}_2\text{O}_5] = \frac{1}{4} k' [\text{N}_2\text{O}_5] = k'' [\text{N}_2\text{O}_5]$$

$$\frac{k}{2} = \frac{k'}{4} = k''$$

$$k' = 2k$$

$$k'' = \frac{k}{2}$$

**Directions (Q. Nos. 13-16) :** Each of the following questions consists of two statements, one is Assertion and the other is Reason. Give answer :

**13. Assertion :** Hydrolysis of sucrose is known as inversion of cane sugar.

**Reason :** Sucrose is a disaccharide.

- (a) Both Assertion and Reason are correct and Reason is a correct explanation of the Assertion.  
 (b) Both Assertion and Reason are correct but Reason is not the a correct explanation of the Assertion.  
 (c) Assertion is correct but Reason is incorrect.  
 (d) Both the Assertion and Reason are incorrect.

**Ans :** (b) Both Assertion and Reason are correct but Reason is not the a correct explanation of the Assertion.

Sucrose is a disaccharide with specific rotation of  $+66.5^\circ$ . On hydrolysis, it gives 1 mole of  $D-(+)$  glucose and 1 mole of  $D-(-)$  fructose. The hydrolysate is laevorotatory hence hydrolysis is known as inversion of sucrose.

## Important MCQ Question Class 12 Chemistry

**14. Assertion :** Glycosides are hydrolyzed in acidic conditions.

**Reason :** Glycosides are acetals.

- (a) Both Assertion and Reason are correct and Reason is a correct explanation of the Assertion.  
 (b) Both Assertion and Reason are correct but Reason is not the a correct explanation of the Assertion.  
 (c) Assertion is correct but Reason is incorrect.  
 (d) Both the Assertion and Reason are incorrect.

**Ans :** (d) Both the Assertion and Reason are incorrect.

Glycosides are formed by treating glucose with methanol in presence of dry HCl gas. They cannot be hydrolysed in acidic conditions. They are not acetals but they are hemiacetals.

**15. Assertion :** According to transition state theory for the formation of an activated complex, one of the vibrational degree of freedom.

**Reason :** Energy of the activated complex is higher than the energy of reactant molecules.

- (a) Both Assertion and Reason are correct and Reason is a correct explanation of the Assertion.  
 (b) Both Assertion and Reason are correct but Reason is not the a correct explanation of the Assertion.  
 (c) Assertion is correct but Reason is incorrect.  
 (d) Both the Assertion and Reason are incorrect.

**Ans :** (b) Both Assertion and Reason are correct but Reason is not the a correct explanation of the Assertion.

The formation of an activated complex takes place when vibrational degree of freedom covert into a translational degree of freedom. This statement is given by transition statement theory. Also the energy of activated complex is higher than the energy of reactant molecule is true but is not the correct explanation of the assertion.

**16. Assertion :** 4-Nitrochlorobenzene undergoes nucleophilic substitution more readily than chlorobenzene.

**Reason :** Chlorobenzene undergoes nucleophilic substitution by elimination-addition mechanism while 4-nitrochlorobenzene undergoes nucleophilic substitution by addition-elimination mechanism.

- (a) Both Assertion and Reason are correct and Reason is a correct explanation of the Assertion.  
 (b) Both Assertion and Reason are correct but Reason is not the a correct explanation of the Assertion.  
 (c) Assertion is correct but Reason is incorrect.  
 (d) Both the Assertion and Reason are incorrect.

**Ans :** (b) Both Assertion and Reason are correct but Reason is not the a correct explanation of the Assertion.

As compared to chlorobenzene, the intermediate carbanion resulting from 4-nitrochlorobenzene is stabilized by-R-effect of the  $\text{NO}_2$  group.

## SECTION-B

**Directions (Q. Nos. 17-21) :** This section contains 5 questions with internal choice in one question. The following questions are very short answer type and carry 2 marks each.

**17. What is meant by molality of the solution ?**

**Ans :**

Molality is defined as the number of moles of the solute per kilogram of the solvent. It is represented by  $m$ .

$$\text{Molality } (m) = \frac{\text{Number of moles of solute}}{\text{Mass of solvent (in kg)}}$$

18. Any transition series contains only ten elements. Why ?

**Ans :**

Transition series elements belongs to d-block. Outer most electron in each series of transition metal belongs to *d*-sub-shell. Also any *d*-sub-shell can only accommodate maximum number of ten (10) electrons. As one electron is added in each next element, as we proceed in a period, in any transition series.

Therefore, only 10 elements are possible in each series of transition elements.

19. What do you mean by half time of a reaction?

**Ans :**

**Half time of a reaction :** Half life or time ( $t_{1/2}$ ) of reaction is the time required for the concentration of a reactant to decrease to one half its initial value.

$$\text{e.g. Half life } (t_{1/2}) = \frac{0.693}{k} \text{ (for first order)}$$

20. What are alcohols?

**Ans :**

**Alcohols** are the hydroxy derivatives of aliphatic hydrocarbons.

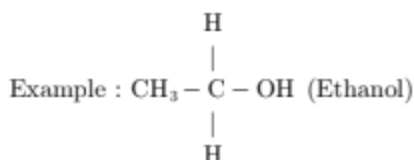
An alcohol is formed when one or more hydrogen atom (s) in an aliphatic hydrocarbon is replaced by hydroxyl (OH) group (s). An alcohol is represented as R – OH.

**or**

What do you mean by primary alcohols?

**Ans :**

In primary alcohols, only one carbon atom is directly bonded to the carbon carrying the –OH group.



21. Give one example of each of the following reactions:

- (i) Wurtz reaction  
(ii) Wurtz-Fitting reaction.

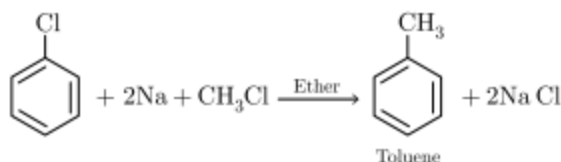
**Ans :**

- (i) **Wurtz Reaction :** It converts alkyl halides into alkane.

Example :



- (ii) **Wurtz-Fitting Reaction :** It converts an aryl halide and alkyl halide into the corresponding hydrocarbon.



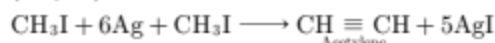
## SECTION-C

**Directions (Q. Nos. 22-28) :** This section contains 7 questions with internal choice in one question. The following questions are short answer type and carry 3 marks each.

22. (i) What happens when iodoform is heated with silver powder? Write the chemical equation.  
(ii) Out of ethyl bromide and ethyl chloride which has higher boiling point and why?

**Ans :**

- (i) When iodoform is heated with silver powder, acetylene (ethyne) is formed.



- (ii) The boiling point of ethyl bromide is higher due to greater magnitude of the van der Waals' forces which depends upon molecular size of the halogen atom.

23. How is standard Gibbs energy of a reaction is related to its equilibrium constant ?

**Ans :**

If standard emf of a cell is  $E_{\text{cell}}^{\circ}$  and  $nF$  is the amount of charge passed, then standard Gibbs energy of the reaction,

$$\Delta_r G^{\circ} = -nFE_{\text{cell}}^{\circ}$$

Further, we know

$$E_{\text{cell}}^{\circ} = \frac{RT}{nF} \ln K_C$$

$$\text{Hence, } \Delta_r G^{\circ} = -nF \times \frac{RT}{nF} \ln K_C$$

$$= -RT \ln K_C$$

$$= -2.303 RT \log K_C$$

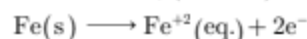
24. Construct electric cells for the following reactions:

- (i)  $\text{Fe} + \text{Cu}^{2+} \longrightarrow \text{Cu} + \text{Fe}^{2+}$   
(ii)  $2\text{Fe}^{3+} + 2\text{Cl}^{-} \longrightarrow 2\text{Fe}^{2+} + \text{Cl}_2$

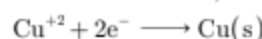
**Ans :**

- (i)  $\text{Fe} + \text{Cu}^{+2} \longrightarrow \text{Cu} + \text{Fe}^{+2}$

Oxidation reaction, (for iron)



Reduction reaction,

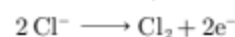


Hence, Cell reaction,

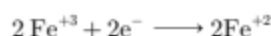


- (ii)  $2\text{Fe}^{+3} + 2\text{Cl}^{-} \longrightarrow 2\text{Fe}^{+2} + \text{Cl}_2$

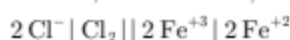
Oxidation reaction,



and Reduction reaction,



Hence, Cell reaction,



**Important MCQ Question  
Class 12 Chemistry**

25. Write the electronic configuration of  $\text{Cu}^+$  and also draw the figure.

**Ans :**

Atomic number of copper,

$$(\text{Cu}) = 29$$

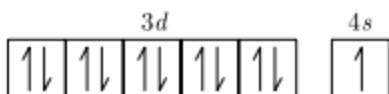
i.e. ( $Z = 29$ )

When Cu changes to  $\text{Cu}^+$  ion, one of its electron is removed from 4s, Thus number of electrons in

$$\text{Cu}^+ = 28$$

Since, outermost electron configuration of

$$\text{Cu} = 3d^{10}, 4s^1$$



Hence, electron configuration of

$$\text{Cu}^+ = 3d^{10}, 4s^0$$



## Important MCQ Question Class 12 Chemistry

26. Write a note on rules for writing IUPAC names of alcohols.

**Ans :**

The most versatile and systematic system is IUPAC. The rules are:

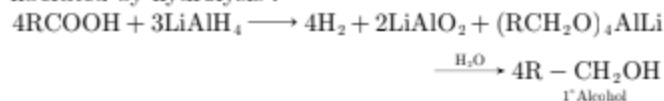
- Alcohols are named by replacing the suffix *e* in the names of alkanes by *ol*. Thus, the generic IUPAC name for alcohol is alkanols.
- The longest continuous carbon chain that contains the  $-\text{OH}$  group is selected as the parent chain.
- The position of the  $-\text{OH}$  group in the parent chain is indicated by a number using the lowest possible number for this purpose.
- The positions of other groups attached to the parent chain are also indicated by numbers.
- For naming polyhydric alcohols, the full name of the alkane is retained (even the ending-*e* is not removed). The positions of carbon atoms carrying-OH groups are indicated by locants written after the name of alkane. The multiplicative prefix di, tri, tetra, etc. before the suffix-*ol* is used for indicating the number of hydroxyl groups.

27. How can one reduce carboxylic acid to alcohol?

**Ans :**

The acids can be reduced to alcohols by using a strong reducing agent, Lithium aluminium hydride ( $\text{LiAlH}_4$ ). The

initial product is an alkoxide from which the alcohol is liberated by hydrolysis :

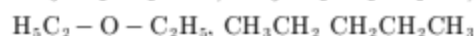
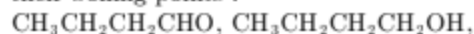


**NOTE :** \*Along the arrow, the numbers in front of the reagents indicate that the second reagent is added only when the reaction with first is complete.

The alcohol is obtained in excellent yield. However,  $\text{LiAlH}_4$  being an expensive reagent, is used in industry only for the reduction of small amounts of valuable raw materials, as in the synthesis of certain drugs and hormones.

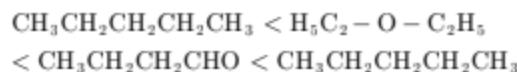
**or**

Arrange the following compounds in the increasing order of their boiling points :



**Ans :**

The molecular masses of these compounds are in the range of 72 to 74.  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CHO}$  (72),  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$  (74),  $\text{C}_2\text{H}_5-\text{O}-\text{C}_2\text{H}_5$  (74),  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$  (72), Since only butan-1-ol ( $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2-\text{OH}$ ) molecules are associated due to extensive intermolecular hydrogen bonding, therefore, the boiling point of butan-1-ol would be the highest. Butanal ( $\text{CH}_3\text{CH}_2\text{CH}_2\text{CHO}$ ) is more polar than ethoxy ethane ( $\text{C}_2\text{H}_5-\text{O}-\text{C}_2\text{H}_5$ ). Therefore the intermolecular dipole-dipole interaction is stronger in Butanal. *n*-pentane ( $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$ ) molecules have only weak Vander Waals forces. Hence the increasing order of boiling points of the given compounds is as follows :



28. Write main series of transition metals.

**Ans :**

There are four main series of transition metals

- 3d series or first transition series :  $_{21}\text{Sc}$  to  $_{30}\text{Zn}$
- 4d series or second transition series :  $_{39}\text{Y}$  to  $_{48}\text{Cd}$
- 5d series or third transition series :  $_{57}\text{La}$  to  $_{80}\text{Hg}$
- 6d series or fourth transition series :  $_{89}\text{Ac}$  to  $_{112}\text{Cn}$

## SECTION-D

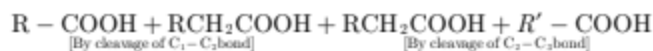
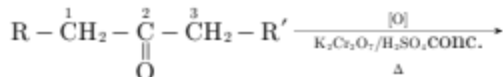
**Directions (Q. Nos. 29-30) :** The following questions are case-based questions. Each question has an internal choice and carries 4 marks each. Read the passage carefully and answer the questions that follow.

29. Oxidation of Aldehydes and Ketones (Popoff's Rule)  
Aldehydes differ from ketones in their oxidation reactions. Aldehydes are easily oxidised to carboxylic acids on treatment with common oxidising agents like  $\text{HNO}_3$ ,  $\text{KMnO}_4$ ,  $\text{K}_2\text{Cr}_2\text{O}_7$ , etc. Even mild oxidising agents mainly Tollen's reagent, Fehling's solution, Benedict reagents, also

oxidise aldehydes.

Ketones are difficult to oxidise. They are oxidised by strong oxidising agents at elevated temperature. Their oxidation involves C—C cleavage to form mixture of carboxylic acids. The oxidation of ketones is governed by Popoff's rule. 'In unsymmetrical ketones, on oxidation of ketones to

carboxylic acids,  $\text{>C=O}$  group is retained by smaller alkyl group' is Popoff's rule.



Ketones do not react with Tollen's reagent and Fehling's solutions. Methyl ketones give yellow precipitate of iodoform with I<sub>2</sub> and NaOH. Ketones can be oxidised by haloform reaction if they have one methyl group.

Answer the following questions:

- (a) Why is it difficult to oxidise ketone as compared to aldehyde?
- (b) What happens when 3-methyl-pentan-2-one reacts with sodium hypochlorite? Write chemical reaction involved?
- (c) A compound A C<sub>5</sub>H<sub>10</sub>O does not give silver mirror with Tollen's reagent, it gives iodoform test with I<sub>2</sub>/NaOH. Write possible structures of compounds and write the chemical reactions involved.

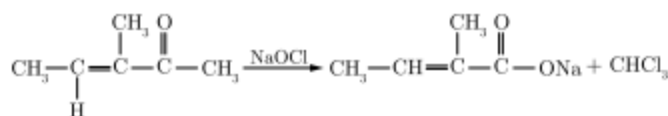
or

(d) What happens when :

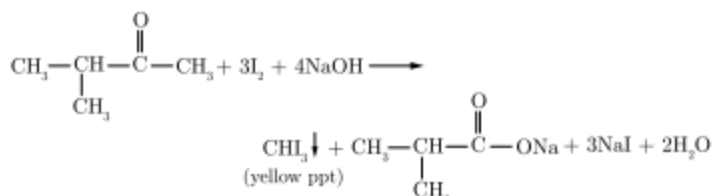
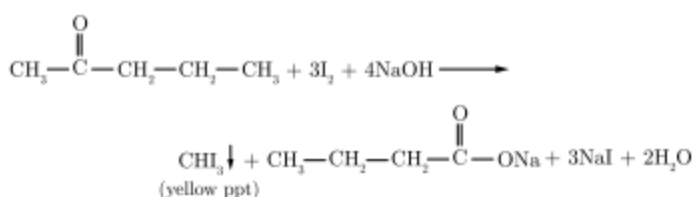
- (i) Pentan-2-one is oxidised with K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>/H<sub>2</sub>SO<sub>4</sub>(conc.) on heating.
- (ii) Acetophenone is oxidised on heating with K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>/H<sub>2</sub>SO<sub>4</sub>(conc.).

Ans :

- (a) It is because C—C bond is difficult to break and needs more bond dissociation enthalpy than C—H bond.
- (b) Sodium salt of 2-methyl but-2-enoate and chloroform are formed.

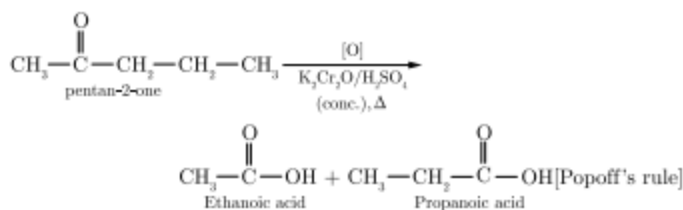


(c)

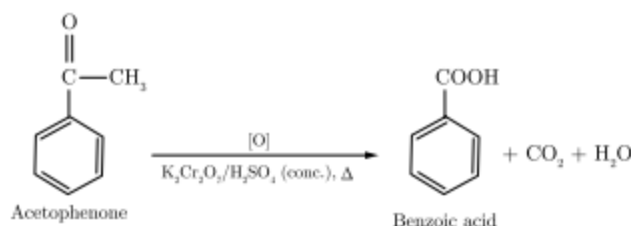


or

(d) (i)



(ii)



## Important MCQ Question Class 12 Chemistry

30. Most distinctive properties of transition metal complexes is their wide range of colours. The colour of complex is complementary to that which is absorbed. The complementary colour is the colour generated from the wavelength left over. The following table gives the relationship of the different wavelength absorbed and the colour observed.

**Table : Relationship between the Wavelength of Light absorbed and the Colour observed in some Coordination Entities**

Coordination entity	Wavelength of light absorbed (nm)	Colour of light absorbed	Colour of coordination entity
[CoCl(NH <sub>3</sub> ) <sub>5</sub> ]	535	Yellow	Violet
[Co(NH <sub>3</sub> ) <sub>5</sub> (H <sub>2</sub> O)] <sup>2+</sup>	500	Blue Green	Red
[Co(NH <sub>3</sub> ) <sub>6</sub> ] <sup>3+</sup>	475	Blue	Yellow Orange
[Co(CN) <sub>6</sub> ] <sup>3-</sup>	310	Ultraviolet	Pale Yellow
[Cu(H <sub>2</sub> O) <sub>4</sub> ] <sup>2+</sup>	600	Red	Blue
[Ti(H <sub>2</sub> O) <sub>6</sub> ] <sup>3+</sup>	489	Blue Green	Violet

- (a) Why does [Co(CN)<sub>6</sub>]<sup>3-</sup> absorb U.V. light and not from visible region?
- (b) Why is [Ti(H<sub>2</sub>O)<sub>6</sub>]<sup>3+</sup> violet in colour where as [Cu(H<sub>2</sub>O)<sub>4</sub>]<sup>2+</sup> is blue?

- (c)
- (i) If CFSE for  $[\text{Co}(\text{NH}_3)_6]^{3+}$  is  $27000 \text{ cm}^{-1}$ , what is CFSE for  $[\text{Cu}(\text{H}_2\text{O})_4]^{2+}$ ?
- (ii) Why is  $[\text{Ti}(\text{H}_2\text{O})_6]^{4+}$  colourless?
- or**
- (d) What will be the correct order for the wavelength of absorption for the following complexes? Give reason.  
 $[\text{Co}(\text{CN})_6]^{3-}$ ,  $[\text{Co}(\text{NH}_3)_6]^{3+}$ ,  $[\text{Cu}(\text{H}_2\text{O})_6]^{2+}$

**Ans :**

- (a) It is because  $\text{CN}^-$  is strong field ligand, therefore,  $\Delta_0$  (CFSE) is high,  $\lambda$  is low  $310 \text{ nm}$  which does not belong to visible region.
- (b)  $\Delta_t = \frac{4}{9} \Delta_0$ ,  
 Crystal field splitting energy is low in  $[\text{Cu}(\text{H}_2\text{O})_4]^{2+}$  is blue.  
 So  $\lambda$  is higher (Since  $E = \frac{hc}{\lambda}$ ) absorbed blue colour, is radiated as compared to  $\lambda = 498 \text{ nm}$  is absorbed by  $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$  and violet colour is radiated.

- (c)
- (i) 
$$\Delta_t = \frac{4}{9} \Delta_0$$
  

$$= \frac{4}{9} \times 27000 \text{ cm}^{-1} = 12000 \text{ cm}^{-1}$$
- (ii) It is because  $\text{Ti}^{4+}$  does not have unpaired electron, can't undergo d-d transition by absorbing light from visible region and does not radiate colour.

- or**
- (d)  $[\text{Co}(\text{CN})_6]^{3-} < [\text{Co}(\text{NH}_3)_6]^{3+} < [\text{Cu}(\text{H}_2\text{O})_4]^{2+}$   
 Since, CFSE follows  $[\text{Co}(\text{CN})_6]^{3-} < [\text{Co}(\text{NH}_3)_6]^{3+} < [\text{Cu}(\text{H}_2\text{O})_4]^{2+}$   
 [Since, CFSE is inversely proportional to  $\lambda$  absorbed.]

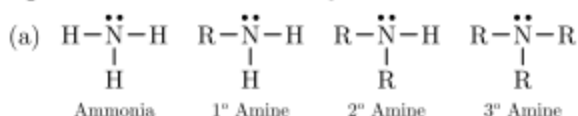
## SECTION-E

**Directions (Q. Nos. 31-33) :** The following questions are long answer type and carry 5 marks each. Two questions have an internal choice.

31. Give explanation for each of the following:
- (i) Why are aliphatic amines stronger bases than ammonia?
- (ii) Why are aliphatic amines stronger base than aromatic amines?

**Ans :**

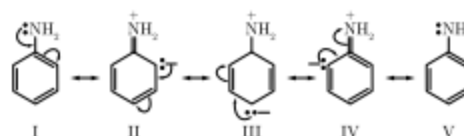
- (i) All three classes of aliphatic amines are stronger bases than ammonia because alkyl groups are electron donating groups they increase the electron density on the nitrogen atom and thus amines can **donate the lone pair of electrons** more easily than ammonia.



- (ii) Aromatic amines are less basic than ammonia and

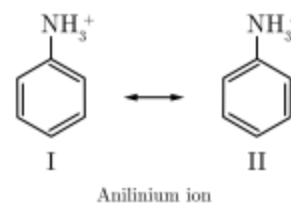
aliphatic amines. The weaker basic character of aniline is due to the following reasons:

- (a) **Resonance in aniline :**



Due to resonance, the lone pair of electrons on the nitrogen atom gets delocalised over the benzene ring and thus is less available for protonation. Therefore aromatic amines are weaker bases than ammonia.

- (b) **Lower stability of anilinium ion :** Aniline is more stable than anilinium ion because anilinium ion has only two resonating structure. Hence aniline has very little tendency to form anilinium ion by accepting a proton.



## Important MCQ Question Class 12 Chemistry

32. What is electrochemical series? Write its applications.

**Ans :**

The standard electrode potential of various electrodes are given in the decreasing order of their reducing strength, in a series called electromotive force series or electrochemical series.

**Applications of Electrochemical Series :**

1. **Calculation of standard EMF of the cell :** Standard EMF of cell can be calculated as follows :

$$\text{EMF} = E_{\text{Cathode}}^{\circ} - E_{\text{Anode}}^{\circ}$$

$E^{\circ}$  cathode and  $E^{\circ}$  anode can be found out from the electrochemical series.

2. **Comparison of the reactivity of metals :** A metal occupying lower position in the series can displace the metal lying above it from the solutions of their salts. It is due to the fact that an element with higher reduction potential is easier to reduce.
3. **Predicting the feasibility of a redox reaction :** If EMF of the hypothetical cell calculated comes out to be positive the redox reaction is feasible.
4. **To predict whether a metal reacts with dilute acid to give  $\text{H}_2$  gas or not :** A metal which lies below hydrogen in the electrochemical series can form positive ions

more readily than hydrogen. Therefore, such a metal can displace hydrogen from dilute acid.

For example :



Metals like Cu, Ag etc. which lies above hydrogen can not liberate  $\text{H}_2$  from dilute acids.

**or**

(a) What is the difference between ferromagnetism and paramagnetism?

(b) For the cell shown below :



Calculate standard cell potential if standard state reduction electrode potential for

$\text{Cu}^{2+} \mid \text{Cu}$  and  $\text{Zn}^{2+} \mid \text{Zn}$  are +0.34 Volt and -0.76 Volt respectively.

**Ans :**

(a) Paramagnetism refers to materials like aluminium, which become magnetized in a magnetic field but their magnetism disappears when the field is removed.

**Example :**  $\text{O}_2$ ,  $\text{Cu}^{2+}$ ,  $\text{Fe}^{2+}$ ,  $\text{Cr}^{3+}$  etc.

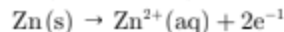
Ferromagnetism refers to materials (such as iron and nickel) that can retain their magnetic properties when the magnetic field is removed.

**Example :** Iron, Cobalt, Nickel etc.

(b)  $\text{Zn} \mid \text{ZnSO}_4(\text{aq}) \parallel \text{CuSO}_4(\text{aq}) \mid \text{Cu(s)}$

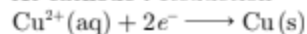
**The cell reaction :**

At anode: Oxidation



$$E^\circ, \text{Zn(s)} \mid \text{Zn}^{2+}(\text{aq}) = +0.34 \text{ Volt}$$

**At cathode : Reduction**



$$E^\circ \text{Cu}^{2+}(\text{aq}) \mid \text{Cu(s)} = 0.34 \text{ Volt}$$

According to formula,

$$\begin{aligned} E^\circ_{\text{Cell}} &= E^\circ_{\text{Cathode}} - E^\circ_{\text{anode}} \\ &= 0.34 - (-0.76) = 0.34 + 0.76 \end{aligned}$$

$$E^\circ_{\text{Cell}} = 1.10 \text{ Volt}$$

33. What are the shortcomings of valence bond theory for bonding in complexes? Briefly describe the crystal field theory.

**Ans :**

Shortcomings of valence bond theory for bonding in complexes are as follows :

- (i) A number of assumptions are made.
- (ii) The theory does not explain the colour and spectra of the complexes.
- (iii) It does not make exact predictions regarding the tetrahedral and square planar structures of four coordinate complexes.
- (iv) It does not distinguish between weak and strong field ligands.

**Crystal Field Theory**

CFT of coordination compounds is based on the effect of different crystal field (provided by the ligands taken as point charges) on the degeneracy of  $d$ -orbitals energies

of the central metal atom/ion. The splitting of  $d$ -orbitals provide different electronic arrangements in the strong and weak crystal field.

**or**

Briefly describe the importance of coordination compounds in:

- (i) Qualitative analysis
- (ii) Extraction of metals
- (iii) Biological systems

**Ans :**

(i) **Qualitative Analysis**

- (a) EDTA is used for the estimation of  $\text{Ca}^{2+}$  and  $\text{Mg}^{2+}$  ions in hard water.
- (b)  $\text{Ni}^{2+}$  ion is tested and estimated by DMG (dimethyl glyoxime).

(ii) **Extraction of Metals**

- (a) Silver and gold are extracted by treating zinc with their cyanide complexes.
- (b) Bauxite is purified by forming complexes with NaOH.
- (c) Impure nickel is converted to  $[\text{Ni}(\text{CO})_4]$ , which is decomposed to yield pure nickel.

(iii) **Biological Systems**

- (a) The pigment responsible for photosynthesis, i.e. chlorophyll is a coordination compound of Mg.
- (b) Haemoglobin is a coordination compound of iron.
- (c) Vitamin  $\text{B}_{12}$ , cyanocobalamin, the antipernicious anaemia factor is a coordination compound of cobalt.

## Important MCQ Question Class 12 Chemistry

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