

# Sample Paper 16 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.

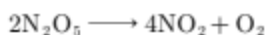
## SECTION-A

**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. For the reaction  $2\text{N}_2\text{O}_5 \longrightarrow 4\text{NO}_2 + \text{O}_2$ , rate and rate constant are  $1.02 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$  and  $3.4 \times 10^{-5} \text{ sec}^{-1}$  respectively then concentration of  $\text{N}_2\text{O}_5$  at that time will be

- (a) 1.732 M (b) 3 M  
(c)  $3.4 \times 10^5$  M (d)  $1.02 \times 10^{-4}$  M

**Ans :** (b) 3 M



From the unit of rate constant it is clear that the reaction follow first order kinetics. Hence by rate law equation

$$r = k[\text{N}_2\text{O}_5]$$

Where,  $r = 1.02 \times 10^{-4}$ ,

$$k = 3.4 \times 10^{-5}$$

$$1.02 \times 10^{-4} = 3.4 \times 10^{-5} \text{N}_2\text{O}_5$$

$$[\text{N}_2\text{O}_5] = 3 \text{ M}$$

2. If A contains 2% NaCl and is separated by a semi-permeable membrane from B Which contains 10% NaCl, then which event will occur ?

- (a) NaCl will flow from A to B  
(b) NaCl will flow from B to A  
(c) Water will net flow from A to B  
(d) Water will net flow from B to A

**Ans :** (c) Water will net flow from A to B

Solvent net flow from low concentration solution to high concentration solution.

3. The standard reduction potential at  $25^\circ\text{C}$  of  $\text{Li}^+/\text{Li}$ ,  $\text{Ba}^{2+}/\text{Ba}$ ,  $\text{Na}^+/\text{Na}$  and  $\text{Mg}^{2+}/\text{Mg}$  are  $-3.03$ ,  $-2.73$ ,  $-2.71$  and  $-2.37$  volt respectively. Which one of the following is the strongest oxidising agent?

- (a)  $\text{Na}^+$  (b)  $\text{Li}^+$   
(c)  $\text{Ba}^{2+}$  (d)  $\text{Mg}^{2+}$

**Ans :** (d)  $\text{Mg}^{2+}$

Higher the reduction potential, stronger is the oxidizing agent.

4. Chloroform is used as

- (a) Fire extinguisher (b) Industrial solvent  
(c) Refrigerant (d) Insecticide

**Ans :** (b) Industrial solvent

Chloroform is used as an extraction solvent for fats, oils, greases, rubber, waxes, gutta-percha, resins, lacquers, floor polishes, artificial silk manufacture, gums and adhesives. It is utilised as an industrial solvent in the extraction and purification of some antibiotics, alkaloids, vitamins and flavours.

5. Faraday's law of electrolysis is related to :

- (a) Atomic number of cation  
(b) Speed of cation  
(c) Speed of anion  
(d) Equivalent weight of element

**Ans :** (d) Equivalent weight of element

According to Faraday's law,

Mass of any element,  $w$ ,  $\propto$  Charge  $Q$ .

i.e., for 1 mol of charge, if given to any element, 1 equivalent weight of that substance is obtained.

Hence, Faraday's law of electrolysis is related with the equivalent weight of electrolytes.

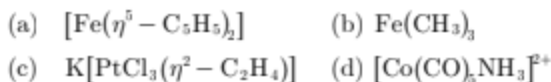
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6. Which of the following organometallic compound is  $\sigma$  and  $\pi$  bonded?



**Ans :** (d)  $[\text{Co}(\text{CO})_5\text{NH}_3]^{\oplus}$

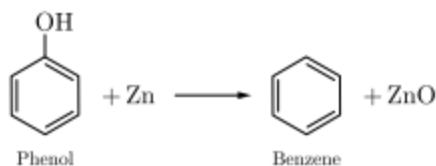
$[\text{Co}(\text{CO})_5\text{NH}_3]^{\oplus}$ . In this complex, Co-atom attached with  $\text{NH}_3$  through  $\sigma$  bonding with CO attached with dative  $\pi$  -bond.

7. On distilling phenol with Zn dust, one gets :

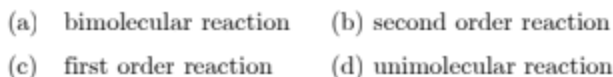


**Ans :** (c) ZnO + benzene

When phenol reacts with Zinc dust, then benzene and zinc oxide are formed.



8. A reaction involving two different reactants can never be



**Ans :** (d) unimolecular reaction

The reaction involving two different reactant can never be unimolecular.

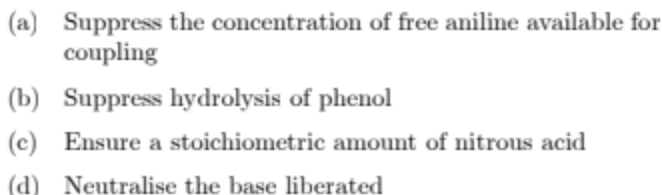
9. Photographic films and plates have an essential ingredient of:



**Ans :** (b) Silver bromide

$\text{AgBr}$  is highly photosensitive and is used in photographic films and plates.

10. In the diazotization of arylamines with sodium nitrite and hydrochloric acid, an excess of hydrochloric acid is used primarily to:



**Ans :** (a) Suppress the concentration of free aniline available for coupling

Excess of  $\text{HCl}$  is used to convert free aniline to aniline hydrochloride otherwise free aniline would undergo coupling

reaction with benzenediazonium chloride.

11. If formaldehyde and  $\text{KOH}$  are heated, then we get



**Ans :** (b) Methyl alcohol

Aldehydes containing no  $\alpha$ -hydrogen atom on warming with 50%  $\text{NaOH}$  or  $\text{KOH}$  undergo disproportionation i.e. self oxidation- reduction known as Cannizzaro's reaction



12. Which of the following protein destroy the antigen when it enters in body cell?



**Ans :** (a) Antibodies

When antigens enter in to the body cells and destroy them, then antibodies being proteins are synthesised in the body and combine with antigens and destroy these antigens by forming inactive complexes. Therefore antibodies protein destroy antigens.

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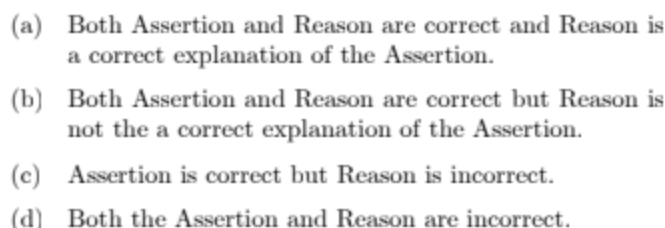
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**Directions (Q. No. 13-16) :** Each of the following questions consists of two statements, one is Assertion and the other is Reason. Give answer :

13. **Assertion :** Acetaldehyde on treatment with alkali gives aldol.

**Reason :** Acetaldehyde molecule contains  $\alpha$ -hydrogen atom.



**Ans :** (a) Both Assertion and Reason are correct and Reason is a correct explanation of the Assertion.

Acetaldehyde gives aldol condensation reaction because it contains  $\alpha$ -hydrogen.

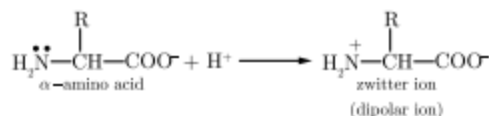
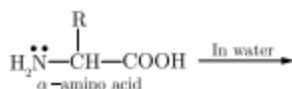
14. **Assertion :** Alpha ( $\alpha$ )- amino acids exist as internal salt in solution as they have amino and carboxylic acid groups in near vicinity.

**Reason :**  $H^+$  ion given by carboxylic group ( $-COOH$ ) is captured by amino group ( $-NH_2$ ) having lone pair of electrons.

- (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 :** (a) Both Assertion and Reason are correct and Reason is a correct explanation of the Assertion.

All  $\alpha$ -amino acids have  $-NH_2$  group is basic and  $-COOH$  group is acidic, in neutral solution it exists as internal salt which is also called as zwitter ion. This zwitter ion is formed due to reason that proton of  $-COOH$  group is transferred to  $-NH_2$  group.



15. **Assertion :** Nucleophilic substitution reaction on an optically active alkyl halide gives a mixture of enantiomers.

**Reason :** The reaction occurs by  $S_N1$  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 :** (a) Both Assertion and Reason are correct and Reason is a correct explanation of the Assertion.

In case of optically active alkyl halides,  $S_N1$  reactions are accompanied by racemisation. The carbocation formed is  $sp^2$  hybridised and planar. The attack of the nucleophile maybe accomplished from either side resulting in a mixture of products with opposite configuration i.e., racemic mixture.

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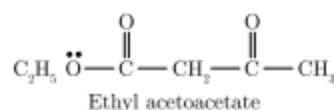
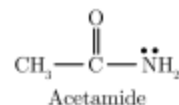
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16. **Assertion :** Acetamide has more polar  $>C=O$  group than ethyl acetoacetate.

**Reason :**  $\ddot{\text{N}}\text{H}_2$  is more electron donating than  $\ddot{\text{O}}\text{C}_2\text{H}_5$

- (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 :** (a) Both Assertion and Reason are correct and Reason is a correct explanation of the Assertion.



As- $\text{NH}_2$  is more basic than  $\text{RO}^-$  hence acetamide has more polar  $>C=O$  group than  $\text{OC}_2\text{H}_5$  group in ethyl acetoacetate. Hence assertion and reason both are true and reason is correct explanation of assertion.

## 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. Define Vapour pressure.

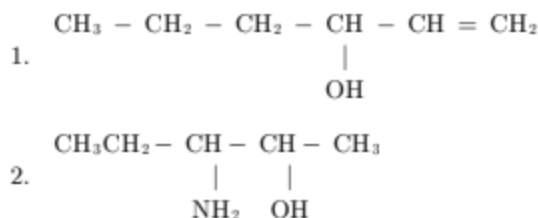
**Ans :**

Vapour Pressure of a liquid (or solution) is the pressure exerted by its vapour in equilibrium with the liquid (or solution) at a particular temperature.

18. Draw the structure of

- hex-1-en-3 ol
- 3-aminopentan-2-ol

**Ans :**



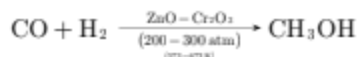
or

What is 'Wood spirit'?

**Ans :**

Methanol,  $\text{CH}_3\text{OH}$  is known as 'Wood spirit' because it

was produced by destructive distillation of wood. Today methanol is produced by catalytic hydrogenation of carbon monoxide.



19. Explain with one example each the terms weak and strong electrolytes.

**Ans :**

Those electrolytes which dissociate almost completely in the aqueous solution or in the molten state are called strong electrolytes e.g., HCl, HNO<sub>3</sub>, H<sub>2</sub>SO<sub>4</sub> etc. Those electrolytes which have low degree of dissociation and hence conduct electricity to a small extent are called weak electrolytes e.g., NH<sub>4</sub> OH, Ca (OH)<sub>2</sub> etc.

20. Write the use of formaldehyde (HCHO).

**Ans :**

Formaldehyde is well known as formalin (40%) solution used to preserve biological specimens and to prepare bakelite, urea-formaldehyde glues and other polymeric products.

or

Write the IUPAC names of :

- CH<sub>3</sub> - CH<sub>2</sub>Br - COOH
- COOH - CH<sub>2</sub> - CH<sub>2</sub> - COOH

**Ans :**

- 2-Bromo propanoic acid.
- Butane-1, 4-dioic acid.

21. Suggest a way to determine the  $\Lambda_m^\circ$  value of water.

**Ans :**

$$\Lambda_m^\circ(\text{H}_2\text{O}) = \lambda_{\text{H}^+}^\circ + \lambda_{\text{OH}^-}^\circ$$

We find out,  $\Lambda_m^\circ(\text{HCl})$ ,  $\Lambda_m^\circ(\text{NaOH})$  and  $\Lambda_m^\circ(\text{NaCl})$

Then,  $\Lambda_m^\circ(\text{H}_2\text{O}) = \Lambda_m^\circ(\text{HCl}) + \Lambda_m^\circ(\text{NaOH}) - \Lambda_m^\circ(\text{NaCl})$

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## 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. What is the difference between inner orbital or low spin complex and outer orbital or high spin complex?

**Ans :**

$d^2sp^3$  hybridised complex involves the inner  $(n-1)d$  orbitals, these complexes are called inner orbital or low spin complexes.

**Example :**  $[\text{Co}(\text{NH}_3)_6]^{3+}$ ,  $[\text{Fe}(\text{CN})_6]^{3-}$ .

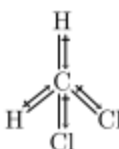
$sp^3d^2$  hybridised complex involves the outer  $nd$  orbitals, these complexes are called outer orbitals or high spin complexes.

**Example :**  $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$ ,  $[\text{CoF}_6]^{3-}$ ,  $[\text{Ni}(\text{NH}_3)_6]^{2+}$

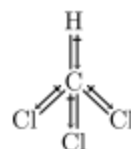
23. Which one of the following has the highest dipole moment?

- CH<sub>2</sub>Cl<sub>2</sub>
- CHCl<sub>3</sub>
- CCl<sub>4</sub>

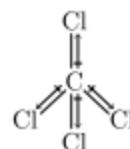
**Ans :**



Dichloromethane  
( $\mu = 1.62 \text{ D}$ )



Trichloromethane  
( $\mu = 1.03 \text{ D}$ )



Tetrachloromethane  
( $\mu = 0 \text{ D}$ )

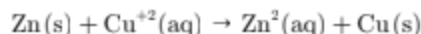
24. Give the representation of a galvanic cell.

**Ans :**

Metal Anode | Metal ion (conc.) | Metal ion (conc) | Metal Cathode | Salt Bridge.

Oxidation takes place at the anode while reduction takes place at the cathode

**Example :** For the cell reaction



Cell representation is :



25. Write the IUPAC names of the following coordinate compounds:

- $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]\text{Cl}_2$
- $[\text{Cr}(\text{NH}_3)_4\text{Cl}_2]^+$

**Ans :**

- $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]\text{Cl}_2$

$$x + 0 \times 2 + (-1) \times 2 + (-1) \times 2 = 0$$

$$x + 0 + (-2) + (-2) = 0$$

$$x = 4$$

Diammine dichloridoplatinum (IV) chloride

- $[\text{Cr}(\text{NH}_3)_4\text{Cl}_2]^+$

$$x + 0 \times 4 + (-1) \times 2 = 1$$

$$x + 0 - 2 = 1$$

$$x = 1 + 2 = 3$$

$$x = 3$$

Tetraammine dichlorido chromium (III) ion.

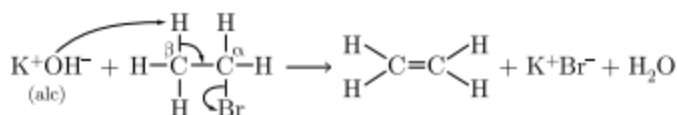
26. The treatment of alkyl chloride with aqueous KOH leads to the formation of alcohols but in presence of alcoholic KOH, alkenes are the major products. Explain why ?

**Ans :**



In aqueous solution, KOH is almost completely ionised to give  $\text{OH}^-$  ions which being a strong nucleophile bring about a substitution reaction on alkyl halide to form alcohol and in aqueous solution  $\text{OH}^-$  are less basic.

But an alcoholic solution of KOH contains alkoxide  $\text{RO}^-$  ions which being a much stronger base than  $\text{OH}^-$  ions therefore eliminates a molecule of HX from an alkyl halide to form alkenes. In these reactions, the hydrogen atom is lost from the  $\beta$ -carbon, therefore these reactions are classified as  $\beta$ -elimination reactions.



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27. Give the dissimilarities between  $\text{>C=O}$  bond and  $\text{-C=C-}$  Bond.

Ans :

The  $\pi$  electron cloud of the  $\text{>C=O}$  is unsymmetrical i.e., shifts towards oxygen due to greater electronegativity to O than C, therefore C atom acquires a partial +ve charge  $\text{>C}^{\delta+}=\text{O}^{\delta-}$  and hence is readily attached by nucleophiles. thus the typical reactions of  $\text{>C=O}$  bond are nucleophilic addition reactions.

The  $\pi$  electron cloud of  $\text{>C=C<}$  is symmetrical due to similar electro-negativities of the two carbon atoms therefore it readily allow electrophile to react. Thus the typical reactions of  $\text{>C=C<}$  bond are electrophilic addition reaction.

or

Arrange the following compounds in increasing order of boiling points ?

- Pentan-1-ol, butan-1-ol, butan-2-ol, propan-1-ol, methanol.
- Pentan-1-ol, *n*-butane, pentanal, ethoxyethane.

Ans :

- Boiling points increases regularly with increase in molecular mass due to increase in Vander Waal forces of attraction.
  - Amongst isomeric alcohol, the boiling point decreases with branching due to decrease in surface area  $1^\circ > 2^\circ > 3^\circ$ . The overall increasing order is methanol < ethanol < propan-1-ol < butan-2-ol < butan-1-ol < pentan-1-ol.
- n*-butane < ethoxyethane < pentanal < pentan-1-ol.

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. Colour may arise from a entirely different cause in ions with incomplete *d* or *f* shells. This source of colours very important in most of the transition metal ions. In free isolated gaseous ion the five *d* orbitals are degenerate, i.e. they are identical in energy. In real life situations, the ion will be surrounded by solvent molecules if it is in solution; by other ligands if it is in a complex; or by other ions if it is in crystal lattice. The surrounding groups affect the energy of some orbitals more than others. Thus the *d* orbitals are no longer degenerate, and they form two groups of orbitals of different energies. Thus in transition element ions with a partly filled *d* shell, it is possible to promote electrons from *d* level to another *d* level of higher energy. The corresponds to a fairly small energy difference and so light is absorbed in the visible region. The colour of a transition metal complex is dependent on how big the energy difference is between the two *d* levels. This in turn depends on the nature of the ligand, and on the type of complex formed. Thus the octahedral complex  $[\text{Ni}(\text{NH}_3)_6]^{2+}$  is blue,  $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$  is green and  $[\text{Ni}(\text{NO}_2)_6]^{4-}$  is brown-red. The colour changes with the ligand, used the colour also depends on the Number of ligands and the shape of the complex formed.

Answer the following questions :

- Account for the following : Copper(I) compounds are white whereas copper(II) compounds are coloured.
- $\text{Cu}^{2+}$  salts are coloured, while  $\text{Zn}^{2+}$  salts are white.
- Which of following cations are coloured in aqueous solutions and why ?  
 $\text{Sc}^{3+}$ ,  $\text{V}^{3+}$ ,  $\text{Ti}^{4+}$ ,  $\text{Mn}^{2+}$   
(At. nos. Sc = 21, V = 23, Ti = 22, Mn = 25)

or

- How would you account for the following : Transition metals form coloured compounds ?

Ans :

- $\text{Cu(I)}$  compounds have completely filled *d*-orbitals and there are no vacant *d*-orbitals for promotion of electrons whereas in  $\text{Cu(II)}$  compounds have one unpaired electron which is responsible for colour formation.
- $\text{Zn}^{2+}$  ion has completely filled *d*-subshell and no *d-d* transition is possible. So zinc salts are white. Configuration of  $\text{Cu}^{2+}$  is  $[\text{Ar}] 3d^9$ . It has partly filled *d*-subshell and hence it is coloured due to *d-d* transition.

(c) Only those ions will be coloured which have partially filled  $d$ -orbitals facilitating  $d-d$  transition. Ions with  $d^0$  and  $d^{10}$  will be colourless. From electronic configuration of the ions,  $V^{3+}$  ( $3d^2$ ) and  $Mn^{2+}$  ( $3d^5$ ), are all coloured.  $Ti^4$  ( $3d^0$ ) and  $Sc^{3+}$  ( $3d^0$ ) are colourless.

or

(d) Due to presence of vacant  $d$ -orbitals and  $d-d$  transitions, compounds of the transition metals are generally coloured. When an electron from a lower energy  $d$ -orbital is excited to a higher energy  $d$ -orbital, the energy of excitation corresponds to the frequency which generally lies in the visible region. The colour observed corresponds to the complementary colour of the light absorbed. The frequency of the light absorbed is determined by the nature of the ligand.

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30. Amines are alkyl or aryl derivatives of ammonia formed by replacement of one or more hydrogen atoms. Alkyl derivatives are called aliphatic amines and aryl derivatives are known as aromatic amines. The presence of aromatic amines can be identified by performing dye test. Aniline is the simplest example of aromatic amine. It undergoes electrophilic substitution reactions in which  $-NH_2$  group strongly activates the aromatic ring through delocalisation of lone pair of electrons of N-atom. Aniline undergoes electrophilic substitution reactions. Ortho and para positions to the  $-NH_2$  group become centres of high electrons density. Thus,  $-NH_2$  group is ortho and para-directing and powerful activating group.

Read the above passage and answer the following question:

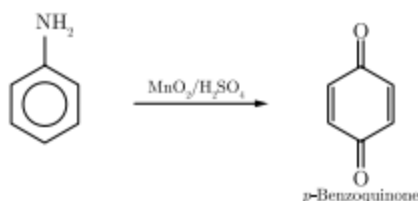
- (a) What does oxidation of aniline in presence of  $MnO_2$ , and,  $H_2SO_4$  produce ?  
(b) How will you distinguish cyclohexylamine and aniline ?  
(c) What is the major product obtained by acetylation of aniline followed by nitration (conc.  $HNO_3$  + conc.  $H_2SO_4$ ) and then alkaline hydrolysis ?

or

- (d) What does aniline produce in carbylamine reaction? Write chemical equation of the reaction involved.

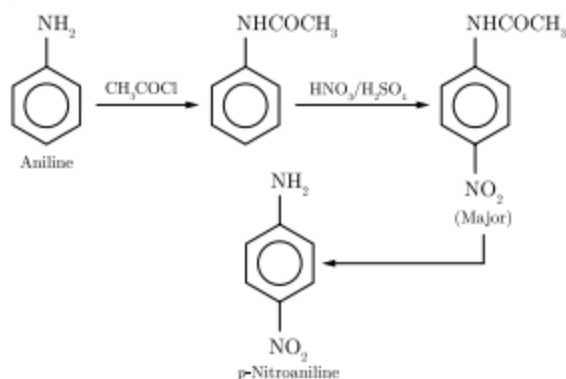
Ans :

(a)



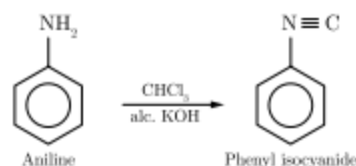
- (b) Azo dye test is used to distinguish between cyclohexylamine and aniline.

(c)



or

- (d) Aniline gives phenyl isocyanide in carbylamine reaction.



## 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. What are carbohydrates ? How are they classified ?

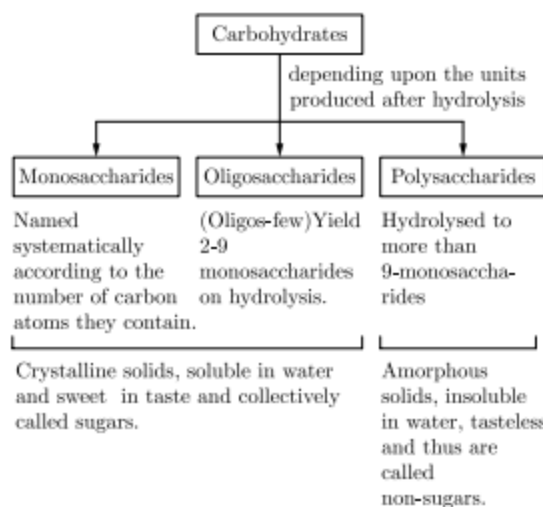
Ans :

**Carbohydrates and its classification :**

According to modern definition optically active polyhydroxy aldehydes or polyhydroxy ketones or compounds which can be hydrolysed to give monomers (i.e as final monosaccharides) product are called carbohydrates.

**Classification of Carbohydrates :**

Carbohydrates are also known as saccharides and classified according to their behaviour towards hydrolysis.



Carbohydrates are also classified as either reducing sugars or non-reducing sugars. The sugars that reduce the Tollen's reagent and Fehling's solution are called reducing sugars. Reducing sugars include all the monosaccharides. The resulting disaccharide would be non-reducing (as sucrose). If one of the carbonyl functions in the anyone of the monosaccharide units is free, the resulting disaccharide would be reducing sugar (as maltose, lactose, cellobiose). All polysaccharides are non-reducing sugars.

## CUET 30 SAMPLE PAPERS

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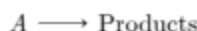
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32. Describe the kinetics of a first order reaction. Why is a first order reaction never completed?

**Ans :**

First order reaction is that in which the reaction-rate is determined by one concentration variable. Consider the reaction,



$$\text{Rate of reaction} = -\frac{d[A]}{dt} = k[A]$$

Suppose that the initial concentration is  $[A_0]$  g-mole per unit-volume and the conc. after a time  $t$  is  $[A]$  g-mole, then

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

on integrating the above equation, we get

$$\int -\frac{d[A]}{[A]} = \int_{t=0}^{t-1} k \cdot dt$$

$$\text{or} \quad -\ln[A] = kt + I$$

$$\text{at} \quad t = 0,$$

$$I = -\ln[A_0]$$

Hence the above equation becomes

$$kt = \ln \frac{[A_0]}{[A]}$$

$$\text{or} \quad k = \frac{2.303}{t} \log \frac{[A_0]}{[A]}$$

This is called the kinetic equation of a first order reaction. Here,  $[A_0]$  is the initial concentration of  $A$ . From the last equation, it is correct that mathematically,  $[A] > 0$  for all  $t < \infty$ . Thus,  $A$  can never be zero as long as infinity is not defined. Hence first order reaction can never completed.

**or**

What do you mean by first order reaction ? Find the expression for first order reaction.

**Ans :**

The first order reaction is defined as the reaction in which the reaction rate is determined by the change of one concentration term of the reactant only e.g. In the reaction,

$$t = \frac{2.303}{k} \log \frac{a}{(a-x)}$$

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

Where,  $t = \text{time}$

$a$  or  $[R]_0 = \text{initial concentration}$

$k = \text{rate constant}$

$(a-x)$  or  $[R] = \text{concentration of } a \text{ after time } t$

According to rate-law, first order reaction can be represented as :

$$\text{Rate, } (r) = k \cdot [a-x]$$

**Expression for First Order Reaction :**

Let for a reaction,

Reactant ( $R$ )  $\longrightarrow$  ( $P$ ) Product.

$$\text{Rate} = -\frac{d[R]}{dt} = k[R]$$

$$\text{or} \quad \frac{d[R]}{[R]} = -kdt$$

After integration of the reaction, we get

$$\ln[R] = -kt + I \quad \dots(1)$$

where,  $I = \text{constant of integration}$

In the beginning, when

$$t = 0$$

$$\text{and} \quad R = [R]_0$$

$[R]_0$  being the initial concentration of the reactant.

Hence, Equation (1) can be rewritten as

$$\ln[R]_0 = -k \times 0 + I$$

$$\ln[R]_0 = I$$

Substituting  $\ln[R]_0 = I$  in the equation (1),

$$\ln[R] = -kt + \ln[R]_0$$

$$\ln \frac{[R]}{[R]_0} = -kt$$

$$\frac{1}{t} \ln \frac{[R]}{[R]_0} = -k$$

$$k = \frac{1}{t} \ln \frac{[R]_0}{[R]}$$

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

33. Describe the general characteristics of transition elements with special reference to the following :

- Formation of colour salt
- Variable oxidation state

**Ans :**

**Characteristics of transition element with respect to :**

- Formation of colour salt :** Most of the compounds of transition metals are coloured due to  $d-d$  transition. structure defects and charge transfer Transition metal ions having  $d^0$  configuration are colorless. The explanation is that in  $d-d$  transition, free metal ion has degenerate  $d$ -orbital which splits into two levels, according to the geometry of complex. Compounds

absorb light of visible range for the excitation of electrons from lower to higher level and complementary colour of light is seen. The wavelength of the light absorbed depends upon the nature of the ligand.

When ligand has free electrons, the transfer of electron from anion to cation takes place. In this case energy is absorbed during this process which is responsible for colour.

- (ii) **Variable oxidation states** : Transition metals show different oxidation states variable valency except the first and the last element this is because of the fact that the difference in the energy of  $(n-1)$   $d$  electrons and  $ns$  electrons is low which implies that electrons from both energy levels can take part bonding.

or

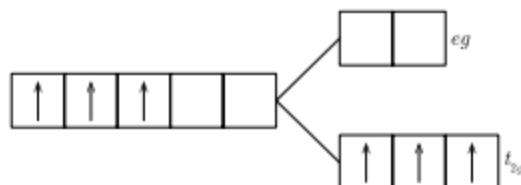
- (a) Account for the following;
- Mn shows the highest oxidation state of +7 with oxygen but with fluorine, it shows the oxidation state of +4.
  - $\text{Cr}^{2+}$  is a strong reducing agent.
  - $\text{Cu}^{2+}$  salts are coloured, while  $\text{Zn}^{+2}$  salts are white.

(b) Complete the following equations:

- $2\text{MnO}_2 + 4\text{KOH} + \text{O}_2 \xrightarrow{\Delta}$
- $\text{Cr}_2\text{O}_7^{2-} + 14\text{H}^+ + 6\text{I}^- \longrightarrow$

Ans :

- (a)
- In case of oxygen, Mn shows the highest oxidation state of +7. This is because Mn forms  $p\pi - d\pi$  multiple bonds using  $2p$  orbitals of oxygen and  $3d$  orbitals of Mn. with F, Mn displays an oxidation state of +4 because of the single bond formation caused by the unavailability of  $2p$  orbitals of F for multiple bonding.
  - $\text{Cr}^{2+}$  is strongly reducing in nature. It has a  $d^4$  configuration. While acting as a reducing agent, it gets oxidised to  $\text{Cr}^{3+}$  (with electronic configuration  $d^3$ ). This  $d^3$  configuration, which represents a more stable configuration.



- $\text{Zn}^{2+}$  salts have a completely filled set of  $d$ -orbitals ( $3d^{10}$ ), while  $\text{Cu}^{2+}$  has an incompletely filled set of  $d$ -orbitals ( $3d^9$ ), and therefore,  $d-d$  transition is possible in  $\text{Cu}^{2+}$ , leading to its blue colour.

(b)

- $2\text{MnO}_2 + 4\text{KOH} + \text{O}_2 \xrightarrow{\Delta} 2\text{K}_2\text{MnO}_4 + 2\text{H}_2\text{O}$
- $\text{Cr}_2\text{O}_7^{2-} + 14\text{H}^+ + 6\text{I}^- \longrightarrow 2\text{Cr}^{3+} + 3\text{I}_2 + 7\text{H}_2\text{O}$

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