# Solved Paper 2017

## CHEMISTRY

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

### General Instructions :

*(i)* ***All*** *questions are compulsory.*

*(ii)* *Q. no.* ***1*** *to* ***5*** *are very short answer questions and carry* ***1*** *mark each.*

*(iii)* *Q. no.* ***6*** *to* ***10*** *are short answer questions and carry* ***2*** *marks each.*

*(iv)* *Q. no.* ***11*** *to* ***22*** *are also short answer questions and carry* ***3*** *marks each.*

*(v)* *Q. no.* ***23*** *is a value based questions and carry* ***4*** *marks.*

*(vi)* *Q. no.* ***24*** *to* ***26*** *are long answer questions and carry* ***5*** *marks each.*

*(vii)* *Use log tables if necessary, use of* ***calculators*** *is* ***not*** *allowed.*

**Delhi Set-I** **Code No. 56/1/1**

**1. Write the formula of an oxo-anion of manganese (Mn) in which it shows the oxidation state equal to its group number. 1**

**Ans.** $MnO_4^-$/ $KMnO_4$. **[CBSE Marking Scheme, 2017] 1**

**Detailed Answer:**

The formula of an oxo-anion of manganese (M*n*) in which it shows the oxidation state equal to its group number (7) is $MnO_4^-$.

**Calculation :**

$$Mn + (-2 \times 4) = -1$$
$$Mn - 8 = -1$$
$$Mn = 7$$

Oxidation state of Mn in $MnO_4^-$ is + 7. The group number of Mn is also 7.

**2. Write IUPAC name of the following compound :**

**$(CH_3CH_2)_2NCH_3$ 1**

**Ans.** N-Ethyl-methylethanamine. **1**
**[CBSE Marking Scheme, 2017]**

**3. For a reaction R $\longrightarrow$ P, half-life ($t_{1/2}$) is observed to be independent of the initial concentration of reactants. What is the order of reaction ? 1**

**Ans.** First order. **[CBSE Marking Scheme, 2017] 1**

**Detailed Answer:**

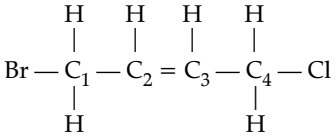
Since the half-life of first order reaction is independent of the initial concentration of reactants, the order of the reaction is first.

**4. Write the structure of 1-Bromo-4-chlorobut-2-ene. 1**

**Ans.** $BrCH_2CH = CHCH_2Cl$. **1**
**[CBSE Marking Scheme, 2017]**

**Detailed Answer:**

The structural formula of 1-Bromo-4-chlorobut-2-ene is:



*** 5. Write one similarity between Physisorption and Chemisorption. 1**

*** 6. Complete the following reactions:**

**(i) $NH_3 + 3Cl_2$ (excess) $\longrightarrow$**

**(ii) $XeF_6 + 2H_2O \longrightarrow$ 2**

**OR**

**What happens when**

**(i) $(NH_4)_2Cr_2O_7$ is heated ?**

**(ii) $H_3PO_3$ is heated ?**

**Write the equation.**

**7. Define the following terms:**

**(i) Colligative properties**

**(ii) Molality (m) 2**

**Ans. (i)** Properties that are independent of nature of solute and depend on number of moles of solute only. **1**

**(ii)** Number of moles of solute dissolved per kg of the solvent. **1**

**[CBSE Marking Scheme, 2017]**

* Out of Syllabus

**Detailed Answer:**

**(i)** Colligative properties are those properties of the solutions which depend upon the number of solute particles present in the solution irrespective of their nature and are relative to the total number of particles present in the solution. Some colligative properties are elevation of boiling point of solvent, depression of freezing point of solvent, etc.

**(ii)** Molality is the number of moles of solute dissolved in 100 g of a solvent. It is represented by m and is used to express concentration of a solution. It can be calculated as:

$$m = \frac{\text{Number of moles of solute}}{\text{Weight of solvent in grams}} \times 1000.$$

*** 8. Draw the structures of the following:**

**(i) $H_2S_2O_7$**

**(ii) $XeF_6$** **2**

**9. Calculate the degree of dissociation ($\alpha$) of acetic acid if its molar conductivity ($\Lambda_m$) is 39.05 S cm$^2$ mol$^{-1}$.**

**Given $\lambda°(H^+) = 349.6$ S cm$^2$ mol$^{-1}$ and $\lambda°(CH_3COO^-) = 40.9$ S cm$^2$ mol$^{-1}$.** **2**

**Ans.** $\Lambda°_{CH_3COOH} = \lambda°_{CH_3COO^-} + \lambda°_{H^+}$ ½

$= 40.9 + 349.6$

$= 390.5$ S cm$^2$/mol ½

Now, $\alpha = \Lambda_m / \Lambda°_m$

$= 39.05 / 390.5 = 0.1$ **1**

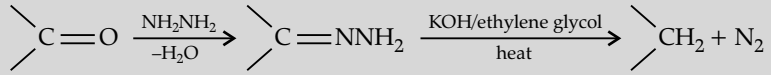
**[CBSE Marking Scheme, 2017]**

**10. Write the equations involved in the following reactions:**

**(i) Wolff-Kishner reduction**

**(ii) Etard reaction.** **2**

**Ans. (i)**

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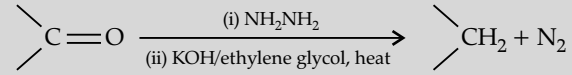
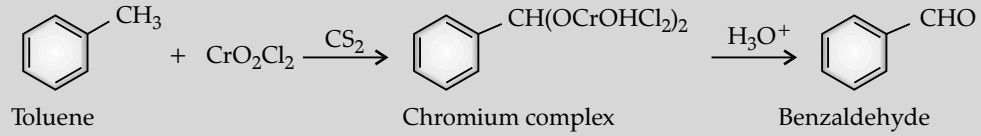
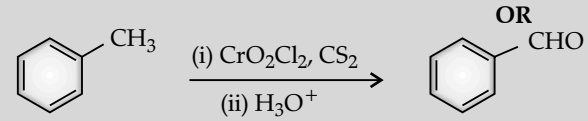



**1**

**(ii)**




**OR**

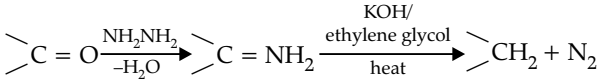



**1**

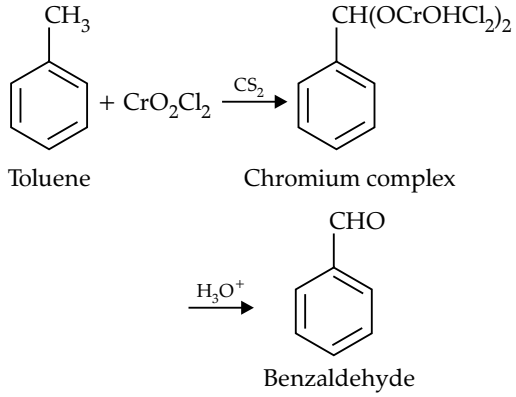
**[CBSE Marking Scheme, 2017]**

**Detailed Answer:**

**(i) Wolff-Kishner reduction** method is used to reduce a carbonyl compound like aldehyde or ketone to a hydrocarbon. The reduction reaction takes place when the carbonyl compound is heated with a mixture of hydrazine and a strong base like potassium hydroxide at a temperature range of 453 K to 473 K in ethylene glycol solvent.




**(ii) Etard reaction** is a reaction in which chromyl chloride oxidises methyl group to a chromium complex which gives benzaldehyde upon hydrolysis.




**11. A 10% solution (by mass) of sucrose in water has freezing point of 269.15 K. Calculate the freezing point of 10% glucose in water, if freezing point of pure water is 273.15 K.**

**Given : (Molar mass of sucrose = 342 g mol$^{-1}$)**

**(Molar mass of glucose = 180 g mol$^{-1}$)** **3**

* Out of Syllabus

**Ans.** $\Delta T_f = K_f m$ ½

Here, $m = w_2 \times 1000 / M_2 \times M_1$

$273.15 - 269.15 = K_f \times 10 \times 1000 / 342 \times 90$ **1**

$K_f = 12.3$ K kg/mol ½

$\Delta T_f = K_f m$

$= 12.3 \times 10 \times 1000 / 180 \times 90$

$= 7.6$ K

$T_f = 273.15 - 7.6 = 265.55$ K

(or any other correct method) **1**

**[CBSE Marking Scheme, 2017]**

**Detailed Answer :**

$\Delta T_t = (273.15 - 269.15)$ K $= 4$K

Molar mass of sucrose ($C_{12}H_{22}O_{11}$)

$= (12 \times 12) + (22 \times 1) + (11 \times 16)$

$= 342$ g mol$^{-1}$

10% solution of sucrose in water means 10 g of sucrose is present in (100 – 10)g of water.

Number of moles of sucrose $= \frac{10}{342}$

$= 0.0292$ mol

Therefore, molality of the solution

$= \frac{0.0292 \times 1000}{90} = 0.3244$ mol kg$^{-1}$

We know that $\Delta T_t = K_f \times m$

$\Rightarrow K_f = \frac{\Delta T_t}{m} = \frac{4}{0.3244} = 12.33$ K Kg mol$^{-1}$

Molar mass of glucose ($C_6H_{12}O_6$)

$= (6 \times 12) + (12 \times 1) + (6 \times 16) = 180$ g mol$^{-1}$

10% solution of glucose in water means 10 g of glucose is present in (100 – 10) g of water.

Number of moles of glucose $= \frac{10}{180} = 0.0555$ mol

Therefore,molality of the solution

$= \frac{0.0555 \times 1000}{90}$

$= 0.6166$ mol kg$^{-1}$

We know that $\Delta T_t = K_f \times m$

$\Rightarrow \Delta T_t = 12.33 \times 0.6166 = 7.60$ K

So, the freezing point of 10% glucose solution in water is (273.15 – 7.60) K = 265.55 K

**12. (a) Calculate the mass of Ag deposited at cathode when a current of 2 amperes was passed through a solution of $AgNO_3$ for 15 minutes. (Given : Molar mass of Ag = 108 g mol$^{-1}$, 1 F = 96500 C mol$^{-1}$)**

**(b) Define fuel cell. 2 + 1 = 3**

**Ans. (a)** $m = Zit$ ½

$= \frac{108 \times 2 \times 15 \times 60}{1 \times 96500}$ **1**

$= 2.01$ g (or any other correct method) ½

**(b)** Cells that convert the energy of combustion of fuels directly into electrical energy.

**[CBSE Marking Scheme, 2017] 1**

**Detailed Answer :**

**(a)** $t = 900$ s

Charge = Current × Time = 2 × 900

= 1800 C

According to the reaction

$Ag^+ (aq) + e^- \longrightarrow Ag(s)$

We require 1 F to deposit 1 mol or 108 g of Ag

For 1800 C, the mass of Ag deposited will be $= \frac{108 \times 1800}{1 \times 96500} = 2.0145$ g

**(b)** **Fuel cell** is the name given to the galvanic cells which are designed to convert the energy of combustion of fuels like hydrogen, methane, methanol, etc. directly into electrical energy.

**13. (i) What type of isomerism is shown by the complex $[Co(NH_3)_6]\,[Cr(CN)_6]$ ?**

**(ii) Why a solution of $[Ni(H_2O)_6]^{2+}$ is green while a solution of $[Ni(CN)_4]^{2-}$ is colourless ? (At. no. of Ni = 28).**

**(iii) Write the IUPAC name of the following complex: $[Co(NH_3)_5(CO_3)]$ Cl. 3**

**Ans. (i)** Co-ordination isomerism. **1**

**(ii)** Unpaired electrons in $[Ni(H_2O)_6]^{2+}$/*d-d* transition. **1**

**(iii)** Pentaamminecarbonatocobalt (III) chloride.

**[CBSE Marking Scheme, 2017] 1**

**Detailed Answer:**

**(i)** Complex $[Co(NH_3)_6]$ $[Cr(CN)_6]$ shows co-ordination isomerism. This type of isomerism arises from the interchange of ligands between cationic and anionic entities of different metal ions present in the complex.

**(ii)** In $[Ni(H_2O)_6]^{2+}$, $H_2O$ is a weak field ligand. So there are unpaired electrons in $Ni^{2+}$. In this complex, the *d* electrons from the lower energy level can be excited to the higher energy level. The possibility of *d-d* electrons is present. Therefore, $Ni(H_2O_6)]^{2+}$ is coloured. In $[Ni(CN)_4]^{2-}$, the electrons are all paired as $CN^-$ is a strong ligand. So, *d-d* transition is not possible in $[Ni(CN)_4]^{2-}$. Hence, it is colourless.

**(iii)** The IUPAC name of $[Co(NH_3)_5\ (CO_3)]$ Cl is Pentaamminecarbonatocobalt (III) chloride.**1**

***14. Write one difference in each of the following:**

**(i) Lyophobic sol and lyophilic sol**

**(ii) Solution and Colloid**

**(iii) Homogeneous catalysis and heterogeneous catalysis. 1 × 3 = 3**

* Out of Syllabus

**15. Following data are obtained for the reaction:**

$$N_2O_5 \longrightarrow 2NO_2 + \tfrac{1}{2}O_2$$

| $t/s$ | 0 | 300 | 600 |
|---|---|---|---|
| $[N_2O_5]$/mol $L^{-1}$ | $1.6 \times 10^{-2}$ | $0.8 \times 10^{-2}$ | $0.4 \times 10^{-2}$ |

**(a) Show that it follows first order reaction.**

**(b) Calculate the half-life.**

**(Given log 2 = 0.3010, log 4 = 0.6021)** **3**

**Ans. (a)** $k = \frac{2.303}{t}\log\frac{[A]_o}{[A]}$ ½

$= \frac{2.303}{300}\log\frac{1.6\times10^{-2}}{0.8\times10^{-2}}$

$= \frac{2.303}{300}\log 2 = 2.31 \times 10^{-3}\ s^{-1}$ ½

At 600 s, $k = \frac{2.303}{t}\log\frac{[A]_o}{[A]}$ ½

$= \frac{2.303}{600}\log\frac{1.6\times10^{-2}}{0.4\times10^{-2}}$

$= 2.31 \times 10^{-3}\ s^{-1}$

k is constant when using first order equation therefore it follows first order kinetics. ½

**OR**

In equal time interval, half of the reactant gets converted into product and the rate of reaction is independent of concentration of reactant, so it is a first order reaction.

**(b)** $t_{1/2} = 0.693/k$

$= 0.693/2.31 \times 10^{-3}$

$= 300$ s

(If student writes directly that half life is 300 s, award full marks). **1**

**[CBSE Marking Scheme, 2017]**

**Detailed Answer:**

**(a) For first order reaction the integral rate law is:**

$$k_t = \ln\left(\frac{a_0}{a_1}\right)$$

Given, $a_0 = 1.6 \times 10^{-2}$ mol $L^{-1}$

For $t = 300$ s, $a_t = 0.8 \times 10^{-2}$ mol $L^{-1}$

For $t = 600$ s, $a_t = 0.4 \times 10^{-2}$ mol $L^{-1}$

Using first set of data in the rate law,

$$k \times 300 = \ln\frac{1.6\times10^{-2}}{0.8\times10^{-2}}$$

$$k = 0.00231\ s^{-1}$$

Using second set of data in the rate law,

$$k \times 600 = \ln\frac{1.6\times10^{-2}}{0.4\times10^{-2}}$$

$$k = 0.00231\ s^{-1}$$

The value of $k$ is consistent,therefore it follows first order reaction.**1½**

**(b)** The half-life of first order reaction is given by the following equation :

$$t_{½} = \frac{\ln 2}{k} = 2.303 \times \frac{\log 2}{k}$$

$$\therefore \quad t_{½} = 2.303 \times \frac{\log 2}{0.00231} = 300.08\ s.$$

**16. Following compounds are given to you :**

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

**(i) Write the compound which is most reactive towards $S_N2$ reaction.**

**(ii) Write the compound which is optically active.**

**(iii) Write the compound which is most reactive towards β-elimination reaction.** **3**

**Ans. (i)** 1-Bromopentane. **1**

**(ii)** 2-Bromopentane. **1**

**(iii)** 2-Bromo-2-methylbutane. **1**

**[CBSE Marking Scheme, 2017]**

**Detailed Answer :**

**(a)** $H_3C - CH_2 - CH_2 - CH_2 - CH_2 - Br$

1-Bromopentane

**(b)** $H_3C - CH_2 - CH_2 - \underset{\underset{\text{Br}}{|}}{CH} - CH_3$

2-Bromopentane

**(c)** $H_3C - CH_2 - \underset{\underset{CH_3}{|}}{\overset{\overset{\text{Br}}{|}}{C}} - CH_3$

2-Bromo-2-methyl butane

(i) These figures show that (a) contains the least steric hindrance so towards the $S_N2$ reaction, 1-bromopentane will be the most reactive.

(ii) Figure b of 2-bromopentane has chiral carbon in it. So, it is optically active.

(iii) Towards the β-elimination, 2-bromo-2-methylbutane will be the most reactive as it will form most stable alkene (on account of the highest number of α-hydrogens.)

***17. (a) Write the principle of method used for the refining of germanium.**

**(b) Out of PbS and $PbCO_3$ (ores of lead), which one is concentrated by froth flotation process ?**

**(c) What is significance of leaching in the extraction of aluminium ?** **3**

* Out of Syllabus

**18. Write structures of compounds A, B and C in each of the following reaction:**

**(i)** $C_6H_5Br \xrightarrow{Mg/dry\ ether} A \xrightarrow[(b)\ H_3O^+]{(a)\ CO_2(g)} B \xrightarrow{PCl_3} C$

**(ii)** $CH_3CN \xrightarrow[(b)\ H_3O^+]{(a)\ SnCl_2/HCl} A \xrightarrow{dil.\ NaOH} B \xrightarrow{\Delta} C$ **3**

**OR**

**Do the following conversions in not more than two steps:**

**(i) Benzoic acid to benzaldehyde**

**(ii) Ethyl benzene to benzoic acid**

**(iii) Propanone to propene** **3**

**Ans. (i)** A : $C_6H_5MgBr$ B : $C_6H_5COOH$ C : $C_6H_5COCl$ ½×3

**(ii)** A : $CH_3CHO$ B : $CH_3CH(OH)CH_2CHO$ C : $CH_3CH = CHCHO$ ½×3

**OR**

**(i)** $C_6H_5COOH \xrightarrow{SOCl_2} C_6H_5COCl \xrightarrow{H_2,\ Pd - BaSO_4} C_6H_5CHO$ **1**

**(ii)** $C_6H_5C_2H_5 \xrightarrow{H_2Cr_2O_7/H^+} C_6H_5COOH$ **1**

**(iii)** $CH_3COCH_3 \xrightarrow{NaBH_4} CH_3CH(OH)CH_3 \xrightarrow{conc.\ H_2SO_4} CH_3CH=CH_2$ **1**

**(or any other correct method)**

**[CBSE Marking Scheme, 2017]**

**Detailed Answer:**

**(i)**

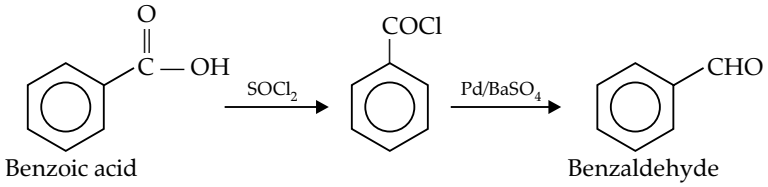
$$C_6H_5Br \xrightarrow[dry\ ether]{Mg/} \underset{(A)}{C_6H_5MgBr} \xrightarrow{(a)\ CO_2\,(g)} C_6H_5-\overset{\overset{O}{\|}}{C}-\overset{\ominus\ \oplus}{O}MgBr \xrightarrow[H^{\oplus}]{(b)\ H_3O^+} \underset{(B)}{C_6H_5COOH} \xrightarrow{PCl_5} \underset{(C)}{C_6H_5-\overset{\overset{O}{\|}}{C}-Cl}$$ **1½**

**(ii)**

$$CH_3CN \xrightarrow[(b)\ H_3O^+]{(a)\ SnCl_2/HCl} \underset{(A)}{CH_3CHO} \xrightarrow{dil.\ NaOH} \underset{(B)}{\begin{matrix} & CH_3 & & OH \\ & \diagdown & \diagup & \\ H & & C & \\ & \diagup & \diagdown & \\ & & CH_2-CH=O & \end{matrix}} \xrightarrow{\Delta} \underset{(C)}{CH_3-CH=CH-CH=O}$$ **1½**

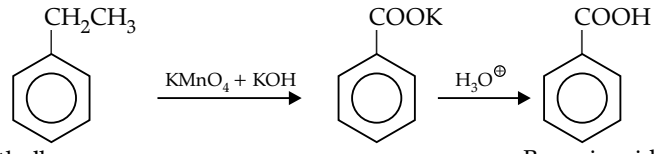
**OR**

**(i)**




Benzoic acid — Benzaldehyde

**(ii)**




Ethylbenzene — Benzoic acid

**(iii)** $CH_3-\overset{\overset{O}{\|}}{C}-CH_3 \xrightarrow{LiAlH_4} CH_3\overset{\overset{OH}{|}}{C}H-CH_3 \xrightarrow{H_2SO_4} CH_3CH=CH_2$

Propanone — Propene

***19. Write the structures of the monomers used for getting the following polymers:**

**(i) Dacron**

**(ii) Melamine - formaldehyde polymer**

**(iii) Buna-N** **3**

***20. Define the following:**

**(i) Anionic detergents**

**(ii) Broad spectrum antibiotics**

**(iii) Antiseptic** **3**

* Out of Syllabus

***21. Give reasons:**

**(i) Thermal stability decreases form $H_2O$ to $H_2Te$.**

**(ii) Fluoride ion has higher hydration enthalpy than chloride ion.**

**(iii) Nitrogen does not form pentahalide.** **3**

**22. Give reasons:**

**(i) Acetylation of aniline reduces its activation effect.**

**(ii) $CH_3NH_2$ is more basic than $C_6H_5NH_2$.**

**(iii) Although $-NH_2$ is o/p directing group, yet aniline on nitration gives a significant amount of *m*-nitroaniline.** **3**

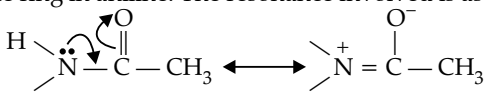
**Ans. (i)** Due to the resonance, the electron pair of nitrogen atom gets delocalised towards carbonyl group / resonating structures. **1**

**(ii)** Because of +I effect in methylamine electron density at nitrogen increases whereas in aniline resonance takes place and electron density on nitrogen decreases / resonating structures. **1**

**(iii)** Due to protonation of aniline / formation of anilinium ion. **[CBSE Marking Scheme, 2017] 1**

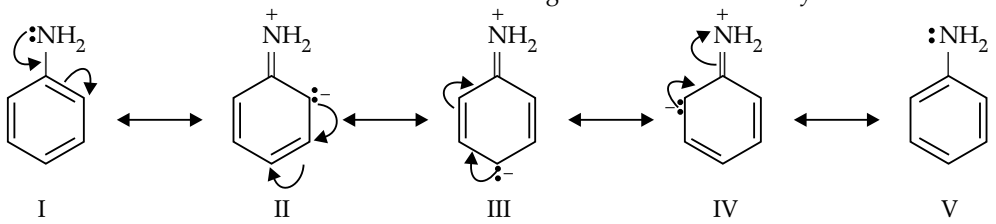
**Detailed Answer:**

**(i)** The lone pair of nitrogen will get involved in resonance with the carbonyl group. Hence it will reduce the activity of benzene ring in aniline. The resonance involved is as under :



**(ii)** Aromatic amines are far less basic than aliphatic amines. This can be explained as follows :

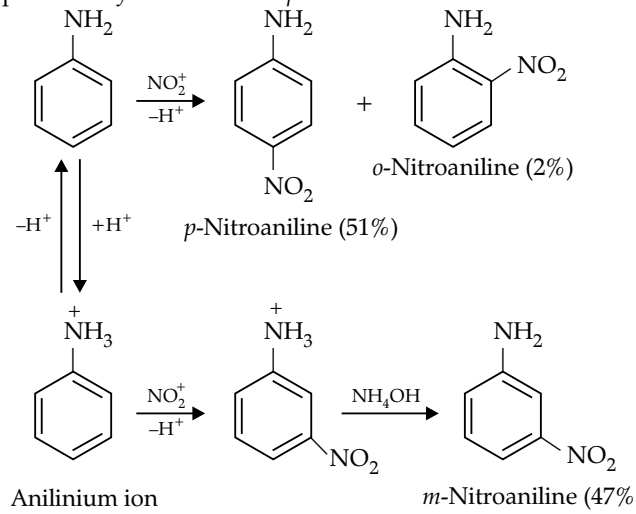
Resonance stabilization is there in aniline. It can be regarded as a resonance hybrid of these structures:



I II III IV V

Hence, the lone pair of electrons on the nitrogen atom gets delocalized over benzene ring and thus is less available for protonation. The electron density on the nitrogen atom is increased by electron-donating inductive effect of the alkyl groups. As a result, aliphatic amines are much stronger bases than aniline.

**(iii)** Nitration is usually carried out with a mixture of concentrated $HNO_3$ and concentrated $H_2SO_4$. In the presence of these acids, most of aniline gets protonated to form anilinium ion. Therefore, in presence of acids, the reaction mixture consists of aniline and anilinium ion. Nitration of aniline due to stearic hindrance at ortho position, mainly gives para nitroaniline and the nitration of anilinium ion gives m-nitroaniline. In actual practice, approximately 1:1 mixture of *p*-nitroaniline and *m*-nitroaniline is obtained.




Thus, nitration of aniline gives a substantial amount of m-nitroaniline due to protonation of the amino group.

* Out of Syllabus

**23. After watching a programme on TV about the presence of carcinogens (cancer causing agents) potassium bromate and potassium iodate in bread and other bakery products, Ritu a class XII student decided to aware others about the adverse effects of these carcinogens in foods. She consulted the school principal and requested him to instruct canteen contractor to stop selling sandwiches, pizza, burgers and other bakery products to the students. Principal took an immediate action and instructed the canteen contractor to replace the bakery products with some proteins and vitamins rich food like fruits, salads, sprouts etc. The decision was welcomed by the parents and students.**

**After reading the above passage, answer the following questions :**

**(i) What are the values (at least two) displayed by Ritu ?**

**(ii) Which polysaccharide component of carbohydrates is commonly present in bread ?**

**(iii) Write the two types of secondary structure of proteins.**

**(iv) Give two examples of water soluble vitamins.**

**4**

**Ans. (i)** Concerned, caring, socially alert, leadership **(or any other 2 values).** ½ + ½

**(ii)** Starch. **1**

**(iii)** α-Helix and β-pleated sheets. ½ + ½

**(iv)** Vitamin B / $B_1$ / $B_2$/ $B_6$ / C (any two ). ½ + ½

**[CBSE Marking Scheme, 2017]**

**Detailed Answer:**

**(i)** Ritu has shown these values :

**(a)** She is attentive towards the dangers.

**(b)** She fulfilled her moral obligation by deciding to aware others about the adverse effects.

**(c)** She went through proper channel (through principal) that shows her respect and trust in the institution.

**(ii)** Polysaccharide component commonly present in bread is starch.

**(iii)** The two types of secondary structures of proteins are α-helix and β-pleated sheet.

**(iv)** Vitamin B-group and Vitamin C are examples of water soluble vitamins.

**24. (a) Account for the following :**

**(i) Transition metals form large number of complex compounds.**

**(ii) The lowest oxide of transition metal is basic whereas the highest oxide is amphoteric or acidic.**

**(iii) $E^\circ$ value for the $Mn^{3+}/Mn^{2+}$ couple is highly positive (+1.57 V) as compared to $Cr^{3+}/Cr^{2+}$.**

**(b) Write one similarity and one difference between the chemistry of lanthanoid and actinoid elements. 3 + 2 = 5**

**OR**

**(a) (i) How is the variability in oxidation states of transition metals different from that of the p-block elements ?**

**(ii) Out of $Cu^+$ and $Cu^{2+}$, which ion is unstable in aqueous solution and why ?**

**(iii) Orange colour of $Cr_2O_7^{2-}$ ion changes to yellow when treated with an alkali. Why ?**

**(b) Chemistry of actinoids is complicated as compared to lanthanoids. Give two reasons.**

**Ans. (a) (i)** Due to small size and high ionic charge / availability of *d*-orbitals. **1**

**(ii)** Higher is the oxidation state, higher is the acidic character / as the oxidation state of a metal increases, ionic character decreases. **1**

**(iii)** Because $Mn^{2+}$ has $d^5$ as a stable configuration whereas $Cr^{3+}$ is more stable due to stable $t_{2g}^3$. **1**

**(b) Similarity–**Both are stable in +3 oxidation state/ both show contraction/irregular electronic configuration (or any other suitable similarity). **1**

**Difference–** actinoids are radioactive and lanthanoids are not / actinoids show wide range of oxidation states but lanthanoids don't (or any other correct difference). **1**

**OR**

**(a) (i)** In *p*-block elements the difference in oxidation state is 2 and in transition metals the difference is 1. **1**

**(ii)** $Cu^+$ , due to disproportionation reaction / low hydration enthalpy. ½ + ½

**(iii)** Due to formation of chromate ion / $CrO_4^{2-}$ ion, which is yellow in colour. **1**

**(b)** Actinoids are radioactive , actinoids show wide range of oxidation states. **1 + 1**

**[CBSE Marking Scheme, 2017]**

**Detailed Answer:**

**(a) (i)** Transition metals form large number of complexes due to following reasons:

a. Small size of metal ion

b. High charge density

c. Availability of empty *d*-orbitals

**(ii)** In the lowest oxides of transition metals, the metal atom has low oxidation state. This means some of the valence electrons of metal atom are not involved in the bonding. So, these electrons are not available for donation. Hence, they are basic in nature.

However, in the higher oxides of transition metals, the metal atom has high oxidation state. This means all of the valence electrons of metal atom are involved in the bonding.

So, these electrons are not available for donation. Also, these metal ions have high effective nuclear charge. As a result, they can accept electrons. Hence, they are acidic in nature.

**(iii)** $Mn^{2+}$ exists in half-filled $d^5$ state which is very stable while $Mn^{3+}$ is $d^4$ which is not so stable. Conversion from $d^4$ to $d^5$ will be quick and have negative $\Delta G$ value. Hence, because the stability factor of the E° value is high for this process.

While $Cr^{3+}$ is $d^3$ is half-filled ($t_{2g}^3$) is stable in nature and $Cr^{2+}$ is $d^4$ has one extra electron which it would like to donate to attain the stable half-filled ($t_{2g}^3$) configuration. Hence, for the process $Cr^{3+}$ to $Cr^{2+}$, the value of E° is less.

**(b)** Similarities between lanthanoid and actinoid:

**(i)** They have prominent oxidation states of +3.

**(ii)** They are electropositive.

**(iii)** They show magnetic properties

Differences between lanthanoid and actinoid :

**(i)** Lanthanoids are involved in filling of 4f-orbitals, actinoids are involved in filling of 5f-orbitals.

**(ii)** Binding energy of 4f-orbitals or lanthanoids is less than 5f-orbitals or actinoids.

**OR**

**(a) (i)** Variable oxidation states shown by transition element can differ by one unit while oxidation state shown by non-transition elements differ by two units (sometimes due to inert pair effect).

For example, oxidation state of

$$S = -2, -4, -6$$

Oxidation state of Co = + 2, + 3, + 4

**(ii)** $Cu^+$ is unstable in aqueous solution while $Cu^{2+}$ is more stable. Stability in aqueous medium depends upon the hydration energy, although it will require energy to remove one electron from $Cu^+$ to convert it into $Cu^{2+}$ but that is compensated by high hydration energy of $Cu^{2+}$. Hence $Cu^{2+}$ is more stable than that of $Cu^+$.

**(iii)** The change in colour is due to the formation of chromate ion.

$$Cr_2O_7^{2-} + H_2O \square 2Cr_2O_4^{2-} + 2H^+$$

**(b)** The reasons for this are as follows :

**(i)** Actinoids display a large number of oxidation states while lanthanoids primarily show only three oxidation states.

**(ii)** Actinoids are radioactive in nature.

***25. (a) An element has atomic mass 93 g mol$^{-1}$ and density 11.5 g cm$^{-3}$ If the edge length of its unit cell is 300 pm, identify the type of unit cell.**

**(b) Write any two differences between amorphous solids and crystalline solids. 5**

**OR**

*** (a) Calculate the number of unit cells in 8.1 g of aluminium if it crystallizes in a f.c.c. structure. (Atomic mass of Al = 27 g mol$^{-1}$)**

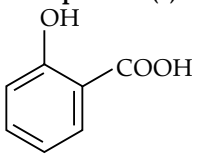
**(b) Give reasons:**

**(i) In stoichiometric defects, NaCl exhibits Schottky defect and not Frenkel defect.**

**(ii) Silicon on doping with phosphorus forms *n*-type semiconductor.**

**(iii) Ferrimagnetic substances show better magnetism than antiferromagnetic substances. 2 + 3 = 5**

**26. (a) Write the product (s) in the following reactions:**

**(i)** 

$\xrightarrow[H^+]{(CH_3CO)_2O}$ **?**

**(ii)** $CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-O-CH_2-CH_3 \xrightarrow{HI}$ **? +?**

**(iii)** $CH_3-CH=CH-CH_2-OH \xrightarrow{PCC}$ **?**

**(b) Give simple chemical tests to distinguish between the following pairs of compounds:**

**(i) Ethanol and phenol**

**(ii) Propanol and 2-methylpropan-2-ol**

**3 + 2 = 5**

**OR**

**(a) Write the formula of reagents used in the following reactions :**

**(i) Bromination of phenol to 2, 4, 6-tribromophenol**

**(ii) Hydroboration of propene and then oxidation to propanol.**

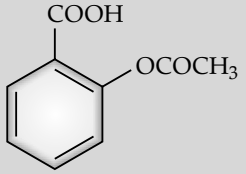
**(b) Arrange the following compound groups in the increasing order of their property indicated:**

**(i) *p*-nitrophenol, ethanol, phenol (acidic character)**

**(ii) Propanol, Propane, Propanal (boiling point)**

**(c) Write the mechanism (using curved arrow notation) of the following reaction :**

$$CH_3-CH_2-\overset{+}{O}H_2 \xrightarrow{CH_3CH_2OH} CH_3-CH_2-\underset{\displaystyle H}{\overset{+}{\underset{|}{O}}}-CH_2-CH_3 + H_2O$$

**Ans. (a) (i)** 

**1**

* Out of Syllabus

**(ii)** $(CH_3)_2CHOH$ and $CH_3CH_2I$ **1**

**(iii)** $CH_3CH{=}CHCHO$ **1**

**(b) (i)** Add neutral $FeCl_3$ to both the compounds, phenol gives violet complex. **1**

**(ii)** Add anhy $ZnCl_2$ and conc. HCl to both the compounds, **1**

2-methyl propan-2-ol gives turbidity immediately. **(or any other correct test)**

**[CBSE Marking Scheme, 2017]**

**OR**

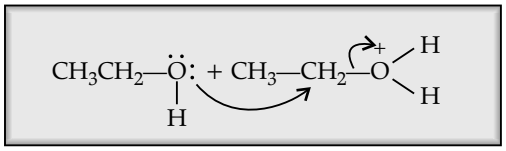
**(a) (i)** Aq. $Br_2$

**(ii)** $B_2H_6$, $H_2O_2$ and $OH^-$

**(b) (i)** Ethanol < phenol < *p*-nitrophenol.

**(ii)** propane < propanal < propanol.

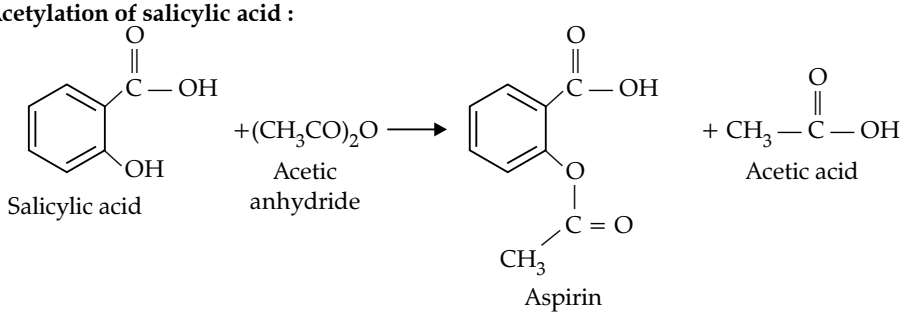
**(c)**




**1**

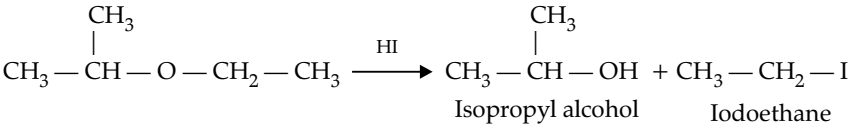
**Detailed Answer :**

**(a) (i) Acetylation of salicylic acid :**




Hence, the products are aspirin and acetic acid.

**(ii)**



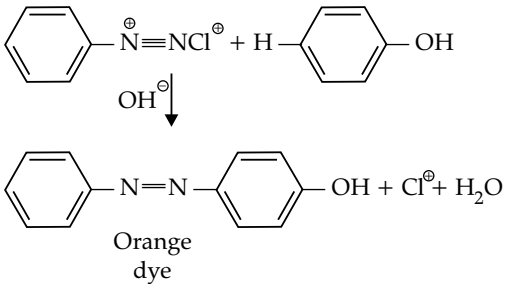

Hence, the products are Isopropyl alcohol and iodoethane.

**(iii)** $CH_3 — CH = CH — CH_2 — OH \xrightarrow{PCC} CH_3 — CH = CH — CHO$

But-2-enal

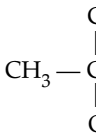
Hence, the product is But-2-enal.

**(b) (i)** Distinguish between ethanol and phenol:

| Test | Ethanol | Phenol |
|---|---|---|
| Coupling reaction | Negative test | Positive test<br>Reaction will be :<br>  <br> |
| Iodoform test | Positive test<br>Reaction will be :<br>$CH_3CH_2OH + NaOH + I_2$<br>↓<br>$HCOONa + CHI_3$<br>Yellow ppt. | Negative test |

**(ii)** Distinction between propanol and 2-methylpropan-2-ol
By Lucas test

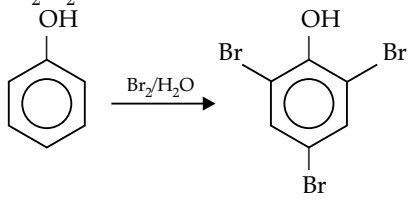
$CH_3 - CH_2 - CH_2 - OH \xrightarrow[ZnCl_2]{\text{Conc. HCl}}$ Turbidity appears after heating
Propanol


Turbidity appears very quickly

2-Methylpropan-2-ol

**OR**

**(a) (i)** $Br_2/H_2O$



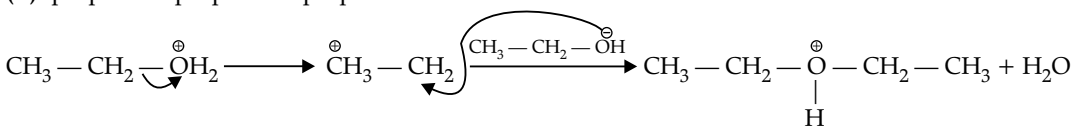
**(ii)** $(BH_3)_2, H_2O_2/OH^-$

$CH_3 - CH = CH_2 \xrightarrow[(b)\ H_2O_2/OH^-]{(a)\ BH_3/\ THF} CH_3 - CH_2 - CH_2 - OH$

**(b) (i)** *p*-nitrophenol> phenol > ethanol

**(ii)** propanol> propanal > propane

**(c)**

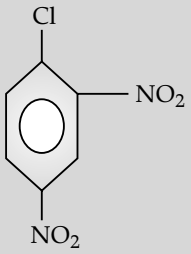


## Delhi Set-II — Code No. 56/1/2

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

**2. Write the structure of 2,4-dinitrochlorobenzene. 1**

**Ans.**



**1**

**[CBSE Marking Scheme, 2017]**

**4. Write IUPAC name of the following compound:**
**$CH_3NHCH(CH_3)_2$ 1**

**Ans.** N-Methylpropan-2-amine. **1**

**[CBSE Marking Scheme, 2017]**

**5. Write the formula of an oxo-anion of chromium (Cr) in which it shows the oxidation state equal to its group number. 1**

**Ans.** $Cr_2O_7^{2-}/CrO_4^{2-}/K_2Cr_2O_7/K_2CrO_4$. **1**

**[CBSE Marking Scheme, 2017]**

**Detailed Answer:**

Formula of an oxo-anion of chromium (Cr) in which it shows the oxidation state equal to its group number (6) is $Cr_2O_7^{2-}$

$$2\,Cr + (-2 \times 7) = -2$$
$$2Cr - 14 = -2$$
$$2\,Cr = +12$$
$$Cr = +6$$

Oxidation state of Cr in $Cr_2O_7^{2-}$ is + 6 which is equal to its group number 6. **1**

*** 7. Draw the structures of the following:**
**(i) $H_3PO_2$ (ii) $XeF_4$ 2**

**8. Define the following terms:**
**(i) Ideal solution (ii) Molarity (M) 2**

**Ans. (i)** The solution that obeys Raoult's Law over the entire range of concentration. **1**

**(ii)** Number of moles of solute dissolved per litre of solution or $M = \frac{w_b \times 1000}{M_b \times V(mL)}$. **1**

**[CBSE Marking Scheme, 2017]**

* Out of Syllabus

**Detailed Answer:**

**(i)** An **ideal solution** which obeys Raoult's law over entire range of concentration. The necessary condition to reach ideal solution is:

Enthalpy of mixing of the pure components to form the solution, $\Delta H_{mix} = 0$ and volume of mixing, $\Delta V_{mix} = 0$

**(ii) Molarity** is defined as the number of moles of solute present in 1000 mL of the solution. Molarity is represented by M.

$$M = \frac{\text{Number of moles of solute}}{\text{Volume of solution in mL}} \times 1000$$

*** 9. Complete the following reactions:**

**(i)** $Cl_2 + H_2O \longrightarrow$

**(ii)** $XeF_6 + 3H_2O \longrightarrow$ **2**

**OR**

**What happens when**

**(i) conc. $H_2SO_4$ is added to Cu ?**

**(ii) $SO_3$ is passed through water ?**

**Write the equations.**

**10. Write the reactions involved in the following:**

**(i) Hell-Volhard-Zelinsky reaction**

**(ii) Decarboxylation reaction** **2**

**Ans. (i)**

$$R-CH_2-COOH \xrightarrow[(ii)\ H_2O]{(i)\ X_2/RedP} R-\underset{\displaystyle X}{\underset{|}{CH}}-COOH$$

X = Cl, Br

**1**

**(ii)** $R-COONa \xrightarrow[Heat]{NaoH\ \&\ CaO} R-H + Na_2CO_3$ 1

**[CBSE Marking Scheme, 2017]**

**Detailed Answer:**

**(i)** In **Hell-Volhard-Zelinsky (HVZ) reaction,** carboxylic acid having an α-hydrogen is halogenated at α-position on treatment with chlorine or bromine in the presence of red phosphorus to give α-halogenated carboxylic acid.

$$RCH_2COOH \xrightarrow[(ii)\ H_2O]{(i)\ X_2/Red\ P} \underset{\displaystyle X}{\underset{|}{RCHCOOH}}$$

**(ii)** In **decarboxylation reaction,** carboxylic acid loses $CO_2$ to form hydrocarbons when their sodium salts are heated with sodalime (NaOH and CaO) in the ratio 3 : 1.

$$RCOONa \xrightarrow[\Delta]{NaOH\ and\ CaO} RH + Na_2CO_3$$

***13. Write the principles of the following methods:**

**(i) Vapour phase refining**

**(ii) Zone refining**

**(iii) Chromatography** **3**

***15. Define the following:**

**(i) Cationic detergents**

**(ii) Narrow spectrum antibiotics**

**(iii) Disinfectants** **3**

***19. Write the structures of the monomers used for getting the following polymers :**

**(i) Neoprene**

**(ii) Melamine-formaldehyde polymer**

**(iii) Buna-S** **3**

## Delhi Set-III — Code No. 56/1/3

**Note: Except these questions, other questions are from Delhi Set-I and II**

**1. What is the effect of catalyst on:**

**(i) Gibb's energy (ΔG) and**

**(ii) Activation energy of a reaction ?** **1**

**Ans. (i)** No effect. ½

**(ii)** Decreases. ½

**[CBSE Marking Scheme, 2017]**

**4. Write the structure of 3-Bromo-2-methylprop-1-ene.** **1**

**Ans.** $BrCH_2(CH_3)C = CH_2$ **1**

**[CBSE Marking Scheme, 2017]**

**Detailed Answer:**

The structure of 3-Bromo-2-methylprop-1-ene is:

$$\overset{1}{C}H_2 = \underset{\displaystyle CH_3}{\underset{|}{\overset{2}{C}}} - \underset{\displaystyle Br}{\underset{|}{\overset{3}{C}}}H_2$$

3-Bromo-2-methylprop-1-ene

**5. Write IUPAC name of the following compound :**

**$(CH_3)_2N - CH_2CH_3$** **1**

**Ans.** N, N-Dimethylethanamine **1**

**[CBSE Marking Scheme, 2017]**

* Out of Syllabus

**6. Write the reactions involved in the following reaction:**

**(i) Clemmensen reduction**

**(ii) Cannizzaro reaction** **2**

**Ans. (i)** $>C=O \xrightarrow[HCl]{Zn-Hg} >CH_2 + H_2O$ **1**

**(ii)** $H-CHO + H-CHO + \text{Conc. KOH} \xrightarrow{\Delta} H-CH_2-OH + H-COOH$ **1**

**[CBSE Marking Scheme, 2017]**

**Detailed Answer:**

**(i) Clemmensen reduction** is the process by which the carbonyl group of aldehydes and ketones is reduced to $CH_2$ group on treatment with zinc-amalgam and concentrated hydrochloric acid. The reaction involved in the process is:

$$>C=O \xrightarrow[HCl]{Zn-Hg} >CH_2 + H_2O$$

**(ii) Cannizzaro reaction** is one in which aldehydes which do not have an α-hydrogen atom, undergo self-oxidation and reduction (disproportionation) reaction on treatment with a concentrated alkali.

$$2\ H-CHO + \text{Conc. KOH} \longrightarrow H-CH_2-OH + H-COOK$$

Formaldehyde Methanol Potassium formate

*** 7. Draw the structures of the following:**

**(i) $H_4P_2O_7$** **(ii) $XeOF_4$** **2**

**8. Define the following terms:**

**(i) Abnormal molar mass**

**(ii) Van't Hoff factor (*i*)** **2**

**Ans. (i)** If the molar mass calculated by using any of the colligative properties to be different than theoretically expected molar mass. **1**

**(ii)** Extent of dissociation or association or ratio of the observed colligative property to calculated colligative property. **1**

**[CBSE Marking Scheme, 2017]**

**Detailed Answer:**

**(i) Abnormal molar mass**: There are certain cases where due to association or dissociation of molecules, the molar mass of a substance calculated from its colligative property is either lower or higher than the expected or normal value. Such molar mass is called abnormal molar mass.

**(ii) van't Hoff factor** – To account for the extent of dissociation or association, Van't Hoff introduced a factor *i*, known as the Van't Hoff factor.

$$i = \frac{\text{Normal molar mass}}{\text{Abnormal molar mass}}$$

$$= \frac{\text{Observed colligative property}}{\text{Calculated colligative property}}$$

Value of *i* is less than 1 in case of association.

Value of *i* is greater than 1 in case of dissociation.

Value of *i* is equal to 1 in case of no association or dissociation.

***10. Complete the following chemical equations:**

**(i) $F_2 + 2Cl^- \longrightarrow$**

**(ii) $2XeF_2 + 2H_2O \longrightarrow$** **2**

**OR**

**What happens when**

**(i) HCl is added to $MnO_2$ ?**

**(ii)** $PCl_5$ is heated ?

Write the equations involved.

***13. Define the following:**

**(i) Anionic detergents**

**(ii) Limited spectrum antibiotics**

**(iii) Tranquilizers** **3**

***14. Write the structures of the monomers used for getting the following polymers:**

**(i) Nylon-6**

**(ii) Melamine – formaldehyde polymer**

**(iii) Teflon** **3**

* Out of Syllabus

***19. Write one difference between each of the following:**
**(i) Multimolecular colloid and Macromolecular colloid**
**(ii) Sol and Gel**
**(iii) O/W emulsion and W/O emulsion** **3**

**20. (i) What type of isomerism is shown by the complex $[Co(en)_3]Cl_3$ ?**
**(ii) Write the hybridisation and magnetic character of $[Co(C_2O_4)_3]^{3-}$.**
**(At. no. of Co = 27)**
**(iii) Write IUPAC name of the following Complex $[Cr(NH_3)_3Cl_3]$.** **3**

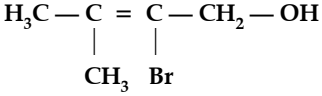
**Ans. (i)** Optical isomerism. **1**
**(ii)** $d^2sp^3$, diamagnetic. **1**
**(iii)** Triamminetrichloridochromiun (III). **1**
**[CBSE Marking Scheme, 2017]**

**Detailed Answer:**
**(i)** $[Co(en)_3]Cl_3$ will show optical isomerism. It will have two optical isomers – dextrorotatory and laevorotatory.
**(ii)** $[Co(C_2O_4)_3]^{3-}$ will have hybridization of $d^2sp^3$ with a diamagnetic behavior.
**(iii)** The IUPAC name of $[Cr(NH_3)_3Cl_3]$ is Triamminetrichloridochromium (III).

## Outside Delhi Set-I — Code No. 56/1

*** 1. Write the formula of the compound of phosphorus which is obtained when conc. $HNO_3$ oxidises $P_4$.** **1**

**2. Write the IUPAC name of the following compound:**



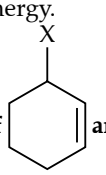
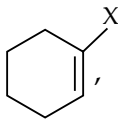
**1**

**Ans.** 2-Bromo-3-methylbut-2-en-1-ol
**[CBSE Marking Scheme, 2017]** **1**

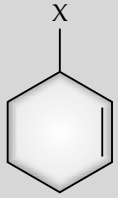
**3. What is the effect of adding a catalyst on**
**(i) Activation energy ($E_a$), and**
**(ii) Gibb's energy ($\Delta G$) of a reaction ?** **1**

**Ans. (i)** Decreases ½
**(ii)** No effect
**[CBSE Marking Scheme, 2017]** ½

**Detailed Answer:**
**(i)** Adding of a catalyst lowers the activation energy ($E_a$) of reactants.
**(ii)** Adding of a catalyst has no effect on Gibb's free energy.

**4. Out of**  **and**  **, which is an example of allylic halide ?**

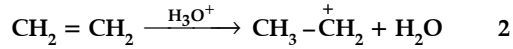
**Ans.**



**1**
**[CBSE Marking Scheme, 2017]**

*** 5. What type of colloid is formed when a liquid is dispersed in a solid ? Give an example.** **1**

**6. (a) Arrange the following compounds in the increasing order of their acid strength:**
***p*-cresol, *p*-nitrophenol, phenol.**
**(b) Write the mechanism (using curved arrow notation) of the following reaction:**



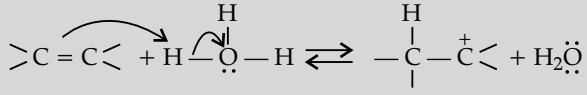
**2**

**OR**

**Write the structures of the products when Butan-2-ol reacts with the following :**
**(a) $CrO_3$** **(b) $SOCl_2$** **2**

**Ans. (a)** *p*-cresol < Phenol < *p*-nitrophenol. **1**

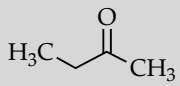
**(b)**



**1**

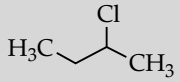
**OR**

**(a)**



**1**

**(b)**

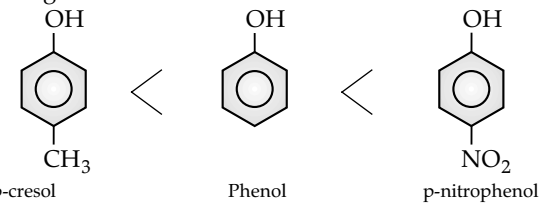


**[CBSE Marking Scheme, 2017]** **1**

* Out of Syllabus

**Detailed Answer:**

**(a)** Increasing order of acidic strength:



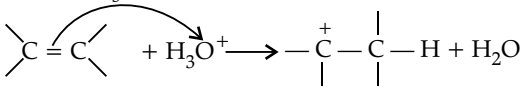

p-cresol Phenol p-nitrophenol

p-nitrophenol in most acidic due to presence of – $NO_2$ group i.e., electron with drawing group (–I group) which stabilises phenoxide ion so increases acidity while p-serve is least acidic due to presence of – CH3 group i.e., electron releasing group (+ I group) which destablises phenoxide ion so decreases acidity.

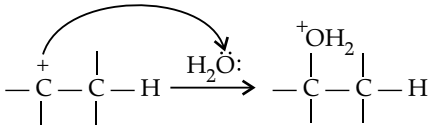
**(b) Mechanism:**

**(i)** Electrophilic attack of $H_3O^+$

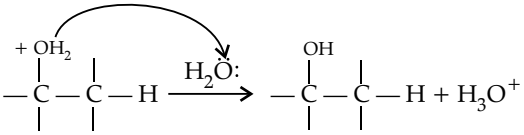
$H_2O + H^+$ (From acid) $\longrightarrow H_3O^+$



**(ii)** Nucleophilic attack of water on carbocation.

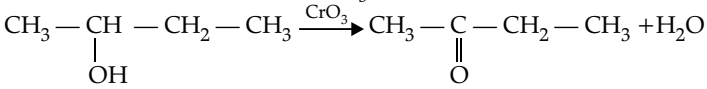


**(iii)** Deprotonation:



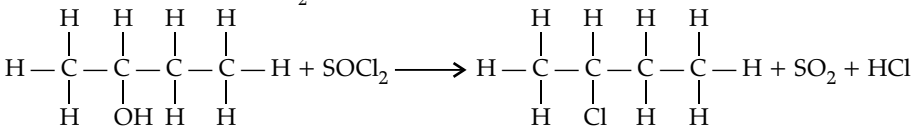
**OR**

**(a)** When Butan-2-ol reacts with $CrO_3$, it forms butan-2-one.



Butan-2-one

**(b)** Butan-2-ol reacts with $SOCl_2$ to form 2-chlorobutane.



2 — Chlorobutane

*** 7. Calculate the number of unit cells in 8.1 g of aluminium if it crystallizes in a face-centred cubic (f.c.c.) structure. (Atomic mass of Al = 27 g $mol^{-1}$)2**

*** 8. Draw the structures of the following:**

**(i) $H_2SO_3$ (ii) $HClO_3$ 2**

**9. Write the name of the cell which is generally used in hearing aids. Write the reactions taking place at the anode and the cathode of this cell. 2**

**Ans.** Mercury cell **1**

**Anode:** $Zn(Hg) + 2OH^- \longrightarrow ZnO(s) + H_2O + 2e^-$ ½

**Cathode:** $HgO + H_2O + 2e^- \longrightarrow Hg(l) + 2OH^-$ ½

**[CBSE Marking Scheme, 2017]**

**Detailed Answer:**

Mercury cell is generally used in hearing aids.

**At anode:** $Zn\,(Hg) + 2\,OH^- \longrightarrow ZnO(s) + H_2O + 2e^-$

**At cathode:** $HgO(s) + H_2O + 2e^- \longrightarrow Hg(l) + 2OH^-$

**Overall reaction:** $Zn(Hg) + HgO(s) \longrightarrow ZnO(s) + Hg(l)$

**10. Using IUPAC norms write formulae for the following:**

**(a) Sodium dicyanidoaurate (I)**

**(b) Tetraamminechloridonitrito-N-platinum (IV) sulphate 2**

**Ans. (a)** $Na[Au(CN)_2]$ **1**

**(b)** $[Pt(NH_3)_4Cl\,(NO_2)]SO_4$ **1**

**[CBSE Marking Scheme, 2017]**

* Out of Syllabus

***11. (a) Based on the nature of intermolecular forces, classify the following solids :**

**Silicon carbide, Argon.**

**(b) ZnO turns yellow on heating. Why ?**

**(c) What is meant by groups 12-16 compounds ? Give an example. 3**

**12. (a) The cell in which the following reaction occurs:**

**$2\,Fe^{3+}\,(aq) + 2\,I^-\,(aq) \longrightarrow 2\,Fe^{2+}\,(aq) + I_2\,(s)$ has $E^\circ_{cell}$ = 0.236 V at 298 K. Calculate the standard Gibb's energy of the cell reaction. (Given : 1 F = 96,500 C $mol^{-1}$)**

**(b) How many electrons flow through a metallic wire if a current of 0.5 A is passed for 2 hours ? (Given : 1 F = 96,500 C $mol^{-1}$) 3**

**Ans. (a)** $\Delta G^0 = -nFE^0_{cell}$ ½

$n = 2$

$\Delta G^0 = -2 \times 96500\ C/mol \times 0.236\ V$ ½

$= -45548\ J/mol$

$= -45.548\ kJ/mol$ ½

**(b)** $Q = I\,t = 0.5 \times 2 \times 60 \times 60$ ½

$= 3600\ C$

$96500\ C = 6.023 \times 10^{23}$ electrons

$3600\ C = 2.25 \times 10^{22}$ electrons **1**

**[CBSE Marking Scheme, 2017]**

**Detailed Answer:**

**(a)** $2\,Fe^{3+} + 2e^- \longrightarrow 2\,Fe^{2+}$

$2I^- \longrightarrow I_2 + 2e^-$

For the given cell reaction, $n = 2$.

$\Delta G^\circ = -n\,FE^\circ_{cell}$

$= -2 \times 96500 \times 0.236$

$= -45548\ J\ mol^{-1}$

$= -45.55\ kJ\ mol^{-1}$

**(b)** $I = 0.5\,A$ $t = 2\ hours = 2 \times 60 \times 60\ s = 7200s$

$Q = It$

$= 0.5 \times 7200$

$= 3600$ coulombs

A flow of 96500 *c* is equal to flow of 1 mole of electrons is $6.023 \times 10^{23}$ electrons.

$\therefore$ 3600 *c* is equivalent to of electrons

$= \frac{6.023 \times 10^{23}}{96500} \times 3600$

$= 2.246 \times 10^{22}$ electrons

**13. (a) What type of isomerism is shown by the complex $[Co(NH_3)_5\,(SCN)]^{2+}$ ?**

**(b) Why is $[NiCl_4]^{2-}$ paramagnetic while $[Ni(CN)_4]^{2-}$ is diamagnetic ? (Atomic number of Ni = 28)**

**(c) Why are low spin tetrahedral complexes rarely observed ? 3**

**Ans. (a)** Linkage isomerism. **1**

**(b)** In $[NiCl_4]^{2-}$, due to the presence of $Cl^-$, a weak field ligand no pairing occurs whereas in $[Ni(CN)_4]^{2-}$, $CN^-$ is a strong field ligand and pairing takes place / diagrammatic representation. **1**

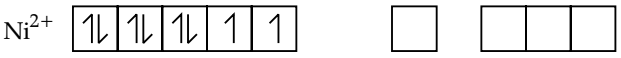
**(c)** Because of very low CFSE which is not able to pair up the electrons. **1**

**[CBSE Marking Scheme, 2017]**

**Detailed Answer:**

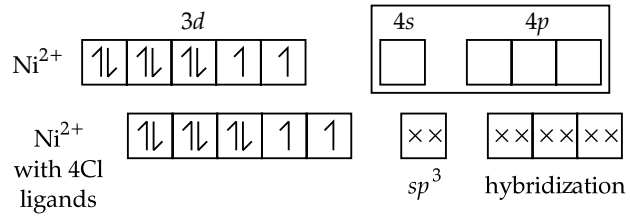
**(a)** Linkage isomerism is shown by the complex $[Co(NH_3)_5(SCN)]^{2+}$

**(b)** $[NiCl_4]^{2-}$ contains $Ni^{2+}$ ion having $3d^8$ configuration.

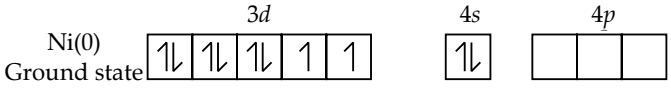



Ground state

$Cl^-$ is a weak field ligand. Hence outer 4*s*-and 4*p*-orbitals are used in hybridization.



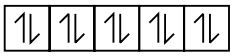

It has two unpaired electrons hence it is paramagnetic whereas $[Ni(CO)_4]$ contains Ni(0) – $3d^8 4s^2$ configuration

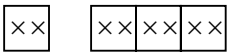



* Out of Syllabus

CO is a strong field ligand hence 4s-electrons will shift to 3d-orbital making 4s-orbital vacant.

Ni(0) with 4CO ligands





$sp^3$ hybridization

The complex has all paired electrons hence it is diamagnetic.

**(c)** In tetrahedral complexes, $sp^3$ hybridization occurs. The 3*d* orbitals are untouched, so unpaired electrons are available always which give high spins. Therefore, low spin tetrahedral complexes are formed rarely.

***14. Write one difference in each of the following :**

**(a) Multimolecular colloid and associated colloid**

**(b) Coagulation and peptization**

**(c) Homogeneous catalysis and heterogeneous catalysis** **3**

**OR**

**(a) Write the dispersed phase and dispersion medium of milk.**

**(b) Write one similarity between physisorption and chemisorption.**

**(c) Write the chemical method by which $Fe(OH)_3$ sol is prepared from $FeCl_3$.**

**15. A first order reaction takes 20 minutes for 25% decomposition. Calculate the time when 75% of the reaction will be completed.**

**(Given : log 2 = 0.3010, log 3 = 0.4771, log 4 = 0.6021)** **3**

**Ans.**

$$t = \frac{2.303}{k}\log\frac{[A]^0}{[A]} \quad ½$$

$$20 \text{ min} = \frac{2.303}{k}\log\frac{100}{75} \quad ...(i)\ ½$$

$$t = \frac{2.303}{k}\log\frac{100}{25} \quad ...(ii)\ ½$$

Divide (i) equation by (ii)

$$\frac{20}{t} = \frac{\frac{2.303}{k}\log\frac{100}{75}}{\frac{2.303}{k}\log\frac{100}{25}} \quad ½$$

$$= \frac{\log 4/3}{\log 4}$$

$$\frac{20}{t} = 0.1250/0.6021$$

$$t = 96.3 \text{ min} \quad \mathbf{1}$$

**(or any other correct procedure)**

**[CBSE Marking Scheme, 2017]**

**16. The following compounds are given to you :**

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

**(a) Write the compound which is most reactive towards $S_N2$ reaction.**

**(b) Write the compound which is optically active.**

**(c) Write the compound which is most reactive towards β-elimination reaction.** **3**

**Ans.** **(a)** 1-Bromopentane **1**

**(b)** 2-Bromopentane **1**

**(c)** 2-Bromo-2-methylbutane **1**

**[CBSE Marking Scheme, 2017]**

**Detailed Answer:**

For answer refer CBSE 2017 D (Set I) Q No. 16.

***17. Write the principle of the following:**

**(a) Zone refining**

**(b) Froth flotation process**

**(c) Chromatography** **3**

**18. Write the structures of compounds A, B and C in the following reactions :**

**(a)** $CH_3 — COOH \xrightarrow{NH_3/\Delta} A \xrightarrow{Br_2/KOH\ (aq)} B \xrightarrow{CHCl_3 + \text{alc. } KOH} C$

**(b)** $C_6H_5N_2^+BF_4^- \xrightarrow[\Delta]{NaNO_2/Cu} A \xrightarrow{Fe/HCl} B \xrightarrow{CH_3COCl\ /\ \text{pyridine}} C$

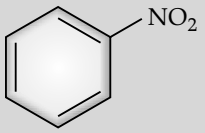
**3**

**Ans.** **(a)** (A) $CH_3CONH_2$ ½

(B) $CH_3NH_2$ ½

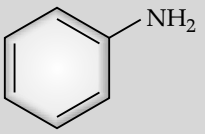
(C) $CH_3NC$ ½

**(b)** (A)



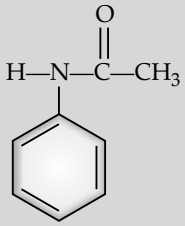
½

(B)



½

(C)



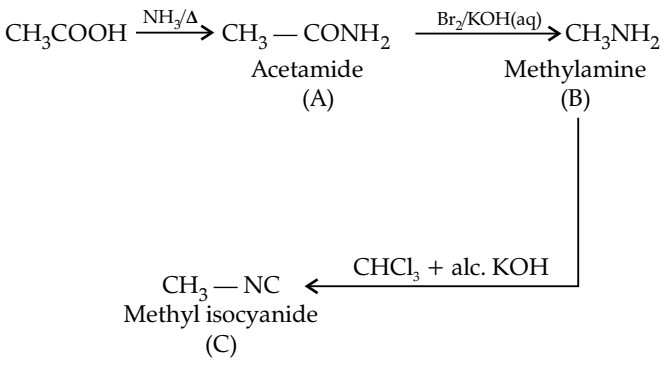
½

**[CBSE Marking Scheme, 2017]**

* Out of Syllabus

**Detailed Answer:**

**(a)**




**(b)** $C_6H_5N_2^+BF_4^- \xrightarrow[\Delta]{NaNO_2/Cu} C_6H_5NO_2 \xrightarrow{Fe/HCl} C_6H_5NH_2 \xrightarrow{CH_3COCl/Pyridine} C_6H_5NHCOCH_3$

Nitrobenzene (A) — Aniline (B) — N-phenyl ethanamide (C)

***19. Write the structures of the monomers used for getting the following polymers :**

**(a) Nylon-6, 6**

**(b) Melamine-formaldehyde polymer**

**(c) Buna-S** **3**

***20. Define the following :**

**(a) Anionic detergents**

**(b) Limited spectrum antibiotics**

**(c) Antiseptics** **3**

***21. Give reasons for the following :**

**(a) Red phosphorus is less reactive than white phosphorus.**

**(b) Electron gain enthalpies of halogens are largely negative.**

**(c) $N_2O_5$ is more acidic than $N_2O_3$.** **3**

**22. Give reasons for the following :**

**(a) Acetylation of aniline reduces its activation effect.**

**(b) $CH_3NH_2$ is more basic than $C_6H_5NH_2$.**

**(c) Although – $NH_2$ is *o/p* directing group, yet aniline on nitration gives a significant amount of *m*-nitroaniline.** **3**

**Ans. (a)** Due to the resonance, the electron pair of nitrogen atom gets delocalised towards carbonyl group / resonating structures. **1**

**(b)** Because of +I effect in methylamine electron density at nitrogen increases whereas in aniline resonance takes place and electron density on nitrogen decreases / resonating structures. **1**

**(c)** Due to protonation of aniline / formation of anilinium ion. **1**

**[CBSE Marking Scheme, 2017]**

**Detailed Answer :**

[For answer refer CBSE 2017 D (Set I) Q No. 22]

**23. After watching a programme on TV about the presence of carcinogens (cancer causing agents) potassium bromate and potassium iodate in bread and other bakery products, Rupali a Class XII student decided to make others aware about the adverse effects of these carcinogens in foods. She consulted the school principal and requested him to instruct the canteen contractor to stop selling sandwiches, pizzas, burgers and other bakery products to the students. The principal took an immediate action and instructed the canteen contractor to replace the bakery products with some protein and vitamin rich food like fruits, salads, sprouts etc. The decision was welcomed by the parents and the students.**

**After reading the above passage, answer the following questions :**

**(a) What are the values (at least two) displayed by Rupali ?**

**(b) Which polysaccharide component of carbohydrates is commonly present in bread ?**

**(c) Write the two types of secondary structures of proteins.**

**(d) Give two examples of water soluble vitamins.** **4**

**Ans. (a)** Concerned, caring, socially alert, leadership (or any other 2 values). **½ + ½**

**(b)** Starch **1**

**(c)** α -Helix and β-pleated sheets. **½ + ½**

**(d)** Vitamin B / $B_1$ / $B_2$/ $B_6$ / C (any two ) **½ + ½**

**[CBSE Marking Scheme, 2017]**

**Detailed Answer:**

[For answer refer CBSE 2017 D (Set I) Q No. 23]

**24. (a) Account for the following:**

**(i) Transition metals show variable oxidation states.**

**(ii) Zn, Cd and Hg are soft metals.**

**(iii) $E^\circ$ value for the $Mn^{3+}/Mn^{2+}$ couple is highly positive (+ 1.57 V) as compared to $Cr^{3+}/Cr^{2+}$.**

**(b) Write one similarity and one difference between the chemistry of lanthanoid and actinoid elements.** **3 + 2 = 5**

* Out of Syllabus

**OR**

**(a) Following are the transition metal ions of 3d series:**

**$Ti^{4+}$, $V^{2+}$, $Mn^{3+}$, $Cr^{3+}$**

**(Atomic numbers : Ti = 22, V = 23, Mn = 25, Cr = 24)**

**Answer the following :**

**(i) Which ion is most stable in an aqueous solution and why ?**

**(ii) Which ion is a strong oxidising agent and why ?**

**(iii) Which ion is colourless and why ?**

**(b) Complete the following equations:**

**(i)** $2\ MnO_4^- + 16\ H^+ + 5\ S^{2-} \longrightarrow$

**(ii)** $KMnO_4 \xrightarrow{heat}$

**24. (a) (i)** Availability of partially filled *d*-orbitals / comparable energies of ns and (*n* – 1) *d*-orbitals. **1**

**(ii)** Completely filled *d*-orbitals / absence of unpaired *d* electrons cause weak metallic bonding. **1**

**(iii)** Because $Mn^{2+}$ has $d^5$ as a stable configuration whereas $Cr^{3+}$ is more stable due to stable $t_{2g}^3$. **1**

**(b)** Similarity-both are stable in +3 oxidation state/ both show contraction/ irregular electronic configuration (or any other suitable similarity) **1**

Difference–actinoids are radioactive and lanthanoids are not / actinoids show wide range of oxidation states but lanthanoids don't (or any other correct difference). **1**

**OR**

**(a) (i)** $Cr^{3+}$, half filled $t_{2g}^3$ ½ + ½

**(ii)** $Mn^{3+}$, due to stable $d^5$ configuration in $Mn^{2+}$ ½ + ½

**(iii)** $Ti^{4+}$, No unpaired electrons ½ + ½

**(b) (i)** $2MnO_4^- + 16H^+ + 5S^{2-} \rightarrow 5S + 2Mn^{2+} + 8H_2O$ **1**

(ii) $2KMnO_4 \longrightarrow K_2MnO_4 + MnO_2 + O_2$ **1**

**[CBSE Marking Scheme, 2017]**

**Detailed Answer :**

**(i)** Transition metals show variable oxidation states because of the small difference in energy of the ns and (*n* – 1) *d* orbitals. Thus, addition to *ns* electrons, (*n* – 1) *d* electrons also participate in bonding.

**(ii)** Zn, Cd and Hg are not transition elements but are regarded as soft metals as they easily oxidize to +2 oxidation state with low melting point.

**(iii)** [For answer refer CBSE 2017 Delhi (Set I) Q No. 24 (a) (iii)]

**(b)** [For answer refer CBSE 2017 Delhi (Set I) Q No. 24 (b)]

**OR**

**(a) (i)** $Cr^{3+}$ is the most stable in aqueous solution as the tripositive ions with increasing atomic number.

**(ii)** $Mn^{3+}$ as they have the highest $E^\circ$ $(M^{3+}/M^{2+})$.

**(iii)** $Ti^{4+}$ is colourless.

**Electronic configuration :** $1S^2 2S^2 2p^6 3S^2 3p^6 4S^2 3d^\circ$

It has completely empty *d*-orbital and there are no electrons for the *d*-*d* transition.

**25. (a) A 10% solution (by mass) of sucrose in water has a freezing point of 269.15 K. Calculate the freezing point of 10% glucose in water if the freezing point of pure water is 273.15 K.**

**Given :**

**(Molar mass of sucrose = 342 g $mol^{-1}$)**

**(Molar mass of glucose = 180 g $mol^{-1}$)**

**(b) Define the following terms :**

**(i) Molality (*m*) (ii) Abnormal molar mass**

**3 + 2 = 5**

**OR**

**(a) 30 g of urea (M = 60 g $mol^{-1}$) is dissolved in 846 g of water. Calculate the vapour pressure of water for this solution if vapour pressure of pure water at 298 K is 23.8 mm Hg.**

**(b) Write two differences between ideal solutions and non-ideal solutions.**

**Ans. (a)** $\Delta T_f = K_f m$ **1**

Here, $m = w_2 \times 1000 / M_2 \times M_1$

$273.15 - 269.15 = K_f \times 10 \times 1000 / 342 \times 90$ **1**

$K_f = 12.3\ K\ kg/mol$ ½

$\Delta T_f = K_f m$

$= 12.3 \times 10 \times 1000/180 \times 90$

$= 7.6\ K$

$T_f = 273.15 - 7.6 = 265.55\ K$

**(or any other correct method) 1**

**(b) (i)** Number of moles of solute dissolved in per kilogram of the solvent. **1**

**(ii) Abnormal molar mass :** If the molar mass calculated by using any of the colligative properties to be different than theoretically expected molar mass. **1**

**[CBSE Marking Scheme, 2017]**

**OR**

**(a) (i)** $(P_A^0 - P_A)/P_A^0 = (w_B \times M_A)/(M_B \times w_A)$

$\frac{23.8 - P_A}{23.8} = (30 \times 18)/60 \times 846$ **1**

$23.8 - P_A = 23.8 \times [(30 \times 18)/60 \times 846]$ ½

$23.8 - P_A = 0.2532$ ½

**(b)**

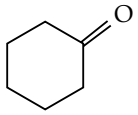
| Ideal solution | Non-ideal solution |
|---|---|
| (a) It obeys Raoult's law over the entire range of concentration. | (a) Does not obeys Raoult's law over the entire range of concentration. |
| (b) $\Delta_{mix}$ H = 0<br>(c) $\Delta_{mix}$ V = 0 | (b) $\Delta_{mix}$ H is not equal to 0.<br>(c) $\Delta_{mix}$ V is not equal to 0. |

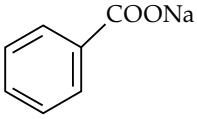
**1 + 1**

**(Any two correct difference)**

**[CBSE Marking Scheme, 2017]**

**26. (a) Write the product (s) in the following reactions:**

**(i)**  **+ HCN ⟶ ?**

**(ii)**  **+ NaOH $\xrightarrow[\Delta]{CaO}$ ?**

**(iii)** $CH_3 - CH = CH - CN \xrightarrow[(b)\ H_2O]{(a)\ DIBAL\text{-}H}$ **?**

**(b) Give simple chemical tests to distinguish between the following pairs of compounds :**

**(i) Butanal and Butan-2-one**

**(ii) Benzoic acid and Phenol** **3 + 2 = 5**

**OR**

**(a) Write the reactions involved in the following :**

**(i) Etard reaction**

**(ii) Stephen reduction**

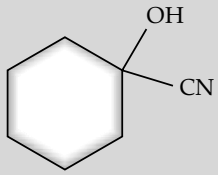
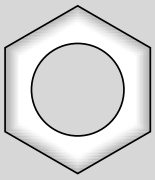
**(b) How will you convert the following in not more than two steps :**

**(i) Benzoic acid to benzaldehyde**

**(ii) Acetophenone to benzoic acid**

**(iii) Ethanoic acid to 2-hydroxyethanoic acid**

**2 + 3 = 5**

**Ans. (a) (i)**  **(ii)**  **1 + 1**

**(iii)** $CH_3 - CH = CH - CHO$ **1**

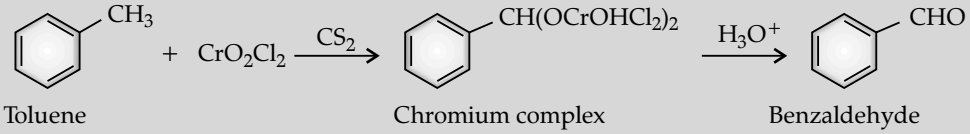
**(b) (i) Tollen's reagent test :** Add ammoniacal solution of silver nitrate (Tollen's reagent) in both the solutions. Butanal gives silver mirror whereas Butan-2-one does not. **1**

**(ii)** Add neutral $FeCl_3$ in both the solutions, phenol forms violet colour but benzoic acid does not.

**(or any other correct test) 1**

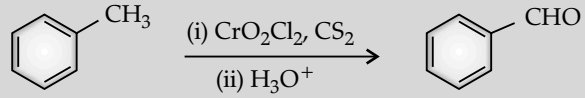
**OR**

**(a) (i)** Etard reaction




Toluene — Chromium complex — Benzaldehyde

**OR**




Toluene — Benzaldehyde **1**

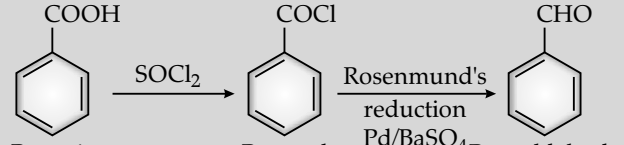
**(ii)** Stephen reaction

$$RCN + SnCl_2 + HCl \longrightarrow RCH = NH \xrightarrow{H_3O^+} RCHO$$

**OR**

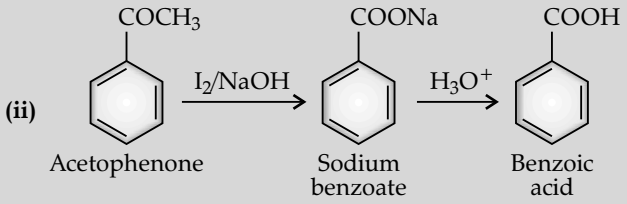
$$RCN \xrightarrow[(ii)\ H_3O^+]{(i)SnCl_2+HCl} RCHO$$ **1**

**(b) (i)**




Benzoic acid — Benzoyl chloride — Benzaldehyde **1**

**(ii)**




**1**

**(iii)** $CH_3COOH \xrightarrow{Cl_{2/p}} CH_2(Cl)COOH \xrightarrow{KOH(Aq)} CH_2(OH)COOH$ **1**

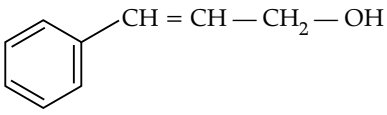
**(or any other correct method)**

**[CBSE Marking Scheme, 2017]**

## Outside Delhi Set-II — Code No. 56/2

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

**3. Write the IUPAC name of the following compound: 1**




**Ans.** 3-phenylprop-2-en-1-ol **1**

**[CBSE Marking Scheme, 2017]**

**6. Using IUPAC norms write the formulae for the following:**

**(a) Tris (ethane-1, 2-diamine) chromium (III) chloride**

**(b) Potassium tetrahydroxozincate (II) 2**

**Ans. (i)** $[Cr(en)_3]Cl_3$ **1**

**(ii)** $K_2[Zn(OH)_4]$ **1**

**[CBSE Marking Scheme, 2017]**

**Detailed Answer:**

**(a)** Tris(ethane-1, 2-diamine) chromium (III) chloride : $[Cr(en)_3]Cl_3$

**(b)** Potassium tetrahydroxozinate (II): $K_2[Zn(OH)_4]$

*** 7. Draw the structures of the following:**

**(a) $H_2S_2O_8$ (b) $ClF_3$ 2**

***11. (a) Write the principle of vapour phase refining.**

**(b) Write the role of dilute NaCN in the extraction of silver.**

**(c) What is the role of collectors in the froth flotation process ? Give an example of a collector. 3**

***16. Define the following:**

**(a) Anionic detergents**

**(b) Narrow spectrum antibiotics**

**(c) Antacids 3**

***17. Write the structures of the monomers used for getting the following polymers:**

**(a) Polyvinyl chloride (PVC)**

**(b) Melamine-formaldehyde polymer**

**(c) Buna-N 3**

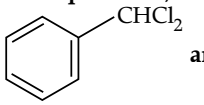
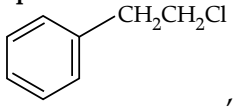
***22. (a) Based on the nature of intermolecular forces, classify the following solids :**
**Benzene, Silver.**

**(b) AgCl shows Frenkel defect while NaCl does not. Give reason.**

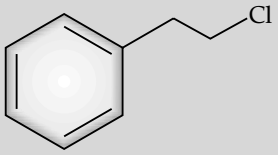
**(c) What type of semiconductor is formed when Ge is doped with Al ? 3**

## Outside Delhi Set-III — Code No. 56/3

**Note: Except these questions, other questions are from Outside Delhi Set-I and II**

**1. Out of**  **and**  **which is an example of a benzylic halide ? 1**

**Ans.**

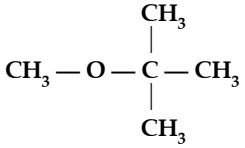



**1**

**[CBSE Marking Scheme, 2017]**

*** 3. Write the formula of the compound of iodine which is obtained when conc. $HNO_3$ oxidises $I_2$. 1**

**5. Write the IUPAC name of the following compound:**




**1**

**Ans.** 2-Methoxy-2-methyl propane **1**

**[CBSE Marking Scheme, 2017]**

*** 6. Draw the structures of the following:**

**(a) $XeF_4$ (b) $BrF_5$ 2**

**7. Write the name of the cell which is generally used in transistors. Write the reactions taking place at the anode and the cathode of this cell. 2**

* Out of Syllabus

**Ans.** Dry Cell/Leclanche cell **1**

**Anode :** $Zn(s) \longrightarrow Zn^{2+} + 2e^-$ ½

Cathode : $MnO_2 + NH_4^+ + e^- \rightarrow MnO(OH) + NH_3$ ½

**[CBSE Marking Scheme, 2017]**

**Detailed Answer:**

The cell which is used in the transistors is Dry cell.

**At anode:** $Zn(s) \longrightarrow Zn^{2+} + 2e^-$

**At cathode:** $MnO_2 + NH_4^+ + e^- \longrightarrow MnO(OH) + NH_3$

Ammonia produced in the reaction forms a complex with $Zn^{2+}$ ion.

$Zn^{2+} + 4NH_3 \longrightarrow [Zn(NH_3)_4]^{2+}$

**9.** Using IUPAC norms write the formulae for the following:

**(a)** Potassium trioxalatoaluminate (III)

**(b)** Dichloridobis(ethane-1, 2-diamine) cobalt (III)

**Ans.** **(a)** $K_3[Al(C_2O_4)_3]$ **1**

**(b)** $[Co\ Cl_2\ (en)_2]^+$ **1**

**[CBSE Marking Scheme, 2017]**

***14.** **(a) Based on the nature of intermolecular forces, classify the following solids: Sodium sulphate, hydrogen.**

**(b) What happens when $CdCl_2$ is doped with AgCl?**

**(c) Why do ferromagnetic substances show better magnetism than antiferromagnetic substances? 3**

***15.** **(a) Write the principle of electrolytic refining.**

**(b) Why does copper obtained in the extraction from copper pyrites have a blistered appearance ?**

**(c) What is the role of depressants in the froth flotation process ? 3**

***19.** **Define the following:**

**(a) Cationic detergents**

**(b) Broad spectrum antibiotics**

**(c) Tranquilizers 3**

***20.** **Write the structures of the monomers used for getting the following polymers:**

**(a) Teflon**

**(b) Melamine-formaldehyde polymer**

**(c) Neoprene**

❑❑❑

* Out of Syllabus