CHEMISTRY

Paper & Solution

Code : 56/3

Time : 3 Hrs. **Max. Marks : 70**

General Instructions :

(i) All questions are compulsory.

(ii) Questions number **1 to 8** are very short answer questions and carry **1** mark each.

(iii) Questions **9** to **18** are short answer questions and carry **2** marks each.

(iv) Question number **19 to 27** are also short-answer questions and carry **3** marks each.

(v) Question number **28 to 30** are long-answer questions and carry **5** marks each.

(vi) Use Log Tables, if necessary. Use of calculators is **not** allowed.

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1. What are the dispersed phase and dispersion medium in milk ? **1**

Sol. Dispersed phase : Oil

Dispersion medium : Water

2. Name the method used for refining of copper metal. **1**

Sol. Electrorefining

3. Why does NH_3 act as a Lewis base ? **1**

Sol. NH_3 acts as a Lewis base because N-atom has a ℓp

4. The conversion of primary aromatic amines into diazonium salts is known as_____ **1**

Sol. Diazotisation Reaction

5. Which of the following is a fibre ? **1**

Nylon, Neoprene, PVC

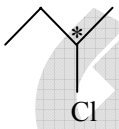
Sol. Nylon

6. Write the products of hydrolysis of lactose. **1**

Sol. β-D-Glucose and β-D-Galactose

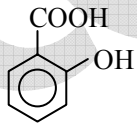
7. Identify the chiral molecule in the following pair: **1**

Sol.



8. Write the structure of 2-hydroxybenzoic acid. **1**

Sol.



9. Complete the following equations: **2**

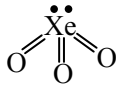
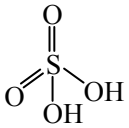
(i) $C + \text{conc. } H_2SO_4 \rightarrow$

(ii) $XeF_2 + H_2O \rightarrow$

Sol. (i) $C + 2H_2SO_{4(conc)} \rightarrow CO_2 + 2SO_2 + 2H_2O$

(ii) $2XeF_2 + 2H_2O \rightarrow 2Xe + O_2 + 4HF$

10. Draw the structures of the following: **2**
(i) XeO_3 (ii) H_2SO_4

Sol. (i)  (ii) 

11. Write the name of monomers used for getting the following polymers: **2**
(i) Teflon (ii) Buna-N

Sol. (i) $CF_2 = CF_2$ (Tetrafuoro ethylene)

(ii)

$$\underset{\text{(Buta 1,3–di–ene)}}{CH_2=CH-CH=CH_2} + \underset{\text{(Acrylonitrile)}}{CH_2=\underset{\displaystyle CN}{\underset{|}{CH}}} \xrightarrow{Na} \underset{\text{(product)}}{\text{Buna-N}}$$

12. An element with density 2.8 g cm^{-3} forms a f.c.c. unit cell with edge length 4×10^{-8} cm. Calculate the molar mass of the element. **2**
(Given: $N_A = 6.022 \times 10^{23}\ mol^{-1}$)

Sol. We know $d = \dfrac{Z \times M}{V \times N_A}$

d = 2.8 g/cmq $Z = 4$ $a = 4 \times 10^{-8}$ cm

$$2.8 = \frac{4 \times M}{(4 \times 10^{-8})^3 \times 6.02 \times 10^{23}}$$

$$2.8 = \frac{4 \times M}{4^3 \times 6.022 \times 10^{-1}}$$

M = 26.97

13. (i) Write the type of magnetism observed when the magnetic moments are aligned in parallel and anti-parallel directions in unequal numbers.
(ii) Which stoichiometric defect decreases the density of the cystal ? **2**

Sol. (i) When magnetic moment is aligned in parallel direction, it is called Ferromagnetic and it magnetic moment is aligned in antiparallel direction, it is called antiferromagnetic.
(ii) Due to schottky defect vacancies are formed and density decreases

14. Define the following terms: **2**
(i) Molar conductivity (Λ_m)
(ii) Secondary batteries

Sol. (i) Molar Conductivity Λ_m : Molar conductivity can be defined as conductance of all the ions present in a certain volume (V cm^3). If solution is kept between electrodes present 1 cm apart and area of electrode such that whole solution is confined them.
(ii) Secondary batteries :
The batteries which can be recharged again and again are called as secondary batteries.
Eg. Lead storage battery

15. Write the mechanism of the following reaction: **2**
$CH_3CH_2OH \xrightarrow{HBr} CH_3CH_2Br + H_2O$

Sol. Step-I :

$$CH_3–CH_2–OH \xrightarrow{\overset{+}{H}Br^-} CH_3-CH_2-\overset{\oplus}{O}H_2$$
(oxonium ion)

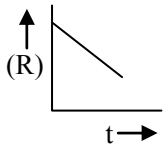
Step-II :

$$CH_3–CH_2–\overset{\oplus}{O}H_2 \longrightarrow CH_3–\overset{\oplus}{C}H_2$$

Step-III :

$$CH_3–\overset{\oplus}{C}H_2 \xrightarrow{Br^-} CH_3–CH_2–Br$$

16. For a chemical reaction R → P, the variation in the concentration (R) vs. time (t) plot is given as



(i) Predict the order of the reaction.
(ii) What is the slope of the curve ?

Sol. (i) Order of reaction = 0

As integrated rate law

is $(a_0 - x) = - kt + a_0$

and slope of curve = –k

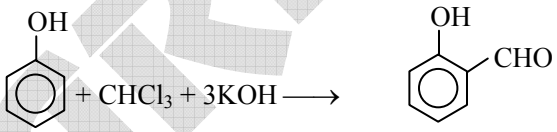
17. Write the principle behind the froth floatation process. What is the role of collectors in this process ? **2**

Sol. Froth floatation process is used when ore has wettiability towards oil while impurities have wettiability towards water. Collectors are used in froth floatation process to collect ore particles and to remove them with froth.

18. Write the equations involved in the following reactions : **2**
(i) Reimer – Tiemann reaction
(ii) Williamson synthesis

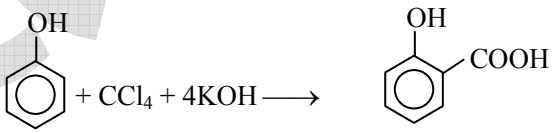
Sol. (i) Reimer tiemann Reaction

* Reimer tiemann formylation



(Salicyldehyde)

* Reimer-tiemann carboxylation



(Salicylic acid)

(ii) Williamson's synthesis

$$C_2H_5–Br + C_2H_5\overline{O}\,Na^+ \xrightarrow{Heat} C_2H_5–O–C_2H_5 + NaBr$$

19. (i) Write the IUPAC name of the complex $[Cr(NH_3)_4Cl_2]Cl$. **3**

(ii) What type of isomerism is exhibited by the complex $[Co(en)_3]^{3+}$?

(en = ethane-1,2-diamine)

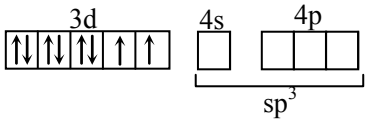
Sol. (i) $[Cr(NH_3)_4Cl_2]Cl$

Tetraamminedichloridochromium(III) chloride

(ii) $[Co(en)_3]^{+3}$ shows optical isomerism

(iii) $[NiCl_4]^{-2}$

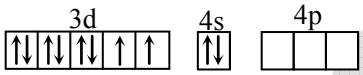
$Ni^{+2} = [Ar]\ 4s^0 3d^8$



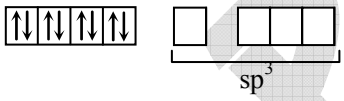
Ni^{+2} has 2 unpaired e^- hence, this complex is paramagnetic

$[Ni(CO)_4]$

$Ni = [Ar]\ 4s^2\ 3d^8$

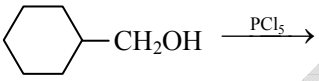


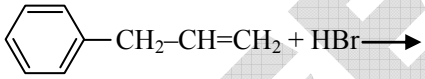
CO is strong field ligand. Hence, pairing occurs.



Ni has zero unpaired electron, this complex is diamagnetic

20. (a) Draw the structures of major monohalo products is each of the following reactions : **3**

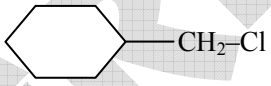
(i) 

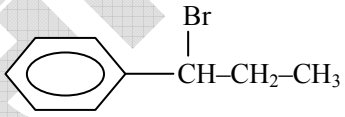
(ii) 

(b) Which halogen compound in each of the following pairs will react faster in S_N2 reaction :

(i) CH_3Br or CH_3I

(ii) $(CH_3)_3C–Cl$ or $CH_3–Cl$

Sol. (a) (i) 

(ii) 

(b) (i) CH_3I

(ii) CH_3Cl

21. Account for the following : **3**

(i) Primary amines ($R\text{-}NH_2$) have higher boiling point than tertiary amines (R_3N).

(ii) Aniline does not undergo Friedel-Crafts reaction.

(iii) $(CH_3)_2NH$ is more basic than $(CH_3)_3N$ in an aqueous solution.

Sol. (i) Due to maximum intermolecular hydrogen bonding in primary amines (due to presence of more number of H-atoms) primary amines have high BP in comparison to tertiary amines.

(ii) Aniline does not undergo Friedel-Crafts reaction due to Acid-Base reaction between Basic compound. Aniline and Lewis Acid/Protic Acid, which is use in Friedel-crafts reaction.

(iii) In $(CH_3)_3$ N there is maximum steric hindrance and least solvation but in $(CH_3)_2NH$ the solvation is more and the steric hindrance is less than in $(CH_3)_3N$; Although +I effect is less, since there are two methyl group; di-methyl amine is still a stronger base than tri-methyl amine.

OR

(i) $C_6H_5NO_2 \xrightarrow{Sn+HCl} \underset{(A)}{C_6H_5NH_2} \xrightarrow[273\,K]{NaNO_2+HCl} \underset{(B)}{C_6H_5N_2Cl} \xrightarrow{H_2O} \underset{(c)}{C_6H_5OH}$

(ii) $CH_3–CN \xrightarrow{H_2O/H^+} \underset{(A)}{CH_3-COOH} \xrightarrow{NH_3} \underset{(B)}{CH_3-CONH_2} \xrightarrow{Br_2+KOH} \underset{(C)}{CH_3-NH_2}$

22. On the occasion of World Heath Day, Dr. Satpal organized a 'health camp' for the poor farmers living in a nearby village. After check-up, he was shocked to see that most of the farmers suffered from cancer due to regular exposure to pesticides and many were diabetic. They distributed free medicines to them. Dr. Satpal immediately reported the matter to the National Human Rights Commission (NHRC). On the suggestions of NHRC, the government decided to provide medical care, financial assistance, setting up of super-speciality hospitals for treatment and prevention of the deadly disease in the affected villages all over India. **3**

(i) Write the values shown by

(a) Dr. Satpal

(b) NHRC

(ii) What type of analgesics are chiefly used for the relief of pains of terminal cancer ?

(iii) Give an example of artificial sweetener that could have been recommended to diabetic patients.

Sol. (i) (a) Dr. Satpal distributed free medicines to them.

(b) Dr. Satpal immediately reported the matter to the National Human Rights Commission.

(ii) Aspirin (iii) Aspartame

23. Define the following terms :

(i) Nucleotide

(ii) Anomers

(iii) Essential amino acids

Sol. (i) **Nucleotide :** It is the monomer unit of DNA which is formed by nitrogenous base, Deoxyribose sugar and Phosphoric acid.

(ii) **Anomer :** Anomers are cyclic monosaccaride which are differing from each other in the configuration of c-1 if they are aldose or in the configuration at c-2 if they are ketoses.

(iii) **Essential amino acid :** The Amino acid can not synthesised by body and essential for body.

24. (a) Calculate Δ_rG^o for the reaction

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

Given : $E^o_{cell} = +2.71$ V, 1 F = 96500 C mol^{-1}.

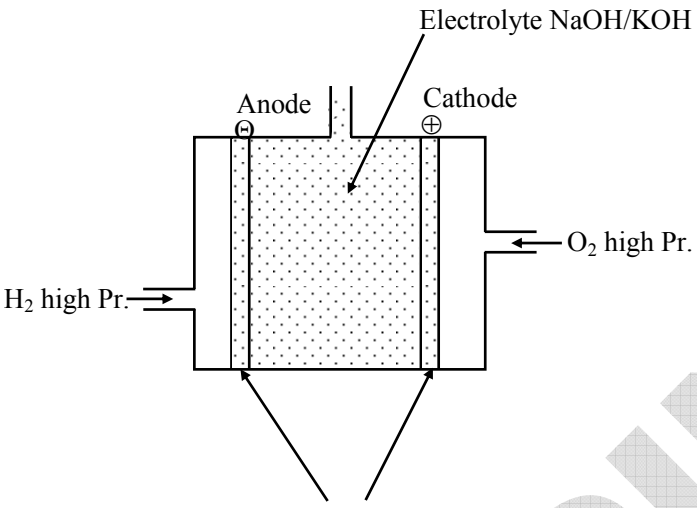
Sol. **(a)** $\Delta G° = –nF\ E°_{Cell}$

$= –2 \times 96500 \times 2.71$

$= –523030$

$= – 523.03$ kJ

(b) Fuel cell



* In fuel cell porous carbon electrodes impregnated with Pt particles are used.
* NaOH or KOH are used as electrolyte
* Reaction at anode :

$$H_2 + 2OH^- \rightleftharpoons 2H_2O + 2e^-$$

At cathode $\frac{1}{2}O_2 + H_2O + 2e^- \rightleftharpoons 2OH^-$

Overall cell reaction

$$H_2(g) + \frac{1}{2}O_2(g) \rightleftharpoons H_2O(l)$$

Advantage of fuel cell

(i) High efficiency
(ii) No harmful products are formed
(iii) No part of the cell creats environmental hazards

25. The following data were obtained during the first order thermal decomposition of SO_2Cl_2 at a constant volume : **3**

$$SO_2Cl_2(g) \longrightarrow SO_2(g) + Cl_2(g)$$

Experiment	Time/s^{-1}	Total pressure/atm
1	0	0.4
2	100	0.7

Sol. $SO_2Cl_2(g) \rightarrow SO_2(g) + Cl_2(g)$

Initial Pr. 0.4
After time (t) 0.4 – x x x

$\therefore$ Total pressure = 0.4 + x = 0.7 $\Rightarrow$ x = 0.3

$$K = \frac{2.303}{t}\log\left(\frac{P_0}{P_0 - x}\right)$$

$$= \frac{2.303}{100}\log\frac{0.4}{0.1}$$

$$= \frac{2.303}{100}\log 4 = \frac{2.303}{100} \times 0.6021$$

$$= 1.3866 \times 10^{-2}\ sec^{-1}$$

26. What are emulsions ? What are their different types ? Give one example of each type. **3**

Sol. Colloidal solution of liquid in liquid is called as emulsion

We have two types of emulsions

(1) Oil in water (o/w)

(2) Water in oil (w/o)

(i) Oil in water : In this type of emulsion water is medium and oil is dispersed phase, it soluble in H_2O, Ex. Milk

(ii) Water is oil : In this type of emulsion oil is medium and water is dispersed into it, it is soluble in oil Ex. Butter

27. Given reasons for the following :

(i) $(CH_3)_3$ P = O exists but $(CH_3)_3N$ = O does not.

(ii) Oxygen has less electron enthalpy with negative sign than sulphur.

(iii) H_3PO_2 is a stronger reducing agent than H_3PO_3.

Sol. (i) Due to absence of vacant d-orbitals N can not form 5 covalent bonds

(ii) O has exceptionally small size. Hence, incoming electron feels more repulsion than expected and its negative electron gain enthalpy becomes less than expected

(iii) In H_3PO_2 oxidation state of P is '+1' while in H_3PO_3 oxidation state of P is '+3' . In H_3PO_2 oxidation state of P is lower than that in H_3PO_3

28. **(a)** Complete the following equations: **5**

(i) $Cr_2O_7^{2-} + 2OH^- \longrightarrow$

(ii) $MnO_4^- + 4H^+ + 3e^- \longrightarrow$

(b) Account for the following :

(i) Zn is not considered as a transition element.

(ii) Transition metals form a larger number of complexes.

(iii) The E^o value for the Mn^{3+} / Mn^{2+} couple is much more positive than that for Cr^{3+}/Cr^{2+} couple.

OR

(i) With reference to structural variability and chemical reactivity, write the difference between lanthanoids and action ions.

(ii) Name of member of the lanthanoid series which is well known to exhibit +4 oxidation state.

(iii) Complete the following equations :

$$MnO^-_4 + 8H^+ + 5e^- \longrightarrow$$

(iv) Out of Mn^{3+} and Cr^{3+}, which is more paramagnetic and why ? **3, 2**

(atomic nos. : Mn = 25, r = 24)

Sol. (a)

(i) $Cr_2O_7^{2-} + 2OH^- \longrightarrow 2CrO_4^{-2} + H_2O$

(ii) $MnO_4^- + 4H^+ + 3e^- \longrightarrow MnO_2 + 2H_2O$

(b)

(i) In Zn inner 3d-subshell is full filled.

(ii) Conditions required to form complex are :

• Metal ion must have high charge density.

• Metal ion must have vacant orbitals. Transition elements follow these requirements. Hence, they form complexes.

(iii) For Mn '+2' oxidation state is more stable than '+3' oxidation state while for Cr '+3' oxidation state is more stable '+2' oxidation state.

OR

(I)

	Lanthanoids		Actinoids
(a)	They are not radioactive (except Pm)	(a)	They are radioactive
(b)	They mainly show '+3' oxidation state. They can show upto '+4' oxidation state.	(b)	They mainly show '+3' oxidation state. They can show upto '+7' oxidation state.
(c)	Their magnetic nature can be easily explained.	(c)	Their magnetic nature can not be easily explained.
(d)	Their physical and chemical properties have been studied throughly.	(d)	Their physical and chemical properties have not been studied throughly.

(ii) Cerium (Ce)

(iii) $MnO_4^- + 8H^+ + 5e^- \longrightarrow Mn^{2+} + 4H_2O$

(iv) $Mn^{+3} = [Ar]\ 4s^0\ 3d^4$ (4 unpaired e^-)

$Cr^{+3} = [Ar]\ 4s^0\ 3d^3$ (3 unpaired e^-)

Mn^{+3} has more no. of unpaired e^- than Cr^{+3}.

29. **(a)** Writhe the products formed when CH_3CHO reacts with the following reagents : **2,2,1**

(i) HCN

(ii) $H_2N - OH$

(iii) CH_3CHO in the presence of dilute NaOH

(b) Give simple chemical tests to distinguish between the following Paris of compounds.

(i) Benzoic acid and Phenol

(ii) Propanal and Propanone.

OR

(a) Account for the following :

(i) $Cl–CH_2COOH$ is a stronger acid than CH_3COOH.

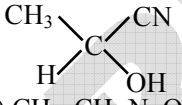
(ii) Carboxylic acids do not give reactions of carbonyl group.

(b) Write the chemical equations to illustrate the following name reactions :

(i) Rosenmund reduction

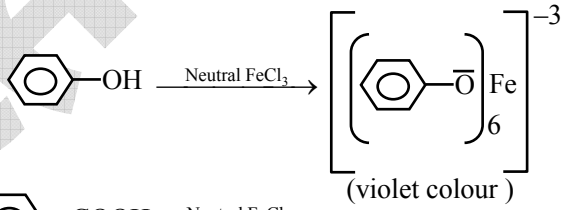
(ii) Cannizzaro's reaction

(c) Out of $CH_3CH_2–CO–CH_2–CH_3$ and $CH_3CH_2–CH_2–CO–CH_3$, which give iodoform test ?

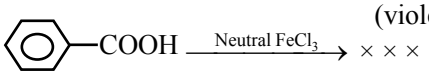
Sol. (a) (i) 

(ii) $CH_3–CH=N–OH$

(iii) $CH_3–\underset{\displaystyle OH}{\underset{|}{CH}}–CH_2–CHO$

(b) (i) 

(violet colour)



(ii) $CH_3–\underset{\displaystyle O}{\underset{\|}{C}}–CH_3 \xrightarrow[-\text{ve Iodoform test}]{I_2+NaOH} CHI_3$ (Iodoform)

$CH_3–CH_2–CHO \xrightarrow[+\text{ve Iodoform test}]{I_2+NaOH} \times\times\times$

OR

(a) (i) Due to presence of –Cl as a – I group

(ii) The carbonyl group is involve in resonance in –COOH grp so the double bond character is decreases here hence –COOH group do not give reaction of carbonyl group although it have >C = O.

(b) (i) Rosenmund reduction :

$$R-\underset{\underset{O}{\|}}{C}-Cl \xrightarrow{(Pd+BaSO_4)} R\text{–}CHO$$

(ii) Cannizzaro's Reaction

$$2H\text{–}CHO \xrightarrow{50\,\%\ NaOH(conc.\,base)} CH_3-OH + H-COONa$$

(c) $CH_3\text{–}CH_2\text{–}CH_2-\underset{\underset{O}{\|}}{C}-CH_3$

(methyl ketone)

30. (a) Define the following terms : **2,3**

(i) Molarity

(ii) Molal elevation constant (K_b)

(b) A solution containing 15 g urea (molar mass = 60 g mol^{-1}) per litre of solution in water has the same osmotic pressure (isotonic) as a solution of glucose (molar mass = 190 g mol^{-1}) in water. Calculate the mass of glucose present in one litre of its solution.

OR

(a) What type of deviation is shown by a mixture of ethanol and acetone ? Give reason.

(b) A solution of glucose (molar mass = 180 g mol^{-1}) in water is labeled as 10% (by mass). What would be the molality and molarity of the solution ?
(Density of solution = 1.2 g mL^{-1})

Sol. **(a)** (i) Molarity (M) : Molarity can be defined as no. of moles of solute dissolved per litre of solution

$$\text{Molarity M} = \frac{\text{Moles of solute}}{\text{Vol. of solution (litre)}}$$

(ii) Molal elevation constant (K_b) :

When 1 molal solution is prepared, the elevation in boiling point is called as molal boiling point elevation constant.

(b) For isotonic solution

$$\pi_1 = \pi_2$$

$C_1 = C_2$ {at same temp.}

or $n_1 = n_2$ {is same vol.}

$$\therefore \frac{15}{60} = \frac{x}{180}$$

x = 45 g , mass of glucose per lit. of solution.

OR

(a) Ethanol and acetone shows +ve deviation because both are non polar compounds and after mixing force of attraction decreases

Like particle force of attraction > unlike particle force of attraction

(b) $$\text{Molarity} = \frac{\%\ \text{Mass} \times 10 \times \text{density}}{\text{Mol. mass of solute}}$$

$$= \frac{10 \times 10 \times 1.2}{180} = 0.66\text{M}$$

$$\text{Molality} = \frac{\%\,\text{Mass}}{\text{Mol. mass of solute}} \times \frac{1000}{(100 - \%\ \text{Mass})}$$

$$= \frac{10}{180} \times \frac{1000}{90} = 0.617\,\text{m}$$