

# CHEMISTRY (Theory)

*Time allowed : 3 hours*

*Maximum Marks : 70*

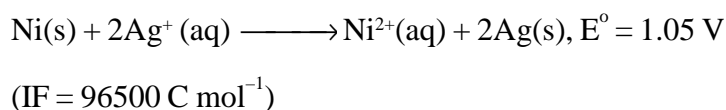
## **General Instructions:**

- (i) All questions are compulsory.
- (ii) Marks for each question are indicated against it.
- (iii) Question numbers 1 to 8 are very short-answer questions and carry 1 mark each.
- (iv) Question numbers 9 to 18 are short-answer questions and carry 2 marks each.
- (v) Question numbers 19 to 27 are also short-answer questions and carry 3 marks each.
- (vi) Question numbers 28 to 30 are long-answer questions and carry 5 marks each.
- (vii) Use Log Tables, if necessary, Use of calculators is **not** allowed.

## QUESTION PAPER CODE 56/1/1

1. 'Crystalline solids are anisotropic in nature.' What does this statement mean?
2. Express the relation between conductivity and molar conductivity of a solution held in a cell.
3. Define 'electrophoresis'.
4. Draw the structure of  $\text{XeF}_2$  molecule.
5. Write the IUPAC name of the following compound:  
 $(\text{CH}_3)_3\text{CCH}_2\text{Br}$
6. Draw the structure of 3-methylbutanal.
7. Arrange the following compounds in an increasing order of their solubility in water:  
 $\text{C}_6\text{H}_5\text{NH}_2$ ,  $(\text{C}_2\text{H}_5)_2\text{NH}$ ,  $\text{C}_2\text{H}_5\text{NH}_2$

8. What are biodegradable polymers?
9. The chemistry of corrosion of iron is essentially an electrochemical phenomenon. Explain the reactions occurring during the corrosion of iron in the atmosphere.
10. Determine the values of equilibrium constant ( $K_c$ ) and  $\Delta G^\circ$  for the following reaction:



11. Distinguish between 'rate expression' and 'rate constant' of a reaction.
12. State reasons for each of the following:
- The N – O bond in  $\text{NO}_2^-$  is shorter than the N – O bond in  $\text{NO}_3^-$ .
  - $\text{SF}_6$  is kinetically an inert substance.

**OR**

State reasons for each of the following:

- All the P-Cl bonds in  $\text{PCl}_5$  molecule are not equivalent.
  - Sulphur has greater tendency for catenation than oxygen.
13. Assign reasons for the following:
- Copper (I) ion is not known in aqueous solution.
  - Actinoids exhibit greater range of oxidation states than lanthanoids.
14. Explain the following giving one example for each:
- Reimer-Tiemann reaction.
  - Friedel Craft's acetylation of anisole.
15. How would you obtain
- Picric acid (2, 4, 6-trinitrophenol) from phenol,
  - 2-Methylpropene from 2-methylpropanol ?

16. What is essentially the difference between  $\alpha$ -form of glucose and  $\beta$ -form of glucose? Explain.
17. Describe what you understand by primary structure and secondary structure of proteins.
18. Mention two important uses of each of the following:
- Bakelite
  - Nylon 6
19. Silver crystallizes in face-centered cubic unit cell. Each side of this unit cell has a length of 400 pm. Calculate the radius of the silver atom. (Assume the atoms just touch each other on the diagonal across the face of the unit cell. That is each face atom is touching the four corner atoms.)
20. Nitrogen pentoxide decomposes according to equation:  $2\text{N}_2\text{O}_5(\text{g}) \longrightarrow 4\text{NO}_2(\text{g}) + \text{O}_2(\text{g})$ .

This first order reaction was allowed to proceed at 40 °C and the data below were collected:

$[\text{N}_2\text{O}_5]$ (M)	Time (min)
0.400	0.00
0.289	20.0
0.209	40.0
0.151	60.0
0.109	80.0

- Calculate the rate constant. Include units with your answer.
- What will be the concentration of  $\text{N}_2\text{O}_5$  after 100 minutes?
- Calculate the initial rate of reaction.

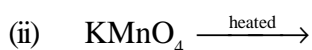
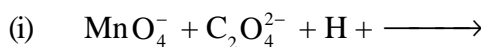
21. Explain how the phenomenon of adsorption finds application in each of the following processes:
- Production of vacuum
  - Heterogeneous catalysis
  - Froth Floatation process

**OR**

Define each of the following terms:

- Micelles
  - Peptization
  - Desorption
22. Describe the principle behind each of the following processes:
- Vapour phase refining of a metal.
  - Electrolytic refining of a metal.
  - Recovery of silver after silver ore was leached with NaCN.

23. Complete the following chemical equations:



24. Write the name, stereochemistry and magnetic behaviour of the following:

(At.nos. Mn = 25, Co = 27, Ni = 28)



25. Answer the following:
- Haloalkanes easily dissolve in organic solvents, why?
  - What is known as a racemic mixture? Give an example.
  - Of the two bromoderivatives,  $C_6H_5CH(CH_3)Br$  and  $C_6H_5CH(C_6H_5)Br$ , which one is more reactive in  $S_N1$  substitution reaction and why?
26. (a) Explain why an alkylamine is more basic than ammonia.
- (b) How would you convert
- Aniline to nitrobenzene
  - Aniline to iodobenzene?
27. Describe the following giving one example for each:
- Detergents
  - Food preservatives
  - Antacids
28. (a) Differentiate between molarity and molality for a solution. How does a change in temperature influence their values?
- (b) Calculate the freezing point of an aqueous solution containing 10.50 g of  $MgBr_2$  in 200 g of water. (Molar mass of  $MgBr_2 = 184$  g)
- ( $K_f$  for water =  $1.86 \text{ K kg mol}^{-1}$ )

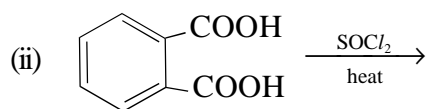
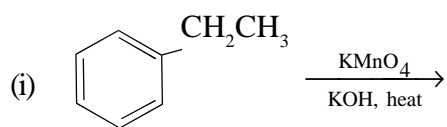
**OR**

- (a) Define the terms osmosis and osmotic pressure. Is the osmotic pressure of a solution a colligative property? Explain.
- (b) Calculate the boiling point of a solution prepared by adding 15.00 g of  $NaCl$  to 250.0 g of water. ( $K_b$  for water =  $0.512 \text{ K kg mol}^{-1}$ ,
- Molar mass of  $NaCl = 58.44$  g)
29. (a) Give chemical tests to distinguish between
- Propanal and propanone,
  - Benzaldehyde and acetophenone.

- (b) How would you obtain
- But-2-enal from ethanal,
  - Butanoic acid from butanol,
  - Benzoic acid from ethylbenzene ?

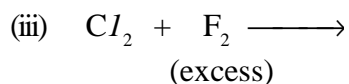
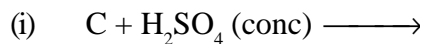
**OR**

- (a) Describe the following giving linked chemical equations:
- Cannizzaro reaction
  - Decarboxylation
- (b) Complete the following chemical equations:



30. (a) Explain the following:
- $\text{NF}_3$  is an exothermic compound whereas  $\text{NCl}_3$  is not.
  - $\text{F}_2$  is most reactive of all the four common halogens.

- (b) Complete the following chemical equations:



OR

- (a) Account for the following:
- The acidic strength decreases in the order  $\text{HCl} > \text{H}_2\text{S} > \text{PH}_3$
  - Tendency to form pentahalides decreases down the group in group 15 of the periodic table.
- (b) Complete the following chemical equations:
- $\text{P}_4 + \text{SO}_2\text{Cl}_2 \longrightarrow$
  - $\text{XeF}_2 + \text{H}_2\text{O} \longrightarrow$
  - $\text{I}_2 + \text{HNO}_3 \longrightarrow$   
(conc)

## QUESTION PAPER CODE 56/1

- Define 'order of a reaction'. 1
- What is meant by 'shape selective catalysis' ? 1
- Differentiate between a mineral and an ore. 1
- What is meant by 'lanthanoid contraction' ? 1
- Write the IUPAC name of the following compound: 1  
 $\text{CH}_2 = \text{CHCH}_2\text{Br}$
- Draw the structure of 4-chloropentan-2-one. 1
- How would you convert ethanol to ethene ? 1
- Rearrange the following in an increasing order of their basic strengths: 1  
 $\text{C}_6\text{H}_5\text{NH}_2$ ,  $\text{C}_6\text{H}_5\text{N}(\text{CH}_3)_2$ ,  $(\text{C}_6\text{H}_5)_2\text{NH}$  and  $\text{CH}_3\text{NH}_2$ .
- Explain how you can determine the atomic mass of an unknown metal if you know its mass density and the dimensions of unit cell of its crystal. 2

10. Calculate the packing efficiency of a metal crystal for a simple cubic lattice. 2
11. State the following: 2
- Raoult's law in its general form in reference to solutions.
  - Henry's law about partial pressure of a gas in a mixture.
12. What do you understand by the rate law and rate constant of a reaction? Identify the order of a reaction if the units of its rate constant are: 2
- $L^{-1} \text{ mol s}^{-1}$
  - $L \text{ mol}^{-1} \text{ s}^{-1}$
13. The thermal decomposition of  $\text{HCO}_2\text{H}$  is a first order reaction with a rate constant of  $2.4 \times 10^{-3} \text{ s}^{-1}$  at a certain temperature. Calculate how long will it take for three-fourths of initial quantity of  $\text{HCO}_2\text{H}$  to decompose. ( $\log 0.25 = -0.6021$ ) 2
14. Describe the principle controlling each of the following processes: 2
- Vapour phase refining of titanium metal
  - Froth floatation method of concentration of a sulphide ore.
15. How would you account for the following:
- $\text{Cr}^{2+}$  is reducing in nature while with the same d-orbital configuration ( $d^4$ )  $\text{Mn}^{3+}$  is an oxidising agent.
  - In a transition series of metals, the metal which exhibits the greatest number of oxidation states occurs in the middle of the series.
16. Complete the following chemical equations: 2
- $\text{MnO}_4^- (\text{aq}) + \text{S}_2\text{O}_3^{2-} (\text{aq}) + \text{H}_2\text{O} (\text{l}) \rightarrow$
  - $\text{Cr}_2\text{O}_7^{2-} (\text{aq}) + \text{Fe}^{2+} (\text{aq}) + \text{H}^+ (\text{aq}) \rightarrow$

**OR**

- State reasons for the following: 2
- $\text{Cu} (\text{I})$  ion is not stable in an aqueous solution.



- (ii) Unlike  $\text{Cr}^{3+}$ ,  $\text{Mn}^{3+}$ ,  $\text{Fe}^{3+}$  and the subsequent other  $\text{M}^{3+}$  ions of the 3d series of elements, the 4d and the 5d series metals generally do not form stable cationic species.
17. Explain what is meant by the following: 2
- (i) peptide linkage
- (ii) pyranose structure of glucose
18. Write the main structural difference between DNA and RNA. Of the four bases, name those which are common to both DNA and RNA. 2
19. A solution prepared by dissolving 8.95 mg of a gene fragment in 35.0 mL of water has an osmotic pressure of 0.335 torr at  $25^\circ\text{C}$ . Assuming that the gene fragment is a non-electrolyte, calculate its molar mass. 3
20. Classify colloids where the dispersion medium is water. State their characteristics and write an example of each of these classes. 3

**OR**

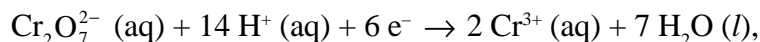
Explain what is observed when

- (i) an electric current is passed through a sol
- (ii) a beam of light is passed through a sol
- (iii) an electrolyte (say NaCl) is added to ferric hydroxide sol 3
21. How would you account for the following: 3
- (i)  $\text{H}_2\text{S}$  is more acidic than  $\text{H}_2\text{O}$ .
- (ii) The N – O bond in  $\text{NO}_2^-$  is shorter than the N – O bond in  $\text{NO}_3^-$ .
- (iii) Both  $\text{O}_2$  and  $\text{F}_2$  stabilize high oxidation states but the ability of oxygen to stabilize the higher oxidation state exceeds that of fluorine.
22. Explain the following terms giving a suitable example in each case: 3
- (i) Ambident ligand
- (ii) Denticity of a ligand
- (iii) Crystal field splitting in an octahedral field

23. Rearrange the compounds of each of the following sets in order of reactivity towards  $S_N2$  displacement: 3
- (i) 2-Bromo-2-methylbutane, 1-Bromopentane, 2-Bromopentane
  - (ii) 1-Bromo-3-methylbutane, 2-Bromo-2-methylbutane, 3-Bromo-2-methylbutane
  - (iii) 1-Bromobutane, 1-Bromo-2,2-dimethylpropane, 1-Bromo-2-methylbutane
24. How would you obtain the following:
- (i) Benzoquinone from phenol
  - (ii) 2-Methylpropan-2-ol from methylmagnesium bromide
  - (iii) Propan-2-ol from propene
25. State reasons for the following: 3
- (i)  $pK_b$  value for aniline is more than that for methylamine.
  - (ii) Ethylamine is soluble in water whereas aniline is not soluble in water.
  - (iii) Primary amines have higher boiling points than tertiary amines.
26. Draw the structures of the monomers of the following polymers: 3
- (i) Polythene
  - (ii) PVC
  - (iii) Teflon
27. What are the following substances? Give one example of each. 3
- (i) Food preservatives
  - (ii) Synthetic detergents
  - (iii) Antacids
28. (a) What type of a battery is lead storage battery? Write the anode and cathode reactions and the overall cell reaction occurring in the operation of a lead storage battery.

- (b) Calculate the potential for half-cell containing

0.10 M  $\text{K}_2\text{Cr}_2\text{O}_7$  (aq), 0.20 M  $\text{Cr}^{3+}$  (aq) and  $1.0 \times 10^{-4}$  M  $\text{H}^+$  (aq)  
The half-cell reaction is



and the standard electrode potential is given as  $E^\circ = 1.33$  V.

5

**OR**

- (a) How many moles of mercury will be produced by electrolysis of 1.0 M  $\text{Hg}(\text{NO}_3)_2$  solution with a current of 2.00 A for 3 hours?

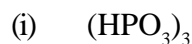
[ $\text{Hg}(\text{NO}_3)_2 = 200.6 \text{ g mol}^{-1}$ ]

- (b) A voltaic cell is set up at  $25^\circ \text{C}$  with the following half-cells  $\text{Al}^{3+}$  (0.001 M) and  $\text{Ni}^{2+}$  (0.50 M). Write an equation for the reaction that occurs when the cell generates an electric current and determine the cell potential.

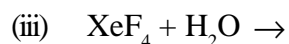
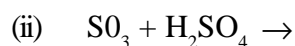
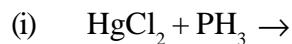
(Given:  $E^\circ_{\text{Ni}^{2+}/\text{Ni}} = -0.25$  V,  $E^\circ_{\text{Al}^{3+}/\text{Al}} = -1.66$  V)

5

29. (a) Draw the structures of the following molecules:



- (b) Complete the following chemical equations:



5

**OR**

- (a) What happens when

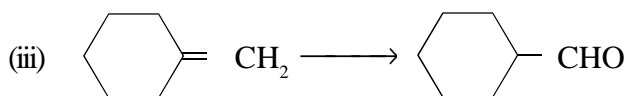
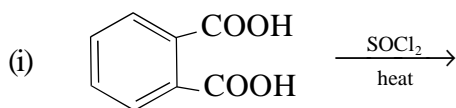
(i) chlorine gas is passed through a hot concentrated solution of NaOH ?

(ii) sulphur dioxide gas is passed through an aqueous solution of a Fe (III) salt ?

- (b) Answer the following:
- What is the basicity of  $\text{H}_3\text{PO}_3$  and why?
  - Why does fluorine not play the role of a central atom in interhalogen compounds?
  - Why do noble gases have very low boiling points?
- 5
30. (a) Illustrate the following name reactions:
- Cannizzaro's reaction
  - Clemmensen reduction
- (b) How would you obtain the following:
- But-2-enal from ethanal
  - Butanoic acid from butanol
  - Benzoic acid from ethylbenzene
- 5

**OR**

- (a) Give chemical tests to distinguish between the following:
- Benzoic acid and ethyl benzoate
  - Benzaldehyde and acetophenone
- (b) Complete each synthesis by giving missing reagents or products in the following:



5

## Marking Scheme — Chemistry

### *General Instructions*

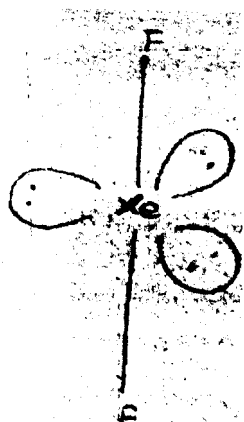
1. The Marking Scheme provides general guidelines to reduce subjectivity in the marking. The answers given in the Marking Scheme are suggested answers. The content is thus indicative. If a student has given any other answer which is different from the one given in the Marking Scheme, but conveys the same meaning, such answers should be given full weightage.
2. The Marking Scheme carries only suggested value point for the answers. These are only guidelines and do not constitute the complete answers. The students can have their own expression and if the expression is correct the marks, will be awarded accordingly.
3. The Head-Examiners have to go through the first five answer-scripts evaluated by each evaluator to ensure that the evaluation has been carried out as per the instruction given in the marking scheme. The remaining answer scripts meant for evaluation shall be given only after ensuring that there is no significant variation in the marking of individual evaluators.
4. Evaluation is to be done as per instructions provided in the Marking Scheme. It should not be done according to one's own interpretation or any other consideration - Marking Scheme should be strictly adhered to and religiously followed.
5. If a question has parts, please award marks in the right hand side for each part. Marks awarded for different parts of the question should then be totalled up and written in the left hand margin and circled.
6. If a question does not have any parts, marks be awarded in the left-hand margin.
7. If a candidate has attempted an extra question, marks obtained in the question attempted first should be retained and the other answer should be scored out.
8. No Marks to be deducted for the cumulative effect of an error. It should be penalized only once.
9. A full scale of marks 0-70 has to be used. Please do not hesitate to award full marks if the answer deserves it.
10. Separate marking schemes for all the three sets have been provided.

## QUESTION PAPER CODE 56/1/1

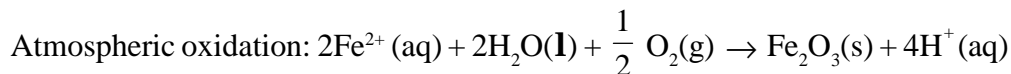
## EXPECTED ANSWERS/VALUE POINTS

- 1 It means that some of their physical properties show different values when measured along different directions in the same crystal. 1
- 2  $\Lambda_m = \kappa / c$  1  
where  $\Lambda_m$  is molar conductivity,  $\kappa$  is conductivity,  $c$  is concentration in  $\text{mol L}^{-1}$
- 3 The movement of colloidal particles under an applied electric potential towards oppositely charged electrodes is called electrophoresis. 1

4



- 5 1-bromo-2, 2 - dimethyl propane 1
- 6  $\text{CH}_3 - \text{CH} - \text{CH}_2 - \text{CHO}$  1  
|  
 $\text{CH}_3$
- 7  $\text{C}_6\text{H}_5\text{NH}_2 < (\text{C}_2\text{H}_5)_2\text{NH} < \text{C}_2\text{H}_5\text{NH}_2$  1
- 8 Polymers which undergo bacterial degradation in the environment and are thus eco-friendly. 1
- 9 oxidation:  $\text{Fe (s)} \rightarrow \text{Fe}^{2+} (\text{aq}) + 2\text{e}^-$  1  
Reduction:  $\text{O}_2 (\text{g}) + 4\text{H}^+ (\text{aq}) + 4\text{e}^- \rightarrow 2\text{H}_2\text{O}(\text{l})$



10  $\Delta_r G^0 = -n F E_{\text{cell}}^0$   
 $= -2 \times (96500 \text{C mol}^{-1}) \times 1.05 \text{V}$  1  
 $= -202650 \text{J mol}^{-1}$  or  $-202.6 \text{kJ mol}^{-1}$

$$\log K_c = \frac{nE^0}{0.0591}$$

$$= \frac{2 \times 1.05 \text{V}}{0.0591}$$

$$= 35.53$$

$$K_c = 3.412 \times 10^{35}$$
 1

[Marks to be given if substitution is done with proper units]

- 11 Rate Law is the expression in which reaction rate is given in terms of molar concentration of reactants with each term raised to some power which may or may not be same as the stoichiometric coefficient of the reacting species in a balanced chemical equation, whereas the rate constant is defined as the rate of reaction when the concentration of the reactant(s) is unity. 1

**(or properly explained in any other way)**

- 12 i) In the resonance structure of these two species, in  $\text{NO}_2^-$ , 2 bonds are sharing a double bond while in  $\text{NO}_3^-$ , 3 bonds are sharing a double bond which means that bond in  $\text{NO}_2^-$  will be shorter than in  $\text{NO}_3^-$ .

Or

In  $\text{NO}_2^-$ , bond order is 1.5 while in  $\text{NO}_3^-$ , bond order is 1.33

- ii) Because  $\text{SF}_6$  is sterically protected by six F atoms / co-ordinatively saturated.

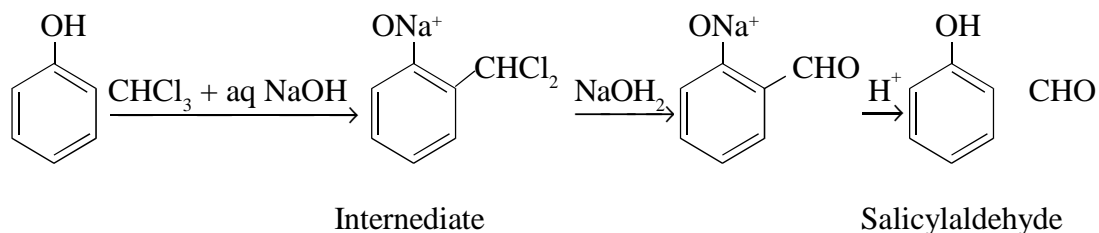
OR

- i) Because  $\text{PCl}_5$  has a trigonal bipyramidal structure in which three P-Cl bonds are equatorial and two P-Cl bonds are axial. 1+1

- ii) Because S-S single bond is stronger than O-O single bond

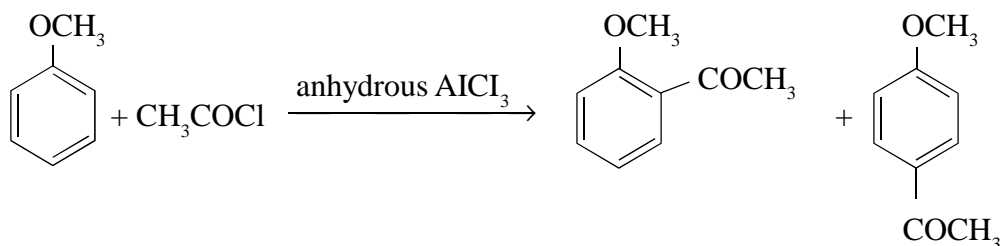
- 13 i) Because copper(I) ion is unstable in aqueous solution and undergoes, disproportionation. 1+1
- ii) Because of comparable energies of 5f, 6d and 7s orbitals in actinoids.

- 14 (i) Reimer-Tiemann Reaction

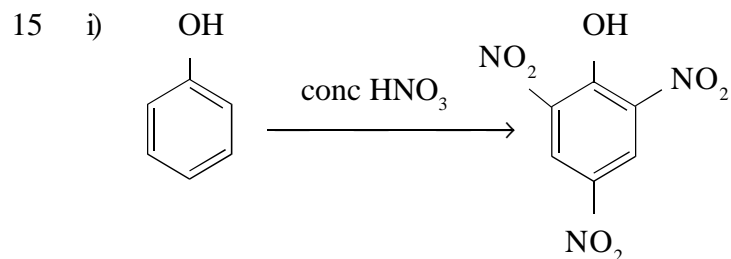


(or any other example)

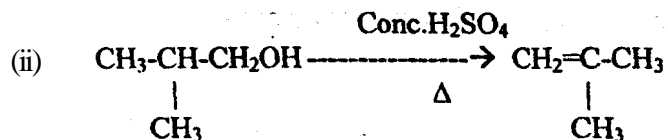
- ii) Friedal-Craft's acetylation of anisole



(or any other example)



(or by action of conc. HNO<sub>3</sub> on phenol)



(or by action of hot conc. H<sub>2</sub>SO<sub>4</sub>)

- 16  $\alpha$  - form of glucose and  $\beta$  - form of glucose differ only in the configuration of the hydroxyl group at C<sub>1</sub> in cyclic structure of glucose/hemiacetal form of glucose/pyranose structure of glucose. (or structure drawn)

2



17 **Primary structure of proteins:**

The protein in which amino acids are linked with each other in a specific sequence is said to be the primary structure of that protein. 1

**Secondary structure of proteins:**

It refers to the shape in which a long polypeptide chain can exist i.e.  $\alpha$  - helix and  $\beta$ -pleated structure. 1

18 i) **Bakelite**

For making combs, electrical switches, handles of utensils, computer discs (or any other use) any two  $\frac{1}{2}+\frac{1}{2}$

ii) **Nylon-6**

For making tyre cords, fabrics, ropes(or any other use) any two  $\frac{1}{2}+\frac{1}{2}$

## 19 For fcc unit cell

$$r = \frac{a}{2\sqrt{2}} \quad 1$$

Given  $a = 400$  pm

$$\therefore r = 400 / 2\sqrt{2} \text{ pm}$$

$$r = 141.4 \text{ pm} \quad 1$$

20 a)  $k = \frac{2.303}{t} \log \frac{[A_0]}{[A]}$

$$k = \frac{2.303}{20 \text{ min}} \log \frac{0.400}{0.289}$$

$$k = 0.0163 \text{ min}^{-1} \quad 1$$

b)  $k = \frac{2.303}{t} \log \frac{[A_0]}{[A]}$

$$0.0163 = \frac{2.303}{100} \log \frac{0.400}{[A]}$$

$$[A] = 0.078 \text{ M} \quad 1$$

c) Initial rate  $R = k [N_2O_5]$

$$= 0.0163 \text{ min}^{-1} \times (0.400 \text{ M})$$

$$= 0.00652 \text{ M min}^{-1} \quad 1$$

21 i) **Production of vacuum:**

The remaining traces of air can be adsorbed by charcoal from a vessel to create a vacuum.

ii) **Heterogeneous catalysis:**

Adsorption of reactants on the solid surface of the catalysts increases the rate of reaction.

iii) **Froth floatation process:**

In this process, sulphide ore is concentrated by using pine oil which adsorbs the ore particles and impurities are wetted by water which settle at the bottom.

1x3 = 3

OR

i) **Micelles:**

Micelles are associated colloids which show colloidal behaviour at high concentration and act as strong electrolytes at low concentration.

ii) **Peptization:**

The process of converting a precipitate into colloidal sol by shaking it with dispersion medium in the presence of a small amount of electrolyte is called Peptization.

iii) **Desorption:**

The process of removing an adsorbed substance from a surface on which it is adsorbed is called desorption.

1x3 = 3

22 i) **Vapour phase refining of a metal:**

1

In this method the metal is converted into its volatile compound which is then decomposed to give pure metal.

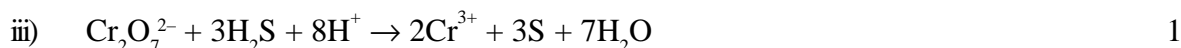
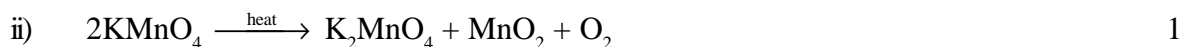
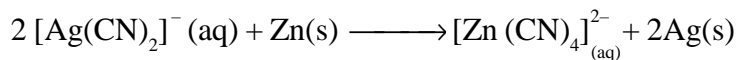
ii) **Electrolytic refining of a metal:**

1

In this method, the impure metal is made to act as anode and metal in pure form is used as cathode. They are put in a suitable electrolytic bath containing soluble salt of the same metal. The more basic metal goes to the anode and the less basic metal gets deposited at the cathode.

iii) **Recovery of silver after silver ore was leached with NaCN:**

More basic and cheaper zinc can displace silver from the complex and silver metal can be recovered. 1



24 i)  $\text{K}_4[\text{Mn}(\text{CN})_6]$ : Potassium hexacyanomanganate (II), Octahedral / paramagnetic.

ii)  $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{Cl}_2$ : pentaamminechloridocobalt(III) chloride, octahedral / diamagnetic.

iii)  $\text{K}_2[\text{Ni}(\text{CN})_4]$ : potassium tetracyanonickelate(II), square planar / diamagnetic.  $\frac{1}{2} + \frac{1}{2} = 1$

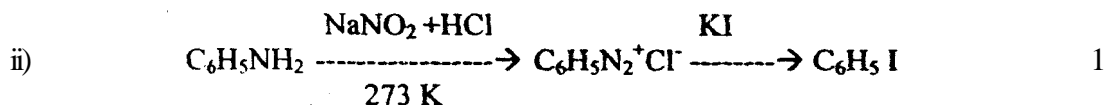
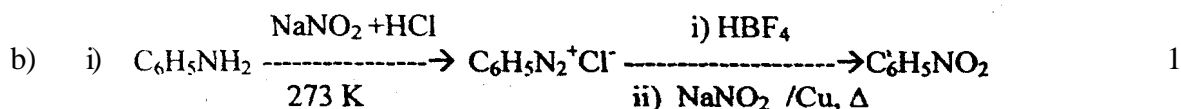
( $\frac{1}{2}$  mark for the nomenclature and  $\frac{1}{2}$  mark for the property in each part)

25 (i) Because the new intermolecular attractions between haloalkanes and solvent molecules have about the same strength or stronger than the existing ones in the molecules. 1

(ii) A mixture containing two enantiomers in equal proportions is known as a racemic mixture. e.g. ( $\pm$ ) butan-2-ol (or any other example)  $\frac{1}{2} + \frac{1}{2} = 1$

(iii)  $\text{C}_6\text{H}_5\text{CH}(\text{C}_6\text{H}_5)\text{Br}$ , because it forms more stable carbocation.

26 a) Due to +I effect / electron donating character of alkyl group, alkylamine is more basic than ammonia. 1



- 27 (i) Detergents are sodium salts of long chain alkyl sulphonates or benzene sulphonates. eg: Sodium Lauryl sulphate.  $\frac{1}{2} + \frac{1}{2} = 1$
- (ii) Food preservatives: are the compounds which prevent spoilage of food due to microbial growth. eg: sodium benzoate, vinegar (or anyone example)  $\frac{1}{2} + \frac{1}{2} = 1$
- (iii) Antacids: are the drugs used to prevent the overproduction of acid in the stomach. e.g. Sodium hydrogen carbonate / or any other suitable example  $\frac{1}{2} + \frac{1}{2} = 1$

- 28 a) Molality (m) is the number of moles of the solute per kilogram (kg) of the solvent whereas Molarity is the number of moles of solute present in one litre (or one cubic decimeter) of solution at a particular temperature. 1

Molality is independent of temperature whereas Molarity is function. of temperature because volume depends on temperature and the mass does not or Molarity decreases with increase of temperature. 1

b)  $\Delta T_f = 7.5^\circ\text{C}$

$$\Delta T_f = iK_f m$$

$$T_f^0 - T_f = 3 \times 1.86^\circ\text{C kg mol}^{-1} \times \frac{10.50\text{g}}{184 \text{ gmol}^{-1}} \times \frac{1000}{200\text{kg}} \quad 2$$

$$0^\circ\text{C} - T_f = 1.59^\circ\text{C}$$

$$T_f = -1.59^\circ\text{C} \quad \text{or} \quad 271.41 \text{ K} \quad 1$$

**OR**

- a) The flow of solvent molecules from solution of low concentration to higher concentration through semipermeable membrane is called osmosis.  $\frac{1}{2}$

The hydrostatic pressure that has to be applied on the solution to prevent the entry of the solvent into the solution through the semipermeable membrane is called the Osmotic Pressure.  $\frac{1}{2}$

Yes osmotic pressure is a colligative property as it depends upon the number of particles of the solute in a solution. 1

b)  $\Delta T_b = iK_b m$

$$T_b - T_b^0 = 2 \times 0.512\text{K kg mol}^{-1} \times \frac{15 \text{ g}}{58.44 \text{ gmol}^{-1}} \times \frac{1000}{250\text{kg}} \quad 2$$

$$T_b - 373 \text{ K} = 1.05 \text{ K}$$

$$T_b = 374.05\text{K} \quad \text{or} \quad 101.05^\circ\text{C} \quad 1$$

- 29 (a) (i) Propanal and Propanone

*Iodoform test.* Warm each compound with iodine and sodium hydroxide on a water bath With.

Propanal ( $\text{CH}_3\text{CH}_2\text{CHO}$ ): No yellow ppt is formed with

Propanone ( $\text{CH}_3\text{COCH}_3$ ): Yellow crystals of Iodoform are formed.

*(Other relevant test can be accepted)*

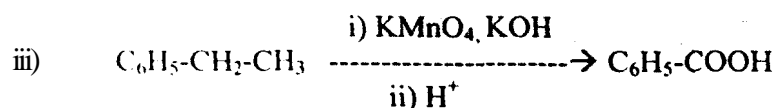
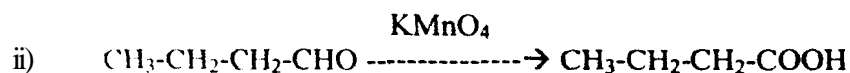
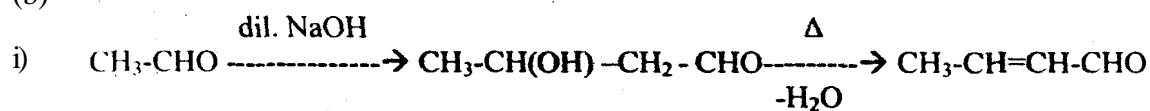
- (ii) Benzaldehyde and Acetophenone

*Iodoform test.* Warm each organic compound with  $\text{I}_2$  and NaOH solution. 1+1=2

Acetophenone ( $\text{C}_6\text{H}_5\text{COCH}_3$ ) Yellow precipitates of iodoform are formed with Benzaldehyde does not respond to this test.

**(Other relevant test can be accepted)**

- (b)



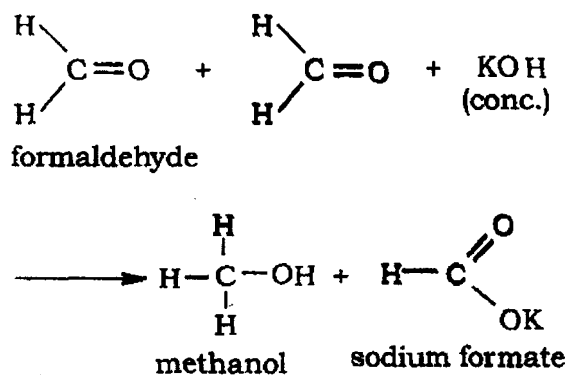
**(Or by any other suitable method)**

1x3=3

**OR**

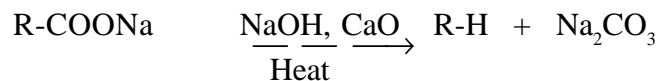
- i) Cannizzaro reaction: Aldehydes which do not have an  $\alpha$ -hydrogen atom, undergo self oxidation and reduction reaction on treatment with concentrated alkali

1

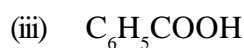
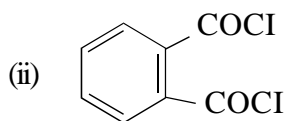
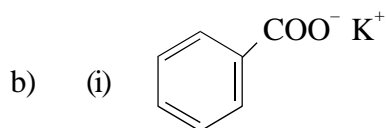


(or any other correct equation)

- ii) Decarboxylation: Carboxylic acids lose carbon dioxide to form hydrocarbons when their sodium salts are heated with sodalime. The reaction is known as decarboxylation. 1



**(Note: Award full marks for correct chemical equation; award ½ mark if only statement is written)**



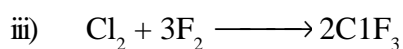
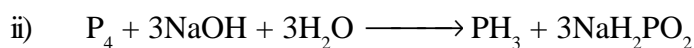
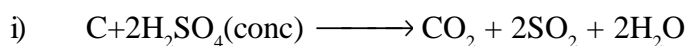
1x3=3

30 (a)

- i) Because bond energy of  $\text{F}_2$  is lower than that of  $\text{Cl}_2$  and N-F bond is smaller & stronger than N-Cl bond. 1

- ii) Because of low bond dissociation enthalpy of F-F bond. 1

b)

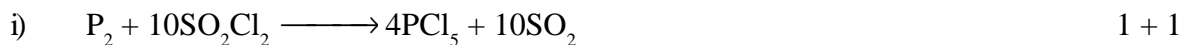


1x3=3

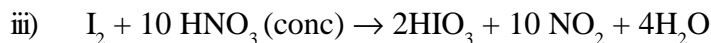
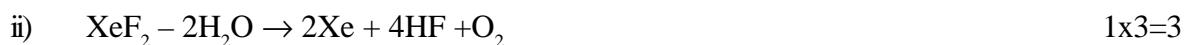
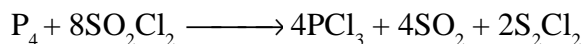
OR

- i) Because of increase in bond dissociation enthalpy from H-Cl bond to H-P bond / Because of decrease in electronegativity from Cl to P.
- ii) Because of the energy factor (inert pair effect), stability of +3 oxidation state increases than that of +5 oxidation state.

b)



or



QUESTION PAPER CODE 56/1

**EXPECTED ANSWERS/VALUE POINTS**

- 1 The sum of powers of the concentration terms of the reactants in the rate law expression is called the order of that chemical reaction. 1
- Or
- $$\text{rate} = k[\text{A}]^p [\text{B}]^q$$
- Order of reaction = P+q
- 2 The catalytic reaction in which the pore structure of the catalyst and the size of the reactant and product molecules are comparable. 1
- 3 The naturally occurring chemical substances which occur in the earth's crust and are obtainable by mining are called minerals, while the mineral from which the element is extracted economically is called an ore. 1
- 4 The regular decrease in the atomic and ionic radii / (having the same charge) of Lathanoids with increasing atomic number is known as Lanthanoid contraction. 1
- 5 3-Bromoprop-I-ene / 3-Bromopropene 1
- 6  $\text{CH}_3 - \text{CO} - \text{CH}_2 - \text{CH}(\text{Cl}) - \text{CH}_3$  1



9 We can determine the atomic mass of an unknown by using the formula.

$$M = \frac{d \times a^3 \times N_A}{Z} \quad 1$$

By knowing d, a,  $N_A$  & Z We can calculate the M

Where

d = density of the element

$N_A$  = Avogadro number 1

a = cell edge or edge length

Z = no. of atoms present in one unit cell.

10 Packing efficiency 1

$$= \frac{Z \times \text{volume of one atom}}{\text{Volume of cubic unit cell}}$$

$$= \frac{1 \times \frac{4}{3} \pi r^3}{a^3}$$

For simple cubic lattice  $a = 2r$

$$\text{Therefore packing efficiency} = \frac{1 \times \frac{4}{3} \pi r^3}{8r^3}$$

$$= \mathbf{0.524 \text{ or } 52.4\%} \quad 1$$

11 i) Raoult's law states that for a solution of volatile liquids, the partial vapour pressure of each component in the solution is directly proportional to its mole fraction. 1

ii) Henry's law states that at a constant temperature, the solubility of a gas in a liquid is directly proportional to the pressure of the gas over the solution. 1



- 12 The representation of rate of reaction in terms of concentration of the reactants is known as rate law. 1/2x4 = 2

The rate constant is defined as the rate of reaction when the concentration of reactants is unity.

- i) zero order
- ii) second order

13 
$$t = \frac{2.303}{k} \times \log \frac{[A]_0}{[A]}$$

$$t = \frac{2.303}{2.4 \times 10^{-3} \text{ s}^{-1}} \times \log \frac{[A]_0}{[A]_0/4}$$
 1/2

$$t = \frac{2.303}{2.4 \times 10^{-3} \text{ s}^{-1}} \times \log 4$$
 1/2

$$t = \frac{2.303}{2.4 \times 10^{-3} \text{ s}^{-1}} \times 0.60212$$

**t = 578s** 1

- 14 (i) In this method the titanium metal is heated with I<sub>2</sub> to form a volatile compound TiI<sub>4</sub> which on further heating at higher temperature decomposes to give pure titanium metal. (or explanation by chemical equations) 1
- (ii) This method is based upon the fact that the surface of the sulphide ores is preferentially wetted by oil while that of gangue is wetted by water. 1
- 15 (i) Cr<sup>2+</sup> is reducing as its configuration changes from d<sup>4</sup> to d<sup>3</sup>, the latter having half filled t<sub>2g</sub> level whereas Mn<sup>3+</sup> to Mn<sup>2+</sup> results in half filled orbitals (d<sup>5</sup>) 1
- (ii) In a transition metal series the oxidation state first increases and then decreases; At the middle it is maximum due to greater number of unpaired electron in (n-1)d and ns orbitals. 1
- 16 (i)  $8\text{MnO}_4^- (\text{aq}) + 3\text{S}_2\text{O}_3^{2-} (\text{aq}) + \text{H}_2\text{O} (1) \rightarrow 8\text{MnO}_2 (\text{s}) + 6\text{SO}_4^{2-} (\text{aq}) + 20\text{H}^- (\text{aq})$  1
- (ii)  $\text{Cr}_2\text{O}_7^{2-} (\text{aq}) + 14\text{H}^+ (\text{aq}) + 6\text{Fe}^{+2} (\text{aq}) \rightarrow 2\text{Cr}^{3+} (\text{aq}) + 6\text{Fe}^{+3} (\text{aq}) + 7\text{H}_2\text{O} (1)$  1

**OR**

- i) Because Copper(I) ion is unstable in aqueous solution and undergoes disproportionation.

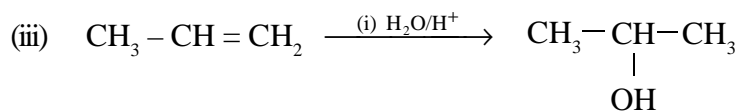
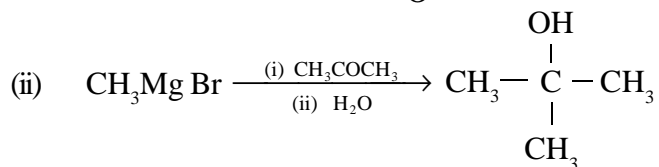
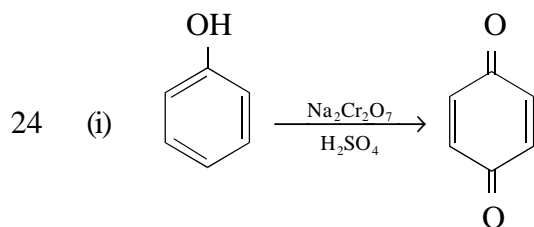
- ii) Due to lanthanoid contraction the expected increase in size does not occur.
- 17 (i) **Peptide linkage:** A link between two amino acids with loss of water / – CO - NH – 1
- (ii) The six membered cyclic structure of glucose is called pyranose structure in analogy with pyran heterocyclic compound / or structure. 1
- 18 In DNA, sugar is Deoxyribose while in RNA, it is ribose. / DNA is as double stranded while RNA is single stranded. (any one) 1
- The common bases present in both are adenine, cytosine & guanine. 1
- 19  $\pi = CRT$  1
- $$M_2 = \frac{w_2 R T}{\pi V}$$
- $$M_2 = \frac{8.95 \times 10^{-3} \text{ g} \times 0.0821 \text{ L atm mol}^{-1} \text{ K}^{-1} \times 298 \text{ K} \times 760 \times 1000}{0.335 \text{ atm} \times 35 \text{ L}}$$
- $M_2 = 14193.3 \text{ g mol}^{-1}$  or  $1.42 \times 10^4 \text{ g mol}^{-1}$  1
- 20 They are of two types
- i) Hydrophilic      ii) hydrophobic 1/2+1/2
- The hydrophile sol is more stable and reversible while hydrophobic sol is less stable and is irreversible. 1
- Hydrophilic sol e.g. → Starch, gum, gelatin etc. (anyone)
- Hydrophobic sol e.g → metal sulphide, metal hydroxide (anyone) 1
- OR**
- i) Electrophoresis takes place when sol **particles move towards opposite electrodes due to attraction.**
- ii) Tyndall effect will be observed due to **scattering of light by colloidal particles.**
- iii) Coagulation takes place (due to neutralisation of charges.) 1x3= 3
- 21 i) Because bond dissociation enthalpy of H-S bond is lower that of H-O bond. / oxygen is more electronegative than S.

- ii) In the resonance structure of these two species, in  $\text{NO}_2^-$ , 2 bonds are sharing a double bond while in  $\text{NO}_3^-$ , 3 bonds are sharing a double bond which means that bond in  $\text{NO}_2^-$  will be shorter than in  $\text{NO}_3^-$ .

Or

- iii) In  $\text{NO}_2^-$ , bond order is 1.5 while in  $\text{NO}_3^-$ , bond order is 1.33 Because of the tendency of oxygen to form multiple bonds with metal. 1x3 = 3

- 22 i) Ambident ligand: a unidentate ligand which can co-ordinate to the central metal atom through more than one co-ordinating bond.e.g.  $\text{NO}_2^-$ ,  $\text{SCN}^-$  1
- ii) The number of donor atoms in ligating groups is known as denticity of that ligand. e.g. in  $\text{C}_2\text{O}_4^{2-}$  denticity is 2 (or any other example) 1
- iii) Crystal field splitting in an Octahedral field: The splitting of d-orbitals under the influence of approaching ligand is known as crystal field splitting for example for  $d^4$ , configuration is  $t_{2g}^3 e_g^1$  / **or diagrammatic representation.** 1
- 23 i) 1-Bromopentane > 2-Bromopentane > 2-Bromo -2-methyle butane.
- ii) 1- Bromo-2 - methyl butane > 3-Bromo- 2-methyl butane > 2-Bromo-2-methyl butane 1
- iii) 1- Bromobutane > 1-Bromo- 2-methyl butane > 1-Bromo-2, 2-dimethyl propane 1



(or by any other suitable method.)

1x3 = 3

- 25 (i) Due to resonance in aniline, N acquires + charge which increases its  $pK_b$  whereas due to electron donating methyl group electron density increases on N which decreases its  $pK_b$ .
- (ii) Due to formation of hydrogen bond with water ethyl amine is soluble in water whereas due to bulky phenyl group aniline does not form H-bond and thus is insoluble.
- (iii) Due to hydrogen bonding in primary amines, they have higher boiling points whereas there is no hydrogen bonding in tertiary amines. 1x3=3
- 26 i)  $CH_2 = CH_2$  1
- ii)  $CH_2 = CHCl$  1
- iii)  $CF_2 = CF_2$  1
- 27 (i) Food preservatives: are the compounds which prevent spoilage of food due to microbial growth. eg: sodium benzoate, vinegar (or anyone example)  $\frac{1}{2} + \frac{1}{2}$
- (ii) Synthetic detergents are sodium salts of long chain alkyl sulphonates or benzene sulphonates. eg: Sodium Lauryl sulphate.  $\frac{1}{2} + \frac{1}{2}$
- (iii) Antacids: are the drugs used to prevent the overproduction of acid in the stomach. e.g, Sodium hydrogencarbonate.  $\frac{1}{2} + \frac{1}{2}$
- 28 a) It is secondary cell  $\frac{1}{2}$
- Anode Reaction:  $- Pb + SO_4^{2-} \rightarrow PbSO_4(s) + 2e^-$   $\frac{1}{2}$
- Cathode. Reaction:  $- PbO_2 + 4H^+ + SO_4^{2-} + 2e^- \rightarrow PbSO_4 + 2H_2O$   $\frac{1}{2}$
- Net reaction:-  $Pb + PbO_2 + 2SO_4^{2-} + 4H^+ \rightarrow 2PbSO_4 + 2H_2O$   $\frac{1}{2}$
- b) 
$$E_{cell} = E_{cell}^{\circ} - \frac{0.0591}{n} \log \frac{[Cr^{3+}]^2}{[Cr_2O_7^{2-}][H^+]^{14}}$$
 1
- $$E_{cell} = 1.33 V - \frac{0.0591}{6} \log \frac{(0.20)^2}{(0.10)(10^{-4})^{14}}$$
  $1\frac{1}{2}$
- $$= 1.33V - 0.55V$$
- $$= 0.78V$$

OR

a)  $m = ZIt$

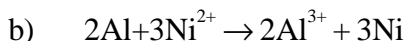
$$m = \frac{M \times I \times t}{nF}$$

$$m = \frac{M}{2 \times 96500 \text{ C mol}^{-1}} \times 2A \times 3 \times 60 \times 60 \text{ s}$$

$$m = 0.112 \text{ mol} \times M$$

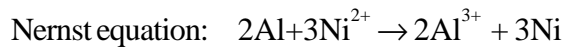
$$\text{no. of moles of mercury} = \frac{0.112 \text{ mol} \times M}{M}$$

$$= 0.112 \text{ mol}$$



$$E_{\text{cell}}^{\circ} = E_{\text{Cathode}}^{\circ} - E_{\text{anode}}^{\circ} = [-0.25 \text{ V} - (-1.66 \text{ V})] = 1.41 \text{ V}$$

$$E_{\text{cell}}^{\circ} = 1.41 \text{ V} \quad \frac{1}{2}$$



n=6 electrons

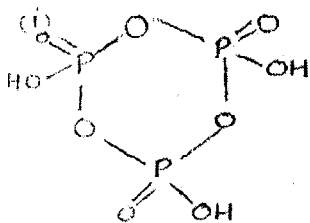
$$E_{\text{cell}} = E_{\text{cell}}^{\circ} - \frac{0.059}{n} \log \frac{[\text{Al}^{3+}]^2}{[\text{Ni}^{2+}]^3} \quad 1$$

$$E_{\text{cell}} = 1.41 \text{ V} - \frac{0.059}{6} \log \frac{(0.001 \text{ M})^2}{(0.50 \text{ M})^3}$$

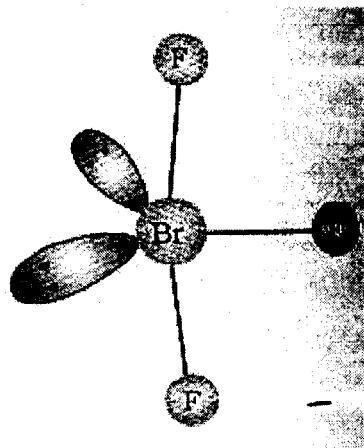
$$= 1.41 \text{ V} - \frac{0.059}{6} [-5.097] \log (10^4) \quad \frac{1}{2}$$

$$= 1.41 \text{ V} + 0.050 \text{ V} = 1.46 \text{ V}$$

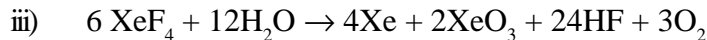
(a)



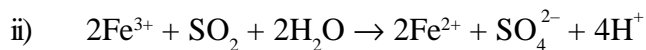
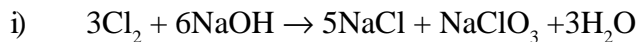
ii)



b)

**OR**

a)

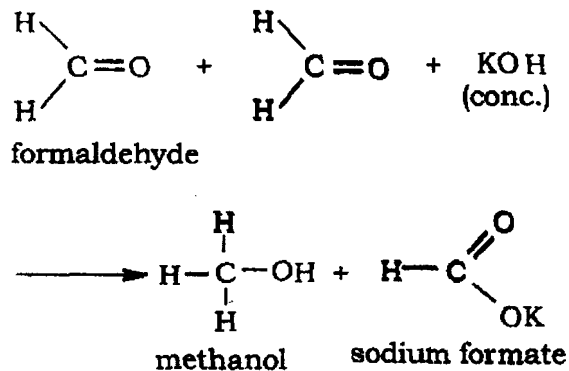


b) i) Two, due to presence of two P-OH bonds.

ii) Due to high electronegativity of fluorine.

iii) There are no interatomic forces except weak dispersion forces.

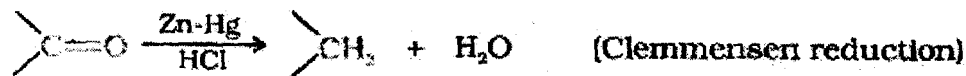
30 a)

i) **Cannizzaro reaction:** Aldehydes which do not have an $\alpha$ -hydrogen atom, undergo self oxidation and reduction reaction on treatment with concentrated alkali

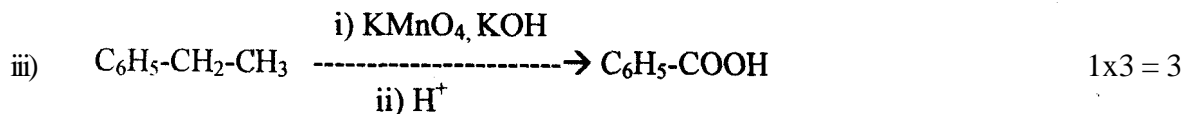
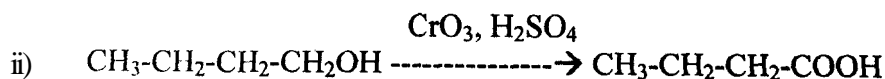
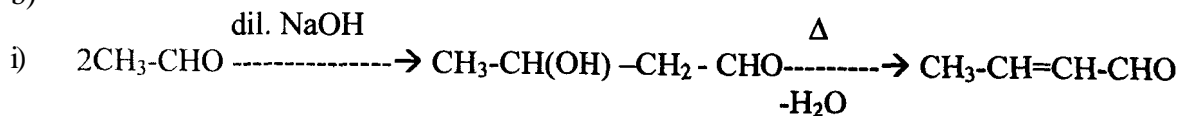
(or any other correct equation)

ii) **Clemmensen reduction:** The carbonyl group of aldehydes and ketones is reduced to  $\text{CH}_2$  group on treatment with zinc amalgam and concentrated HCl

1+1



b)



(Or by any other suitable method)

OR

(i) Benzoic acid and ethyl benzoate

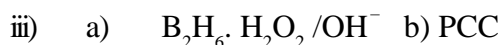
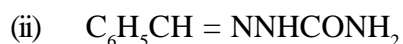
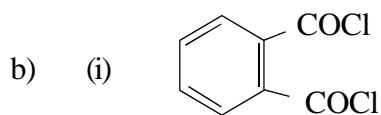
Sodium bicarbonate test. Warm each compound with  $\text{NaHCO}_3$ ,Benzoic acid gives brisk effervescence of  $\text{CO}_2$  gas whereas ethyl benzoate does not respond to this test*(Other relevant test can be accepted)*

(ii) Benzaldehyde and Acetophenone

**Iodoform test:** Warm each organic compound with  $\text{I}_2$  and  $\text{NaOH}$  solution. with Acetophenone ( $\text{C}_6\text{H}_5\text{COCH}_3$ ) Yellow precipitates of iodoform is formed white Benzaldehyde does not respond to this test.

1+1

(Other relevant test can be accepted)

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