Time: 3 Hours   **Maximum Marks: 70**

General Instructions: Read the following instructions carefully.

Read the following instructions carefully.

(a) There are 33 questions in this question paper with internal choice.

(b) SECTION A consists of 16 multiple -choice questions carrying 1 mark each.

(c) SECTION B consists of 5 short answer questions carrying 2 marks each.

(d) SECTION C consists of 7 short answer questions carrying 3 marks each.

(e) SECTION D consists of 2 case - based questions carrying 4 marks each.

(f) SECTION E consists of 3 long answer questions carrying 5 marks each.

(g) All questions are compulsory.

(h) Use of log tables and calculators is not allowed.

R= 8.314 $JK^{-1}Mol^{-1}$, Atomic number: Ti = 22, Cr = 24, Fe = 26, Co = 27, Ni = 28, Zn = 30

SECTION A

The following questions are multiple-choice questions with one correct answer. Each question carries 1 mark. There is no internal choice in this section.

A solution contains Fe^{2+}, Fe^{3+} and I^- ions. This solution was treated with iodine at 35°C. $E°$ for   1
Fe^{3+}/Fe^{2+} is + 0.77 V and $E°$ for $I_2/2I^- = 0.536$ V. The favorable redox reaction is

(a) I_2 will be reduced to I^- (b) there will be no redox reaction

(c) I^- will be oxidized to I_2 (d) Fe^{2+} will be oxidized to Fe^{3+}

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

$$\frac{-d[N_2O_5]}{dt}=k[N_2O_5]; \quad \frac{d[NO_2]}{dt}=k'[N_2O_5]; \quad \frac{d[O_2]}{dt}=k''[N_2O_5]$$

The relationship between k and k' and between k and k" are :

(a) K' =2k , k" = k   (b) k' = 2k, k"=k/2   (c) K' = 2k, k" =2k   (d) k' = k, k" = k

3   Which one of the following is not an allylic halide?

(a) 4-Bromopent-2-ene

(b) 3-Bromo-2-methylbut-1-ene

(c) 1-Bromobut-2-ene

(d) 4-Bromobut-1-ene

4   Which of the following fact(s) explain as to why p-nitrophenol is more acidic than phenol?   1

I.   – I Effect of nitro group.

II. Greater resonance effect of p-nitrophenyl group

III. Steric effect of bulky nitro group

(a) I and II   (b) I and III   (c) II and III   (d) II alone

5. For the ions Zn^{2+}, Ni^{2+} and Cr^{3+} which among the following statements is correct?
(a) All these are colorless.
(b) All these are colored.
(c) Only Ni^{2+} is colored and Zn^{2+} and Cr^{3+} are colorless.
(d) Only Zn^{2+} is colorless and Ni^{2+} and Cr^{3+} are colored.

6. The rate constant of a reaction is 3.00×10^3 L mol^{-1} sec^{-1}. The order of this reaction will be: 1
(a) 0   (b) 1   (c) 2   (d) 3

7. Addition of hydrogen cyanide to aldehydes and ketones occurs in presence of a base. The role of   1
base is to
(i) Catalyze the reaction   (ii) Generate CN^- ion
(iii) Slow down the reaction   (iv) To stabilize the cyanohydrins

(a) (i) and (iii)   (b) (i) and (ii)   (c) (i) and (iv)   (d) (ii) and (iv)

8. Which of the following statements are correct?   1
(i) As a result of Lanthanoid contraction members of $4d$ and $5d$ series exhibit similar radii.
(ii) IE_2 is high for Cr and Cu whereas IE_3 is very high for Zn.
(iii) Heavier members of d-block elements like p-block elements favours lower oxidation states.
(iv) In any transition series maximum number of oxidation states is shown by middle elements or
elements near middle elements.
(a) (i) and (ii)   (b) (i), (ii) and (iv)   (c) (i), (ii) and (iii)   (d) (ii) and (iv)

9. Read the following statements and choose the correct option   1
(i) Propan-2-ol has lower boiling point than propan-1-ol.
(ii) Boiling points decrease with branching.
(iii) The lower members of aldehydes and ketones are miscible with water in all proportions,
because they form hydrogen bond with water.
(iv) The solubility of aldehydes and ketones increases rapidly on increasing the length of alkyl
chain
(a) TTFF   (b) TFFT   (c) FTTT   (d) TTTF

10. Which of the statements about "Denaturation" given below are correct?   1
(1) Denaturation of proteins causes loss of secondary and tertiary structures of the protein.
(2) Denaturation leads to the conversion of double strand of DNA into single strand.
(3) Denaturation affects primary structure which gets distorted.
(a) (2) and (3)   (b) (1) and (3)   (c) (1) and (2)   (d) (1), (2) and (3)

11. Which of the following is not correct ?   1
(a) Ethyl amine and aniline both have – NH_2 group
(b) Ethyl amine and aniline dissolve in HCl
(c) Ethyl amine and aniline both react with $CHCl_3$ and KOH to form unpleasant smelling
compound
(d) Ethyl amine and aniline both react with HNO_2 in cold to give hydroxy compounds.

Which of the following reagents can be used to oxidize primary alcohols to aldehydes?   1
(i) CrO_3 in anhydrous medium.
(ii) $KMnO_4$ in acidic medium.
(iii) Pyridinium chlorochromate.
(iv) Heat in the presence of Cu at 573K.
(a) (i) and (iii)   (b) (ii), (iii) and (iv)   (c) (i), (iii) and (iv)   (d) (i), (iii) and (i)

Q. Nos. 13-16 consist of two statements, one is Assertion and the other is Reason.
Select the most appropriate answer from the options given below:
a. Both A and R are true and R is the correct explanation of A
b. Both A and R are true but R is not the correct explanation of A.
c. A is true but R is false.
d. A is false but R is true.

Assertion: Alcohols react both as nucleophiles and electrophiles.   1
Reason: The bond between C–O is broken when alcohols react as nucleophiles.

Assertion: Formaldehyde is a planar molecule.   1
Reason: It is very reactive towards nucleophilic addition.

5 Assertion: During rusting iron acts as anode and reduction of H^+ ions takes place.   1
Reason: in dry conditions rusting is very slow, since H^+ ions are not present.

6 Assertion: Aniline on nitration gives a substantial amount of m- Nitroaniline.   1
Reason: $-NH_2$ group is an activating group and activates meta position also.
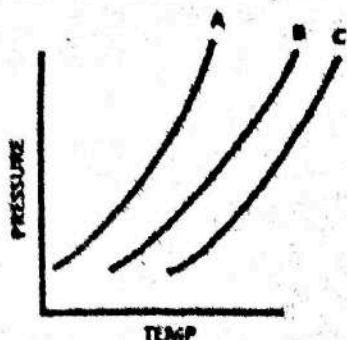
SECTION B
This section contains 5 questions with internal choice in one question. The following questions are very short answer type and carry 2 marks each.

17 A chemical reaction $2A \rightarrow 4B + C$ in gas phase occurs in a closed vessel. The conc. of B is found to be increased by 5×10^{-3} mol/L in 10 seconds. Calculate the rate of appearance of C and the rate of disappearance of A.

18 (a) Arrange the following in order of increasing reactivity for nucleophilic addition: 1
benzaldehyde, p- Tolualdehyde, p-Nitrobenzaldehyde, Acetophenone. Justify your answer.   1
(b) Draw the structure of Acetaldehydedimethylacetal.

19 (a) How will you convert Ethanol to propanenitrile?   1
(b) Which has higher melting point: p-Dichlorobenzene or o- Dichlorobenzene? Why?   1

20 (a) When RNA is hydrolyzed, there is no relationship among the quantities of different bases obtained. What does this fact suggest about the structure of RNA?

(b) Amino acids move towards cathode /anode when electricity is passed through their solution. Why?

21 The following figure shows vapour pressure curves of two pure liquids and the solution of the two. Which curve represents the solution? Justify your answer   2

SECTION C

This section contains 7 questions with internal choice in two questions. The following questions are short answer type and carry 3 marks each.

22 (a) Write the IUPAC name of the compound: $CH_3CH=CH- CH_2-CH_2Br$.   1
(b) Write all the products obtained when 2, 2, 3-Trimethyl-3-bromopentane is treated with alc. KOH. Which among these is the major product?   1
(c) How will you convert Benzyl alcohol to 2-phenylethanoic acid.   1

OR

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.   1
(c) Arrange the three compounds in order of increasing boiling point.   1

     1

23 (a) On the basis of crystal field theory explain why both $Ni(CO)_4$ and $[Ni(CN)_4]^{2-}$ have zero   1
     magnetic moment value, although their shapes are different.
(b) Write the IUPAC name of the linkage isomer of $[Co(NH_3)_2(NO_2)_2Py_2]NO_3$.   1
(c). Calculate the magnetic moment of $[CoF_6]^{3-}$.   1

(1.6×10^{-19}) charge on $\bar{e}$

24 (a) How much charge is required for the reducing 5.4 g of Al^{3+} ions to Al? (Atomic mass Al = 27 u)
(b) If a current of 0.5 ampere flows through a metallic wire for 2 hours, then how many   2
electrons would flow through the wire? (Charge on one electron = 1.6×10^{-19} C)

25 (a). How are the following conversions carried out?   1X 2
     (i) Ethyl magnesium chloride → Propan-1-ol.
     (ii) Cyclohexylmethanol prepared using a suitable Grignard reagent.
(b) Write the reaction when Phenol is heated with chloroform and NaOH and the resulting   1
mixture is acidified.

OR

(a) Write a suitable reaction for the preparation of 1-methoxy-4-nitrobenzene.   1

(b) How do you convert Methyl magnesium bromide → 2-Methylpropan-2-ol.   1

(c) Explain why alcohols are weaker acids than phenols.?   1

26 (a) Enumerate two reactions of D-glucose which cannot be explained by its open chain structure.   (2)

(b) What are essential amino acids? Give one example.   (1)

27 (a) Arrange the following compounds in increasing order of their reactivity for addition of HCN: 1
Benzaldehyde, p-Tolualdehyde, p-Nitrobenzaldehyde, Acetophenone and Benzophenone.

(b) Give reasons for the following

(i) There are two –NH₂ groups in semicarbazide. However, only one is involved in the formation of semicarbazones.   1

(ii) 2,2,-Dimethylpropanal does not react with dilute NaOH but reacts only with conc. NaOH.   1

OR

   3

An organic compound (A) (molecular formula $C_8H_{16}O_2$) was hydrolyzed with dilute sulphuric acid to give a carboxylic acid (B) and an alcohol (C). Oxidation of (C) with chromic acid produced (B). (C) on dehydration gives but-1-ene. Identify A, B and C and write equations for the reactions involved.

28 The rate constant for a first order reaction is given as: $\log k = 14.34 - 1.25 \times 10^4 \, K/T$. Calculate the energy of activation for this reaction.   3

SECTION D

The following questions are case-based questions. Each question has an internal choice and carries 4 (1+1+2) marks each. Read the passage carefully and answer the questions that follow.

30 In coordination compounds metals show two types of linkages (valences)-primary and secondary. The primary valences are normally ionisable and are satisfied by negative ions. The secondary valences are non ionisable. These are satisfied by neutral molecules or negative ions. The secondary valence is equal to the coordination number and is fixed for a metal. The ions/groups bound by the secondary linkages to the metal have characteristic spatial arrangements corresponding to different coordination numbers. In modern formulations, such spatial arrangements are called coordination polyhedra.

(a) What is the primary and secondary valence of Co in $[Co(en)_3]^{3+}$?   1

(b) What is an ambidentate ligand? Give an example.   1

(c) If $[CoCl_3.3NH_3$ does not react with $AgNO_3$, what is the formula of the coordination entity?   1

(d) Write the IUPAC name of the complex entity mentioned in part c.   1

OR

What type of isomerism would be shown by the complex mentioned in part c.   1

The following questions are long answer type and carry 5 marks each. Two questions have an internal choice.

31   (a) Which Colligative property is preferred to determine molecular mass of substances? Justify your answer.   1

   (b) Two elements A and B form compounds having formula AB_2 and AB_4. When dissolved in 20 g of benzene (C_6H_6), 1 g of AB_2 lowers the freezing point by 2.3 K whereas 1.0 g of AB_4 lowers it by 1.3 K. The molar depression constant for benzene is 5.1 K kg mol^{-1}. Calculate atomic masses of A and B.   3

   (c) Why do scuba divers take air diluted with Helium with them?

OR

   (a) A mixture of two liquids is colder as compared to the individual components. Draw a vapour pressure diagram for this mixture.   2

   (b) How much $BaCl_2$ (molar mass = 208) would be required to lower freezing point of 10 kg of water by 10 °C. Given that Kf of water = 1.86 K kg mol^{-1}.   3

32   Attempt any five of the following: 1 X5

   (a) Name two oxometal anions of the first series of the transition metals in which the metal exhibits the oxidation state equal to its group number.

   (b) Why is a regular trend in the reduction potential not observed for 3d series elements?

   (c) Despite a stable configuration Cu^+ ion is not as stable as Cu^{2+} ion in aqueous solution. Why?

   (d) Of the d^4 species, Cr^{2+} is strongly reducing while manganese (III) is strongly oxidizing. Justify.

   (e) Cobalt(II) is stable in aqueous solution but in the presence of complexing reagents why it is easily oxidized.

   (f) Write the ionic equation for reaction of $KMnO_4$ and Iodide ions in basic medium.

33   (a) Give reasons the following observations:

   (i) pKb of aniline is lower than the m-nitroaniline.   1

   (ii) Amines less acidic than alcohols of comparable molecular masses?   1

   (iii) Diazonium salts of aromatic amines are more stable than those of aliphatic amines.   1

   (b) Arrange the following compounds in decreasing order of the pKb: $C_6H_5NH_2$, $C_6H_5NHCH_3$ and $C_6H_5CH_2NH_2$.   1

   (c) How do you convert Ethanoic acid into Propanoic acid?   1

OR

   (a) Why is Gabriel phthalimide synthesis preferably used for synthesizing primary amines?

   (b) How would you distinguish between Methanamine and Ethanamine?   1

   (c) Arrange the following in increasing order of boiling point: C_2H_5OH, $(CH_3)_2NH$, $C_2H_5NH_2$

   (d) How do you convert: 1

   (i) Ethanamine into Methanamine.   1X2

   (ii) Benzene to m-bromophenol

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29. In an electrolytic cell external source of voltage is used to bring about a chemical reaction. The electrochemical processes are of great importance in the laboratory and the chemical industry. Electrolysis can be carried out in molten or in solution state. During electrolysis oxidation takes place at anode and reduction at cathode. If inert electrodes are used then water competes for both the reactions, thus the reduction potentials play a significant role in electrolysis. The amounts of various substance deposited or obtained during electrolysis are governed by Faraday's laws of electrolysis.

(a) What products are obtained when dilute sulphuric acid is electrolysed using platinum electrodes? 1

(b) Chlorine and not oxygen is obtained when aqueous solution of NaCl is electrolyzed. Why? 1

(c) How much electricity in terms of Faraday is required to produce 5.4 g of Al from molten AlCl₃? 2

OR

How much electricity is required to oxidize 3.6 g of water to hydrogen? 2