Total No. of Printed Pages—12

HS/XII/Sc/Ch/NC/21

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CHEMISTRY

(Theory)

(New Course)

Full Marks : 70

Time : 3 hours

The figures in the margin indicate full marks for the questions

General Instructions :

(i) Attempt all parts of a question together in one place.

(ii) All questions are compulsory.

(iii) Section—A : Question Nos. **1** to **5** are of Multiple-Choice Type, each of *1* mark.

(iv) Section—B : Question Nos. **6** to **12** are short Answer-type Questions and carry *2* marks each.

(v) Section—C : Question Nos. **13** to **24** are also short Answer-type Questions and carry *3* marks each.

(vi) Section—D : Question Nos. **25** to **27** are long Answer-type Questions and carry *5* marks each.

(vii) There is no overall choice. However, an internal choice has been provided in all five questions of *1* mark, three questions of *2* marks, in four questions of *3* marks, and, two questions of *5* marks weightage. Students have to attempt only one of the choices in such questions.

(viii) Use of non-programmable ordinary scientific calculators and log tables are allowed.

(ix) Mobile phones and Pagers are not allowed inside the Examination Hall.

SECTION—A

Choose and write the correct answers for the following in the Answer Script :

1. The appearance of colour in solid alkali metal halides is generally due to

(a) Schottky defect

(b) Frenkel defect

(c) interstitial defect

(d) F-centres 1

2. In the colloidal system, if the dispersion medium is water, the sol is called

(a) aerosol

(b) alcosol

(c) aquasol

(d) foam 1

3. Trimethylamine, $(CH_3)_3N$ is a

(a) 1° amine

(b) 2° amine

(c) 3° amine

(d) 4° amine 1

4. The correct IUPAC name of $[Ni(CO)_4]$ is

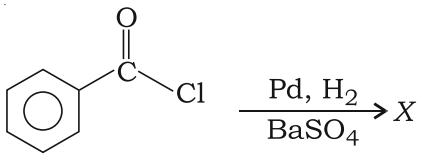
(a) tetracarbonyl nickel (0)

(b) tetracarbonyl nickel (I)

(c) tetracarbonyl nickel (II)

(d) tetracarbonyl nickel (III) 1

5. In the reaction



X is

(a) propionaldehyde

(b) benzaldehyde

(c) acetone

(d) acetophenone 1

SECTION—B

6. The boiling point of benzene is 353·23 K. When 1·80 g of a non-volatile solute was dissolved in 90 g of benzene, the boiling point is raised to 354·11 K. Calculate the molar mass of the solute, K_b for benzene is 2·53 K kg mol^{-1}. 2

7. The inversion of cane sugar is represented by the reaction

$$\underset{\text{(Cane sugar)}}{C_{12}H_{22}O_{11}} + \underset{\text{(excess)}}{H_2O} \xrightarrow{H^+} \underset{\text{(Glucose)}}{C_6H_{12}O_6} + \underset{\text{(Fructose)}}{C_6H_{12}O_6}$$

(a) What is the order of this reaction? 1

(b) Give one condition that determines the order of this reaction. 1

8. *Either*

(a) Why nitrogen exists as a diatomic molecule, N_2 whereas phosphorus exists as P_4? 2

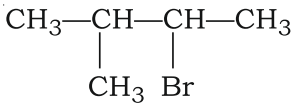
Or

(b) Why dry chlorine does not act as a bleaching agent? 2

9. Calculate the spin only magnetic moment of $Mn^{2+}(aq)$ (Z = 25). 2

10. *Either*

(a) Write the IUPAC name of



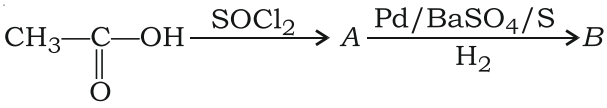
1

(b) Write one condition for an organic compound to be called a chiral compound. 1

Or

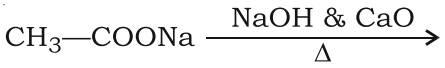
(c) Explain Wurtz reaction with a suitable example. 2

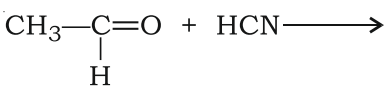
11. Identify the compounds *A* and *B* in the following sequence of reactions : 2



12. *Either*

(a) Write the structures of the products of the following reactions : 1+1

(i) 

(ii) 

Or

(b) Carboxylic acids are higher boiling liquids than aldehydes, ketones and even alcohols of comparable molecular masses. Why? 1

(c) Which acid in the following pair is stronger and why? 1

CH_3CO_2H or CH_2FCO_2H

SECTION—C

13. Silver forms c.c.p. lattice and X-ray studies of its crystals show that the edge length of its unit cell is 408·6 pm. Calculate the density of silver. (Atomic mass = 107·9 u) 3

14. *(a)* What are colligative properties? 1

(b) Define osmosis and osmotic pressure. 2

15. For a zero-order reaction, $R \rightarrow P$, derive the integrated rate equation and find its half-life ($t_{½}$) time period. 3

16. *(a)* What is an adsorption isotherm? 1

(b) Give the equation for Freundlich adsorption isotherm for a gas adsorbed by a solid. 1

(c) Why are powdered substances more effective adsorbents than their crystalline forms? 1

17. *Either*

(a) Why does $\ddot{N}H_3$ act as a Lewis base? 1

(b) How does ammonia react with an aqueous solution of Cu^{2+}? 1

(c) Mention any two conditions required to maximise the yield of ammonia by Haber's process. 1

Or

(d) Why does O_3 act as a powerful oxidising agent? 1

(e) Complete the following reactions :

(i) $CH_4 + O_2 \rightarrow$ 1

(ii) $Al + O_2 \rightarrow$ 1

18. What happens when—

(a) chlorine reacts with cold and dilute NaOH;

(b) SO_2 is passed through an aqueous solution of Fe(III) salt;

(c) sodium azide (NaN_3) is decomposed thermally? 1+1+1

19. *(a)* Name the only metal of the *d*-block elements which is a liquid at room temperature. 1

(b) Write the exceptional electronic configurations of the elements Cr ($Z = 24$) and Cu ($Z = 29$). 1

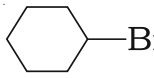
(c) Why scandium, Sc ($Z = 21$) is a transition element but zinc, Zn ($Z = 30$) is not? 1

20. *Either*

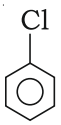
(a) Write the structures of the major products of the following reactions :

(i) $CH_3—CH_2—CH=CH_2 + HCl \longrightarrow$ 1

(ii) $CH_3CH_2Br + NaI \longrightarrow$ 1

(iii)  1

Or

(b) What happens when  reacts with the following (Give equations only) : 1+1+1

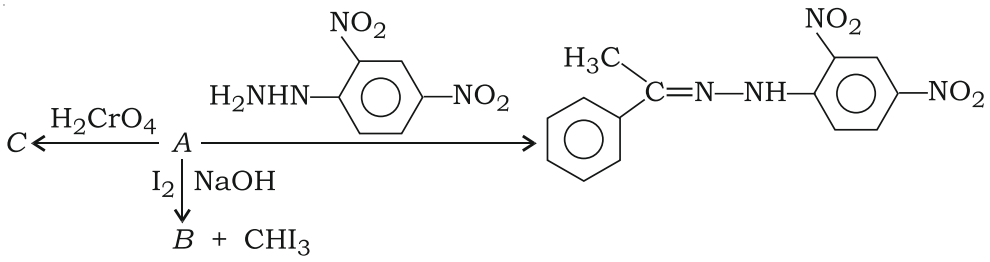
(i) CH_3Cl in presence of anhydrous $AlCl_3$;

(ii) conc. HNO_3 and conc. H_2SO_4;

(iii) Na and *RX* in the presence of dry ether?

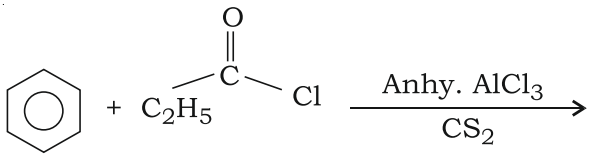
21. *Either*

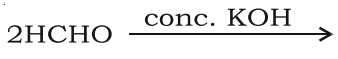
(a) Identify the compounds *A*, *B* and *C* in the following reaction : 3

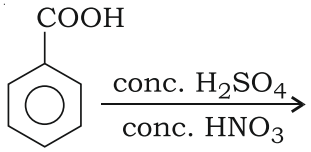


Or

(b) Complete the following reactions : 1+1+1

(i) 

(ii) 

(iii) 

22. *Either*

(a) Account for the following : 1+1+1

(i) Ethylamine is soluble in water whereas aniline is not;

(ii) pK_b of aniline is more than that of methylamine;

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

Or

(b) Arrange the following in decreasing order of their basic strength : 1

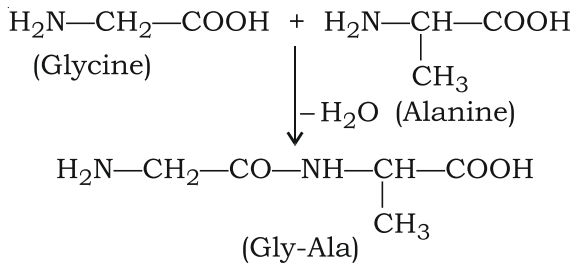
$$C_6H_5NH_2,\ C_2H_5NH_2,\ (C_2H_5)_2NH,\ NH_3$$

(c) Give equation only for the preparation of primary amines by Hofmann bromamide degradation reaction. 1

(d) What happens on reduction of nitriles (R—C≡N) with $LiAlH_4$? (Give equation only) 1

23. *(a)* What are essential and non-essential amino acids? 1

(b) Glycylalanine (Gly-Ala) forms by the following reaction :



Name the type of linkage connecting the two different types of amino acids (Gly and Ala). 1

(c) Name the type of proteins present in hair and muscles. 1

24. *(a)* Mention two important biological functions of nucleic acids. 2

(b) What happens when D-glucose is heated with HI? (Give equation only) 1

SECTION—D

25. *Either*

(a) Represent the cell in which the following reaction takes place :

$$Mg(s) + 2Ag^{+}(0{\cdot}0001M) \rightarrow Mg^{2+}(0{\cdot}130M) + 2Ag(s)$$

Calculate its E_{cell} if

$$E^{\circ}_{Mg/Mg^{2+}} = -2{\cdot}37 \text{ V and } E^{\circ}_{Ag^{+}/Ag} = +0{\cdot}80 \text{ V}$$ 5

Or

(b) The standard electrode potential, E°_{cell} for Daniel cell is 1·1 V. Calculate ΔG° for the reaction

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

(c) Δ°_{m} for NaCl, HCl and CH_3COONa are 126·4, 425·9 and 91·0 S cm^2 mol^{-1} respectively. Calculate the Δ°_{m} for CH_3COOH. 2

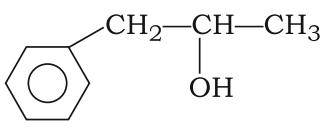
(d) Write the Nernst equation for the reaction

$$Cu^{2+}(aq) + 2e^{-} \rightarrow Cu(s)$$ 1

26. *Either*

(a) Classify the following as primary/secondary/tertiary alcohols :

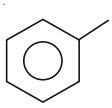
$CH_3—CH_2—CH_2—OH$,



1

(b) Predict the products of the following reactions : 1+1

(i) $CH_3—CH_2—CH_2—O—CH_3 + HBr \xrightarrow{373\ K}$

(ii)  $\xrightarrow[conc.\ HNO_3]{conc.\ H_2SO_4}$

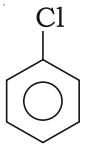
(c) Give the structure of the products you would expect when Butan-1-ol reacts with the following : 2

(i) $SOCl_2$

(ii) $HCl—ZnCl_2$

Or

(d) Identify the products *A*, *B*, *C* and *D* from the following reactions : ½×4=2

(i)  $\xrightarrow[623\ K,\ 300\ atm]{NaOH,\ HCl} A \xrightarrow[\Delta]{Zn\text{-}dust} B$

(ii) $CH_3CHO \xrightarrow[(ii)\ H_2O/H^+]{(i)\ CH_3MgBr} C \xrightarrow[443\ K]{H_2SO_4} D + H_2O$

(e) Convert cumene to phenol. 1

(f) Give the structures and IUPAC names of the products expected from the following reactions : 1×2=2

(i) Catalytic reduction of butanal

(ii) Hydration of propene in the presence of dilute sulphuric acid.

27. *(a)* What is a ligand? Give one example each of a bidentate and an ambidentate ligand. 1+½+½=2

(b) Explain on the basis of VBT, why tetrahedral Ni(II) complexes are paramagnetic but square planar Ni(II) complexes are diamagnetic. 2

(c) According to CFT, what happens to the degeneracy of the *d*-orbitals in the presence of asymmetrically negative field due to the ligands? 1

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Total No. of Printed Pages—12

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2021

CHEMISTRY

(Theory)

(Old Course)

Full Marks : 70

Time : 3 hours

The figures in the margin indicate full marks for the questions

General Instructions :

(i) Write all answers in the Answer Script.

(ii) Attempt all parts of a question together in one place.

(iii) All questions are compulsory.

(iv) Marks for each question are indicated against it.

(v) Question No. **1** of Part—I is of Multiple-choice Type, containing eight part questions, each of ½ mark. Choose and write the correct answer in the Answer Script from the four options given.

(vi) Question Nos. **2** to **9** of Part—II are Very Short-answer Type Questions of 1 mark each. Answer these either in *one* sentence or in *one* word each, wherever applicable.

(vii) Question Nos. **10** to **17** of Part—III are Short-answer Type–I Questions of 2 marks each. Answer these in about *20–30* words each, wherever applicable.

(viii) Question Nos. **18** to **26** of Part—IV are Short-answer Type–II Questions of 3 marks each. Answer these in about *40–50* words each, wherever applicable.

(ix) Question Nos. **27** to **29** of Part—V are Long-answer Type Questions of 5 marks each. Answer these in about *70–80* words each, wherever applicable.

(x) There is no overall choice. However, an internal choice has been provided in two questions of *2* marks, three questions of *3* marks and two questions of *5* marks weightage. Students have to attend only one of the choices in such questions.

(xi) Use of non-programmable ordinary Scientific Calculators and Log Tables is allowed.

(xii) Mobile Phones and Pagers are not allowed inside the Examination Hall.

PART—I

1. Choose and write the correct answer for the following in the Answer Script : ½×8=4

(a) The number of atoms in b.c.c. arrangement is

(i) 1

(ii) 2

(iii) 3

(iv) 4

(b) To get *n*-type semiconductor, impurity to be added to silicon should have which of the following numbers of valence electrons?

(i) 2

(ii) 3

(iii) 1

(iv) 5

(c) The colloidal system in which the dispersed phase and the dispersion medium are both liquids is known as

(i) a gel

(ii) an aerosol

(iii) an emulsion

(iv) a foam

(d) The process of separation of dissolved impurities from colloids by passing through a suitable membrane is called

(i) filtration

(ii) electrophoresis

(iii) dialysis

(iv) ultrafiltration

(e) Which of the following is an example of unidentate and monodentate ligand?

(i) $H_2N—CH_2—CH_2—NH_2$

(ii) $C_2O_4^{-2}$

(iii) Cl^-

(iv) $H_2NCH_2COO^-$

(f) The coordination number of Pt in $[PtCl_6]^{2-}$ is

(i) 2

(ii) 6

(iii) 4

(iv) 8

(g) The deficiency of which of the following vitamins in our body causes night-blindness?

(i) Vitamin C

(ii) Vitamin D

(iii) Vitamin K

(iv) Vitamin A

(h) The coagulation of egg-white on boiling is a common example of

(i) denaturation of proteins

(ii) hydrolysis of proteins

(iii) solubility of proteins

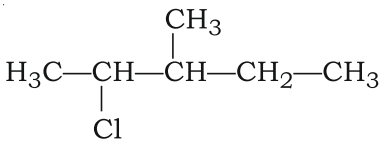
(iv) formation of proteins

PART—II

2. What are 'point defects' in crystalline substances? 1

3. In crystalline solids, what is a space lattice? 1

4. Write the IUPAC name of

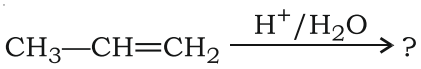


1

5. Arrange the following compounds in increasing order of their boiling points : 1

Bromomethane, Bromoform, Chloromethane, Dibromomethane

6. Write the structure of the major product of



1

7. Write the structures of the functional groups in aldehydes and ketones. 1

8. Classify the following amines as primary or secondary :

CH_3NH_2 and $(CH_3)_2NH$ 1

9. Give one reaction to show the basic character of primary amines. 1

PART—III

10. Silver crystallises in f.c.c. lattice. If edge length of the cell is $4{\cdot}07 \times 10^{-8}$ cm and density is $10{\cdot}5$ gcm^{-3}, calculate the atomic mass of silver. (Given $N_A = 6{\cdot}022 \times 10^{23}\ mol^{-1}$). 2

11. Define the term 'solution'. Give one example of liquid solution. 2

12. *Either*

(a) Calculate the molarity of a solution containing 5 g of NaOH in 450 ml solution. (Mol. wt. of NaOH=40 $g\ mol^{-1}$) 2

Or

(b) Calculate the molality of $2{\cdot}5$ g of ethanoic acid ($C_2H_4O_2$) in 75 g of benzene (molar mass of $C_2H_4O_2$ = 60 $g\ mol^{-1}$). 2

13. Define speed/rate of a reaction. Give any one specific way of expressing the rate of a reaction. 2

14. *(a)* Name an element in the 3*d*-series of transition metals which is usually not regarded as a transition metal and write its electronic configuration. 1

(b) Which transition metal of the 3*d*-series exhibits the largest number of oxidation states and why? 1

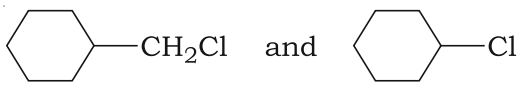
15. What are homoleptic and heteroleptic complexes? Give one example of each. 2

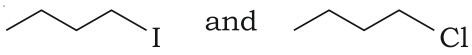
16. *Either*

(a) Why is chloroform ($CHCl_3$) stored in dark coloured bottles? 2

Or

(b) In the following pairs of halogen compounds, which would undergo S_N2 reaction faster and why?

(i)  1

(ii)  1

17. Why have primary amines (RNH_2) higher boiling point than tertiary amines (R_3N) of comparable molecular mass? 2

PART—IV

18. *(a)* Calculate the overall order of a reaction, which has the rate expression :

(i) Rate = $k[A]^{3/2}[B]^{1/2}$ 1

(ii) Rate = $k[A]^{3/2}[B]^{-1}$ 1

(b) The reaction $R \rightarrow P$ has zero order. Write the rate equation for this reaction. 1

19. *(a)* What are lyophilic and lyophobic sols? Write one example of each type. 2

(b) Write one difference between Homogeneous catalysis and heterogeneous catalysis. 1

20. *Either*

(a) What types of ores are roasted? 1

(b) Name the method used for refining of nickel. 1

(c) Why is pine-oil used in froth-floatation method? 1

Or

(d) Write the chemical reaction involved in the extraction of zinc from zinc oxide. How is it collected? 2

(e) Write one difference between 'pig iron' and 'cast iron'. 1

21. *Either*

(a) In the manufacture of H_2SO_4 by contact process, giving step-wise reactions, write the principle and conditions involved. 3

Or

(b) Why is dinitrogen less reactive at room temperature? 1

(c) In the manufacture of ammonia by Haber's process, give the equation involved and mention the optimum conditions required to maximise the yield of ammonia. 2

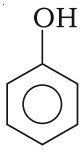
22. The magnetic moments of Sc^{3+} and Fe^{2+} are 0·00 BM and 4·90 BM. Which of these ions—

(a) has the maximum number of unpaired electrons and why;

(b) forms colourless aqueous solutions and why? 3

23. Write the structures of the products in the following reactions : 1+1+1=3

(a) $C_2H_5OH \xrightarrow[443\ K]{H_2SO_4} ?$

(b)  + Zn $\xrightarrow{Heat}$?

(c) $CH_3CH_2OCH_2CH_3 + HI \xrightarrow{373\ K} ?$

24. How are vitamins classified? Name the vitamin responsible for the coagulation of blood. 3

25. *Either*

(a) Explain the terms 'polymer' and 'monomer' with an example of each. 3

Or

(b) Write the names and structures of the monomers used for synthesizing the following polymers : 1+1+1

(i) Polythene

(ii) Teflon

(iii) Polyacrylonitrile

26. *(a)* What are soaps? 1

(b) Why do soaps not work in hard water? 2

PART—V

27. In the Daniel cell, the following redox reaction occurs :

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

Answer the following : 1×5=5

(a) Write the reduction half-cell reaction.

(b) Write the oxidation half-cell reaction.

(c) Write the half-cell reaction which acts as the anode.

(d) Write the half-cell reaction which acts as the cathode.

(e) Define galvanic cell.

28. *Either*

(a) Account for the following : 2+1+2=5

(i) Moist chlorine is a powerful bleaching agent for vegetable or organic matter

(ii) Formation of a black residue occurs when concentrated H_2SO_4 is added to a test tube containing cane sugar (a carbohydrate)

(iii) Anomalous behaviour of fluorine

Or

(b) *(i)* Which substances deplete the ozone layer in the upper atmosphere? 1

(ii) How is SO_2 responsible in producing acid rain? 1

(iii) Which gas is used in oxyacetylene welding? 1

(iv) Write the name and ratios of the two acids used for dissolving noble metals like Au, Pt, etc. 1

(v) Name the Gr 17 element used in sterilising drinking water. 1

29. *Either*

(a) Arrange the following compounds in the increasing order of their boiling points : 1

CH_3CHO, CH_3CH_2OH, CH_3OCH_3, $CH_3CH_2CH_3$

(b) What happens when (give equations only)— 1×4=4

(i) acetaldehyde (CH_3CHO) reacts with HCN;

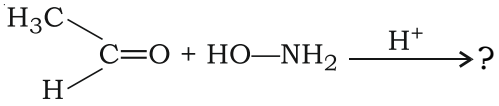
(ii) propanone reacts with CH_3MgI in the presence of H_2O/H^+;

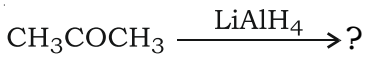
(iii) acetic acid (CH_3COOH) is heated in the presence of strong dehydrating agent such as P_2O_5;

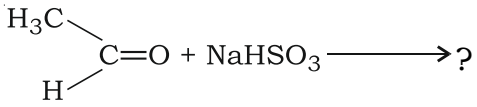
(iv) two moles of acetaldehyde (CH_3CHO) condense in the presence of NaOH.

Or

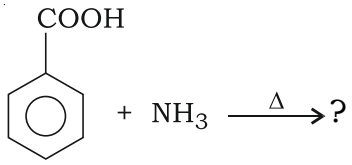
(c) Write the products of the following reactions : 1×5=5

(i) 

(ii) 

(iii) 

(iv) 

(v) 

★ ★ ★