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

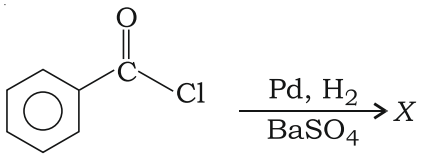
(a) tetracarbonyl nickel (0)

(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

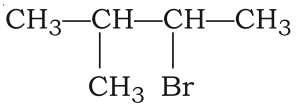
Or

(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



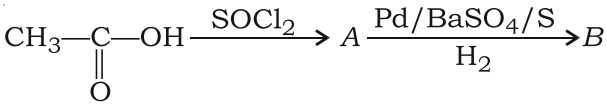
1

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

Or

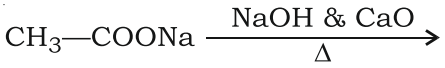
(c) Explain Wurtz reaction with a suitable example. 2

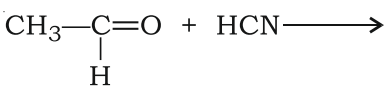
11. Identify the compounds *A* and *B* in the following sequence of reactions : 2



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

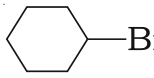
(c) Why scandium, Sc ($Z = 21$) is a transition element but zinc, Zn ($Z = 30$) is not? 1

20. *Either*

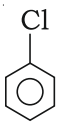
(a) Write the structures of the major products of the following reactions :

(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

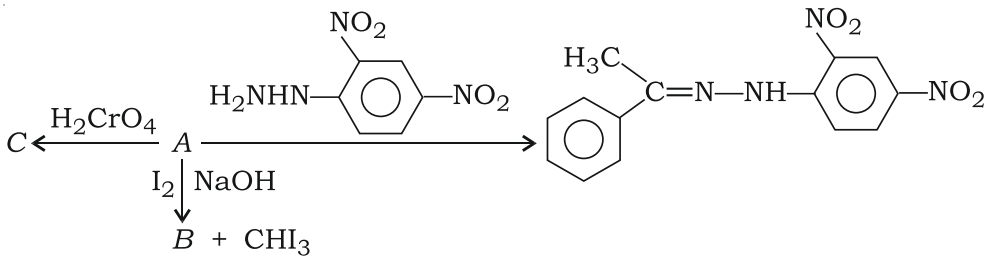
(i) CH_3Cl in presence of anhydrous $AlCl_3$;

(ii) conc. HNO_3 and conc. H_2SO_4;

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

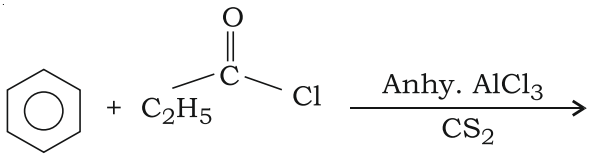
21. *Either*

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

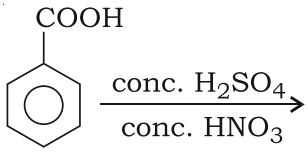


Or

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

(i) 

(ii) $2HCHO \xrightarrow{\text{conc. KOH}}$

(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

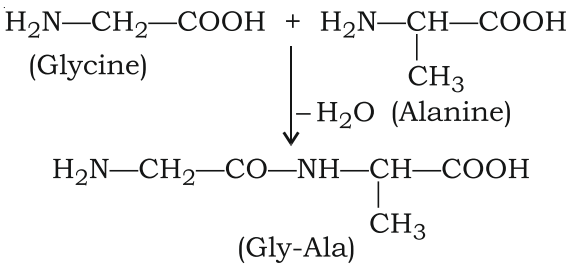
$$C_6H_5NH_2,\ C_2H_5NH_2,\ (C_2H_5)_2NH,\ NH_3$$

(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

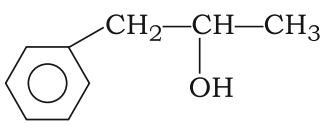
(d) Write the Nernst equation for the reaction

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

26. *Either*

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

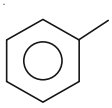
$CH_3—CH_2—CH_2—OH$,



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

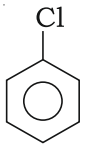
(c) Give the structure of the products you would expect when Butan-1-ol reacts with the following : 2

(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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