

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.

(2)

- (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) alcocol
- (c) aquasol
- (d) foam

1

(3)

3. Trimethylamine, $(\text{CH}_3)_3\text{N}$ is a

- (a) 1° amine
- (b) 2° amine
- (c) 3° amine
- (d) 4° amine

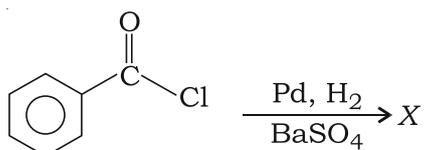
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4. The correct IUPAC name of $[\text{Ni}(\text{CO})_4]$ is

- (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

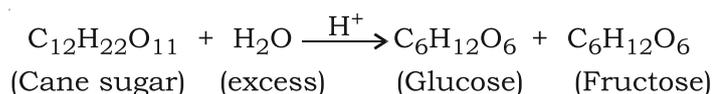
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(4)

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



- (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, N₂ whereas phosphorus exists as P₄? 2

Or

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

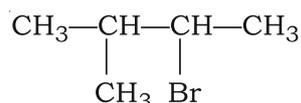
9. Calculate the spin only magnetic moment of Mn²⁺(aq) (Z = 25). 2

(5)

10.

Either

(a) Write the IUPAC name of



1

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

1

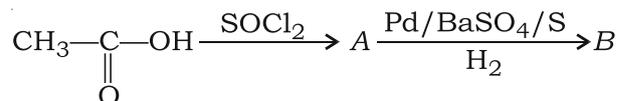
Or

(c) Explain Wurtz reaction with a suitable example.

2

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

2

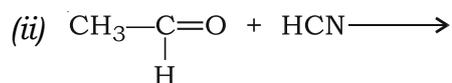
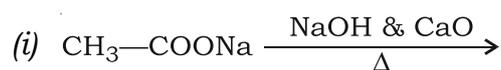


12.

Either

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

1+1



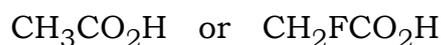
Or

(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



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 ($t_{1/2}$) 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 $\ddot{\text{N}}\text{H}_3$ 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) $\text{CH}_4 + \text{O}_2 \rightarrow$ 1
(ii) $\text{Al} + \text{O}_2 \rightarrow$ 1

(7)

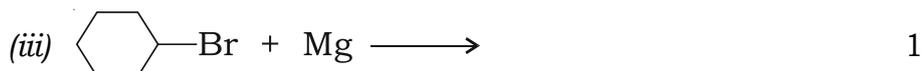
18. What happens when—

- (a) chlorine reacts with cold and dilute NaOH;
(b) SO₂ is passed through an aqueous solution of Fe(III) salt;
(c) sodium azide (NaN₃) 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 :



Or

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

(i) CH₃Cl in presence of anhydrous AlCl₃;

(ii) conc. HNO₃ and conc. H₂SO₄;

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

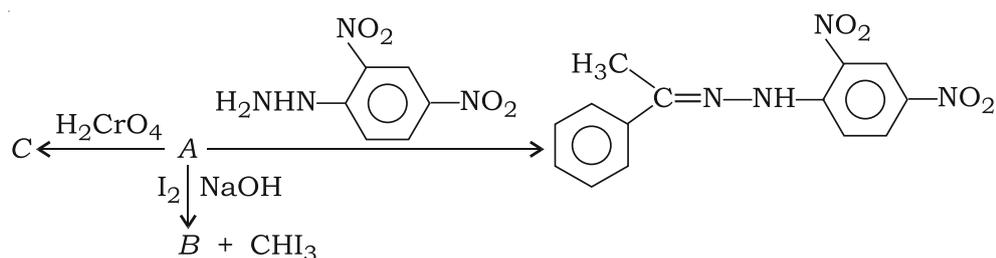
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21.

Either

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

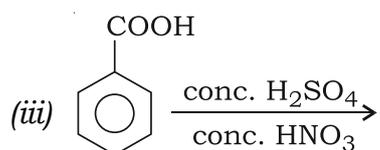
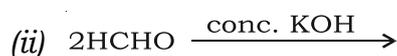
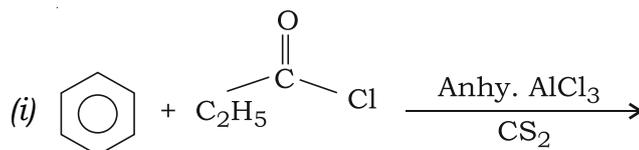
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Or

(b) Complete the following reactions :

1+1+1



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.

(9)

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 ($R-C\equiv N$) 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 :
- $$\begin{array}{ccc} H_2N-CH_2-COOH & + & H_2N-CH-COOH \\ \text{(Glycine)} & & | \\ & & CH_3 \\ & \downarrow & \\ & -H_2O \text{ (Alanine)} & \\ & \downarrow & \\ H_2N-CH_2-CO-NH-CH-COOH & & \\ & & | \\ & & CH_3 \\ & \text{(Gly-Ala)} & \end{array}$$
- 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

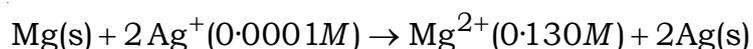
(10)

SECTION—D

25.

Either

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



Calculate its E_{cell} if

$$E_{\text{Mg/Mg}^{2+}}^{\circ} = -2.37 \text{ V and } E_{\text{Ag}^+/\text{Ag}}^{\circ} = +0.80 \text{ V} \quad 5$$

Or

- (b) The standard electrode potential, E_{cell}° for Daniel cell is 1.1 V. Calculate ΔG° for the reaction



- (c) Δ_m° for NaCl, HCl and CH_3COONa are 126.4, 425.9 and 91.0 $\text{S cm}^2 \text{ mol}^{-1}$ respectively. Calculate the Δ_m° for CH_3COOH . 2

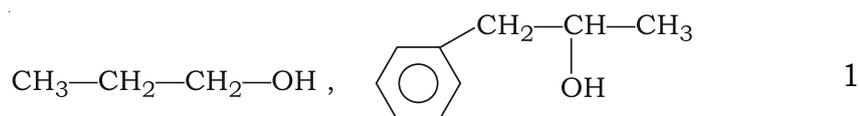
- (d) Write the Nernst equation for the reaction



26.

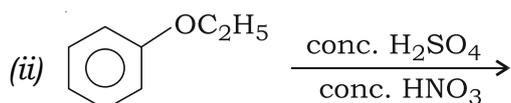
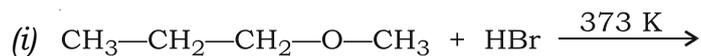
Either

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

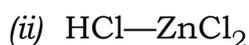


(11)

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

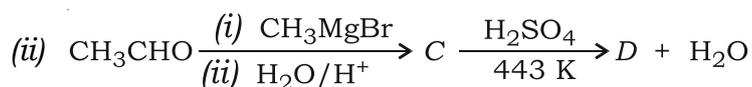
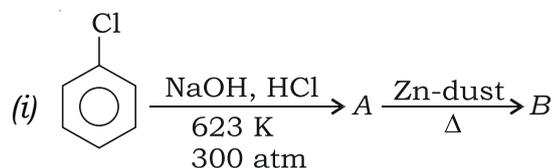


(c) Give the structure of the products you would expect when Butan-1-ol reacts with the following : 2



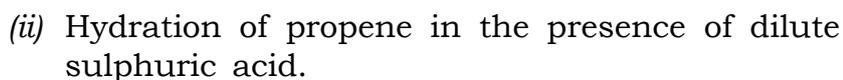
Or

(d) Identify the products A, B, C and D from the following reactions : $\frac{1}{2} \times 4 = 2$



(e) Convert cumene to phenol. 1

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



(12)

27. (a) What is a ligand? Give one example each of a bidentate and an ambidentate ligand. $1 + \frac{1}{2} + \frac{1}{2} = 2$
- (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
