Total No. of Printed Pages—12

HS/XII/Sc/Ch/25

2025

CHEMISTRY

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 carrying *1* mark.

(iv) Section—B : Question Nos. **6** to **12** are of 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 four questions of *2* marks, four questions of *3* marks, and all three 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

(*Marks* : 5)

Choose and write the correct answers for the following in the answer script :

1. Which of the following colligative properties is used to determine molar masses of proteins, polymers or other macromolecules?

(a) Depression in freezing point

(b) Relative lowering of vapour pressure

(c) Osmotic pressure

(d) Elevation in boiling point 1

2. The amount of electricity required to deposit 1 mol of aluminium from a solution of $AlCl_3$ will be

(a) 0·33 faraday

(b) 1 faraday

(c) 3 faraday

(d) 1 ampere 1

3. How many ions are produced from the complex $[Co(NH_3)_6]Cl_2$ in solution?

(a) 6

(b) 3

(c) 4

(d) 2 1

4. The coordination number of Fe in $[Fe(C_2O_4)_3]^3$ is

(a) 2

(b) 3

(c) 4

(d) 6 1

5. When phenol is treated with $CHCl_3$ and NaOH, the product formed is

(a) benzaldehyde

(b) salicylaldehyde

(c) salicylic acid

(d) benzoic acid 1

SECTION—B

(*Marks* : 14)

6. *Either*

(a) A reaction is second-order with respect to a reactant. How is the rate of reaction affected if the concentration of the reactant is *(i)* doubled and *(ii)* reduced to half? 2

Or

(b) For a first-order reaction, show that time required for 99% completion is twice the time required for the completion of 90% of the reaction. 2

7. What is the effect of temperature on the rate constant of a reaction? How can this effect of temperature on rate constant be represented quantitatively? 1+1=2

8. *Either*

(a) What are interstitial compounds? Why are such compounds well-known for transition metals? 1+1=2

Or

(b) Explain giving reasons : 1×2=2

(i) Ti^{3} salts are purple whereas Ti^{4} salts are colourless.

(ii) Transition metals and their many compounds act as good catalyst.

9. *Either*

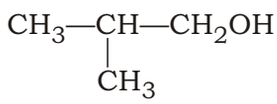
(a) Give evidence that $[Co(NH_3)_5Cl]SO_4$ and $[Co(NH_3)_5SO_4]Cl$ are ionization isomers. 2

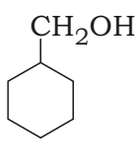
Or

(b) $[NiCl_4]^{2}$ is paramagnetic while $[Ni(CO)_4]$ is diamagnetic though both are tetrahedral. Explain why. 2

10. *Either*

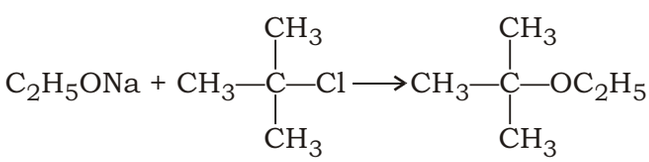
(a) Show how are the following alcohols prepared by the reaction of a suitable Grignard reagent on methanal? 1×2=2

(i) 

(ii) 

Or

(b) The following is not an appropriate reaction for the preparation of tert-butyl ethyl ether :



(i) What would be the major product of this reaction? 1

(ii) Write a suitable reaction for the preparation of tert-butyl ethyl ether. 1

11. *(a)* Name the vitamin whose deficiency causes rickets. 1

(b) What is the basic structural difference between starch and cellulose? 1

12. Differentiate between globular proteins and fibrous proteins. 2

SECTION—C

(*Marks* : 36)

13. *Either*

(a) What do you mean by abnormal molecular mass? 1

(b) Calculate the molality of 2·5 g of ethanoic acid (CH_3COOH) in 75 g of benzene. 2

Or

(c) Why do gases always tend to be less soluble in liquids as the temperature is raised? 1

(d) 1·00 g of a non-electrolyte solute dissolved in 50 g of benzene lowered the freezing point of benzene by 0·40 K. Find the molar mass of the solute. (K_f of benzene is 5·12 K kg mol ^{1}) 2

14. *(a)* What are hypertonic solutions? 1

(b) Define Raoult's law for a solution containing a non-volatile solute. 1

(c) Under what condition do non-ideal solutions show positive deviation from Raoult's law? 1

15. *Either*

(a) Consider the following reaction :

$$Cr_2O_7^{2} \quad 14H \quad 6e \quad 2Cr^{3} \quad 7H_2O$$

What is the quantity of electricity in coulombs needed to reduce 1 mol of $Cr_2O_7^{2}$? 1

(b) The molar conductivity of 0 025 mol L ^{1} methanoic acid is 46 1 S cm^{2} mol ^{1}. Calculate its degree of dissociation and dissociation constant. Given $^{\circ}$(H) 349 6 S cm^{2} mol ^{1} and $^{\circ}$(HCOO) 54 6 S cm^{2} mol ^{1}. 2

Or

(c) Calculate the equilibrium constant of the reaction

Cu (s) 2Ag (aq) Cu^{2} (aq) 2Ag (s)

Given, E°_{cell} 0 46 V. 1

(d) A solution of $Ni(NO_3)_2$ is electrolyzed between platinum electrodes using a current of 5 amperes for 20 minutes. What mass of Ni is deposited at the cathode? (At. mass of Ni 58 7) 2

16. *(a)* A first-order reaction is found to have a rate constant, k 5 5 10 ^{14} s ^{1}. Find the half-life of the reaction. 1

(b) Derive the integrated rate equation for first-order reaction. 2

17. *(a)* Draw a figure to show the splitting of *d*-orbitals in an octahedral crystal field. 1

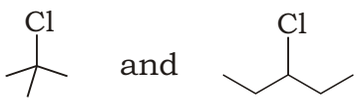
(b) Draw structures of geometrical isomers of $[Fe(NH_3)_2(CN)_4]$. 1

(c) Write the IUPAC name of the following coordination compound : 1

$[Co(NH_3)_5(CO_3)]Cl$

18. *Either*

(a) In the following pairs of halogen compounds, which compound undergoes faster S_N1 reaction? 1



(b) Explain why—

(i) alkyl halides, though polar, are immiscible with water;

(ii) Grignard reagent should be prepared under anhydrous conditions. 1+1=2

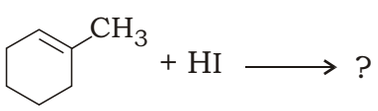
Or

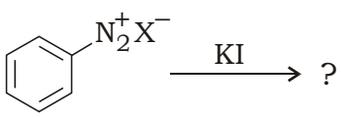
(c) What is Wurtz-Fittig reaction? 1

(d) The treatment of alkyl chlorides with aqueous KOH leads to the formation of alcohols but in the presence of alcoholic KOH, alkenes are the major products. Explain. 2

19. Draw the structures of major monohalo products in each of the following reactions : 1×3=3

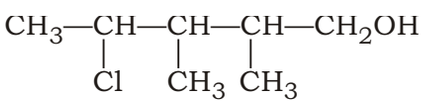
(i) 

(ii) 

(iii) 

20. *Either*

(a) Give the IUPAC name of the following compound : 1



(b) Write the equations of the following reactions : 2

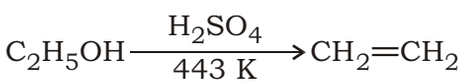
(i) Nitration of anisole

(ii) Bromination of phenol in CS_2 at 273 K

Or

(c) Give the equations of reactions for the preparation of phenol from cumene. 1

(d) Write the mechanism of the following reaction : 2



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

CH_3CHO, CH_3CH_2OH, CH_3OCH_3, $CH_3CH_2CH_3$

(b) What is aldol condensation? Give a reaction between two ethanals to illustrate aldol condensation. 1+1=2

22. *(a)* Give one chemical test to distinguish between an aromatic primary amine from an aliphatic primary amine. 1

(b) Write the structure and IUPAC name of the amine produced by the Hofmann degradation of benzamide. 1

(c) 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

23. (a) Why cannot aromatic primary amines be prepared by Gabriel phthalimide synthesis? 1

(b) Diazonium salts of aromatic amines are more stable than those of aliphatic amines. Give reason. 1

(c) Ethylamine is soluble in water whereas aniline is not. Explain. 1

24. (a) What is invert sugar? 1

(b) How do you explain the amphoteric behaviour of amino acids? 2

SECTION—D

(*Marks* : 15)

25. *Either*

(a) What is a fuel cell? 1

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

Mg(s) 2Ag (0 0001 *M*) Mg^2 (0 130 *M*) 2Ag(s)

Calculate its E_{cell} if E°_{cell} 3 17 V. 2

(c) Write the chemistry of recharging the lead storage battery, highlighting all the materials that are involved during recharging. 2

Or

(d) How much electricity in terms of Faraday is required to produce 20 0 g of calcium from molten $CaCl_2$? (At. mass of Ca = 40 g mol ^{1}) 2

(e) Define conductivity and molar conductivity for the solution of an electrolyte. 2

(f) Why does conductivity of a solution decrease with dilution? 1

26. *Either*

(a) Which is a stronger reducing agent Cr^{2} or Fe^{2} and why? 1

(b) Calculate the 'spin only' magnetic moment of M^{2} (aq) ion. (*Z* 27) 1

(c) Mention the steps involved in the preparation of $K_2Cr_2O_7$ from sodium chromate. What is the effect of increasing pH on a solution of $K_2Cr_2O_7$? 2+1=3

Or

(d) What is the general electronic configuration of *d*-block elements? 1

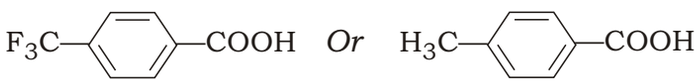
(e) Draw the structure of $Cr_2O_7^{2}$ ion. 1

(f) Mention any one cause of lanthanoid contraction. 1

(g) How does the acidified permanganate solution react with *(i)* Fe^{2} ion and *(ii)* H_2S? 1+1=2

27. *Either*

(a) Which of the following acids is more stronger? Why? 1



(b) What is Clemmensen reaction? Give relevant equation involved. 1

(c) Formic acid reduces Tollens' reagent whereas acetic acid does not. Why? 1

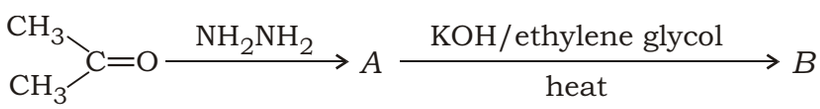
(d) Why are aldehydes more reactive than ketones towards nucleophilic addition reaction? 2

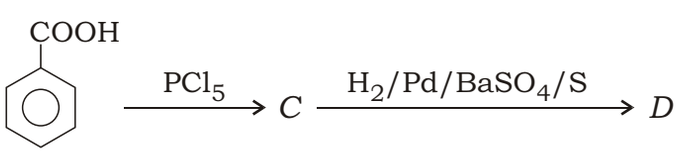
Or

(e) What types of aldehyde undergo Cannizzaro reaction? 1

(f) Carboxylic acid is a stronger acid than phenol. Explain why. 2

(g) Identify the products *A*, *B*, *C* and *D* from the following reactions : 1×2=2

(i) 

(ii) 

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