Total No. of Printed Pages—7

4 SEM TDC CHMH (CBCS) C 8

2025

(May/June)

CHEMISTRY

(Core)

Paper : C–8

(Inorganic Chemistry)

Full Marks : 53

Pass Marks : 21

Time : 3 hours

The figures in the margin indicate full marks for the questions

1. Select the correct answer : 1×6=6

(a) The common oxidation state of lanthanides is

(i) +2

(ii) +3

(iii) +4

(iv) Both +2 and +4

(b) Which of the following does not belong to lanthanides?

(i) Am

(ii) Pm

(iii) Sm

(iv) Tm

(c) Which of the following is labile?

(i) $[Fe(CN)_6]^{3-}$

(ii) $[Fe(H_2O)_6]^{2+}$

(iii) $[Cr(CN)_6]^{3-}$

(iv) $[Mn(CN)_6]^{4-}$

(d) Which of the following is paramagnetic?

(i) $Fe(CO)_5$

(ii) $[Ni(CN)_4]^{2-}$

(iii) $[Co(NH_3)_6]^{3+}$

(iv) $[Fe(NH_3)_6]^{2+}$

(Continued)

(e) The oxidation state of Fe in haemoglobin is

(i) 0

(ii) +2

(iii) +3

(iv) None of the above

(f) Japanese itai-itai disease is caused by the poisoning of

(i) Pb

(ii) Cd

(iii) Hg

(iv) As

UNIT—I

2. Answer the following questions : 2×4=8

(a) Write the name and formula of each of the following types of ligand : 1+1=2

(i) One asymmetric bidentate ligand

(ii) One hexadentate ligand

(Turn Over)

(b) What is spectrochemical series? Write one application of the spectrochemical series. 1+1=2

(c) Write the IUPAC names of the following compounds : 1+1=2

(i) $Na_3[Co(CN)_5NO]$

(ii) $[(NH_3)_5Co—NH_2—Co(NH_3)_5]Cl_3$

(d) Draw the structures of all possible isomers of $[Co(en)_3]^{3+}$ ion. 2

3. Answer any *two* questions : 3×2=6

(a) On the basis of crystal field theory, explain the splitting of *d*-orbitals in an octahedral complex. 3

(b) Show the crystal field splitting of $[Fe(H_2O)_6]^{2+}$. Calculate its spin only magnetic moment. 2+1=3

(c) Determine the structure of $[Ni(CN)_4]^{2-}$ in the light of valence bond theory. Discuss its magnetic property. 2+1=3

4. Answer any *two* questions : 4×2=8

(a) (i) What are chelating ligands? Discuss with a suitable example.

(ii) Give the structural formulae of the following compounds : 2+2=4

Pentaammineazidocobalt (III) sulphate and Tetrafluoro oxochromate (IV) ion

(Continued)

(b) What do you mean by CFSE (Crystal Field Stabilization Energy)? Calculate CFSE for the following octahedral systems : 1+1+1+1=4

(i) d^3

(ii) d^5 high-spin

(iii) d^6 low-spin

(c) (i) Explain ambidentate and macrocyclic ligands with suitable example. 2

(ii) Explain why tetrahedral complexes are generally high-spin. 2

UNIT—II

5. Answer any *three* questions : 3×3=9

(a) Write any three differences between first and second transition series elements. 3

(b) Give reasons why (i) Sc^{3+} is more stable than Sc^{2+} and (ii) transition elements exhibit colour. Explain with example. 1½+1½=3

(Turn Over)

(c) Give three applications of Latimer diagram. 3

(d) Explain the stability of various oxidation states of transition metals in terms of their e.m.f. values. What is Latimer diagram? 2+1=3

6. Find the number of unpaired electrons and calculate spin only magnetic moment in the following complexes : 2×2=4

(a) $[Cr(H_2O)_6]^{3+}$

(b) $[Mn(CN)_6]^{4-}$

UNIT—III

7. Answer any *two* questions : 2×2=4

(a) What do you mean by lanthanide contraction?

(b) Eu and Yb exhibit +2 oxidation state. Explain.

(c) Give any two differences between lanthanides and actinides.

UNIT—IV

8. Answer any *two* questions : 4×2=8

(a) Discuss the structure and function of carbonic anhydrase. 2+2=4

(Continued)

(b) What is sodium-potassium ion pump? Discuss its biological roles. 1+3=4

(c) Write a note on mercury poisoning. How can it be treated? 2+2=4

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4 SEM TDC CHMH (CBCS) C 9

2025

(May/June)

CHEMISTRY

(Core)

Paper : C–9

(Organic Chemistry)

Full Marks : 53

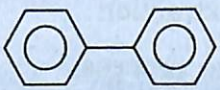
Pass Marks : 21

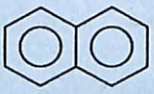
Time : 3 hours

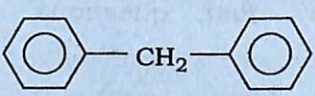
The figures in the margin indicate full marks for the questions

1. Choose the correct answer from the following : 1×4=4

(a) Which one of the following is a condensed polynuclear hydrocarbon?

(i) 

(ii) 

(iii) 

(iv) All of the above

(b) Nucleophilic substitution in pyridine occurs at

(i) N-atom

(ii) α-position

(iii) β-position

(iv) Does not occur

(c) Which one is used as a local anaesthetic?

(i) Quinoline

(ii) Cocaine

(iii) Morphine

(iv) Reserpine

(d) Which of the following methods is used for isolation of terpenoids?

(i) Steam distillation

(ii) Solvent extraction

(iii) Enfleurage process

(iv) All of the above

2. Answer any *four* questions from the following : 2×4=8

(a) Aniline is a weaker base than ethylamine. Explain.

(b) How will you prepare benzene diazonium chloride? What happens when benzene diazonium chloride is treated with KI? 1+1=2

(c) Naphthalene at high temperature gives mainly β-naphthalene sulphonic acid. Explain why?

(d) Pyridine, though aromatic like benzene, can undergo nucleophilic substitution easily, while benzene cannot. Explain.

(e) What are the natural sources of nicotine and cocaine? 1+1=2

UNIT—I

3. Answer any *three* questions : 3×3=9

(a) How would you distinguish among 1°, 2° and 3° amines with the help of nitrous acid test?

(b) Write short notes on any *two* of the following : 1½×2=3

(i) Hofmann elimination

(ii) Schotten-Baumann reaction

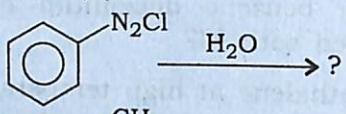
(iii) Gabriel phthalimide synthesis

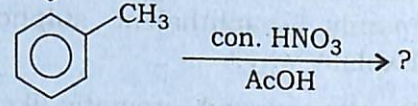
(c) Discuss the synthesis of the following : 1½×2=3

(i) Aniline from chlorobenzene

(ii) p-Benzoquinone from aniline

(d) Complete the following reactions (any *three*) : 1×3=3

(i) 

(ii) 

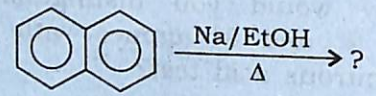
(iii) $C_6H_5OH + NH_3 \xrightarrow[ZnCl_2]{300\ °C} ?$

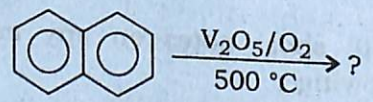
(iv) $ArNH_2 + HNO_2 \xrightarrow[0–5\ °C]{} ?$

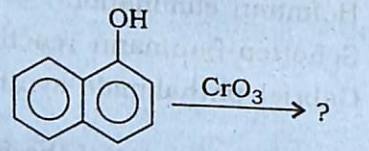
UNIT—II

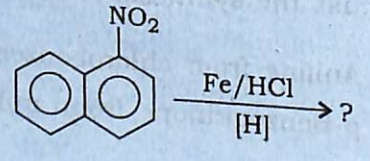
4. Answer any *three* questions : 3×3=9

(a) Complete the following reactions (any *three*) : 1×3=3

(i) 

(ii) 

(iii) 

(iv) 

(Continued)

(b) Electrophilic substitution of naphthalene takes place mainly at α-position (C–1). Explain.

(c) How will you convert any *two* of the following? 1½×2=3

(i) Naphthalene into phthalic-anhydride

(ii) Anthracene into 9,10-anthraquinone

(iii) 1,4-Naphthaquinone into anthracene

(d) What happens when α-naphthol is oxidised by alk.$KMnO_4$? How will you convert α-naphthol into 1,4-naphtha-quinone? 1+2=3

UNIT—III

5. (a) Out of pyrrole and furan, which is more aromatic? Explain. 2

(b) Starting with furan, how will you get the following? 1+1=2

(i) 2-Nitrofuran

(ii) Furan-2-sulfonic acid

(c) Explain why pyridine is less basic than tert aliphatic amines. 2

(d) Out of pyrrole and furan, which is more aromatic? 1

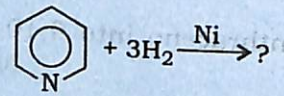
(Turn Over)

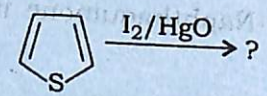
(e) Answer any *three* questions : 2×3=6

(i) Give Friedlander's synthesis of quinoline.

(ii) What happens when quinoline is treated with conc.HNO_3 and conc.H_2SO_4?

(iii) Complete the following reactions : 1+1=2

1. 

2. 

4. (iv) Convert the following : 1+1=2

1. 2-Formyl pyrrole from pyrrole
2. Furan from furfural

UNIT—IV

6. (a) What is Hofmann exhaustive methylation? Explain with suitable example. 2

Or

Give the medicinal use of nicotine and hygrine. 1+1=2

(b) What are physiological actions of alkaloid? Discuss in detail. 3

Or

Give one method of synthesis of hygrine.

UNIT—V

7. What is isoprene rule? Explain with suitable example. Outline the synthesis of neral. 1+1+3=5

Or

Establish the structure of citral. How does it differ from neral? How will you convert it into neral and α-terpineol? 1+1+3=5

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4 SEM TDC CHMH (CBCS) C 10

2025

(May/June)

CHEMISTRY

(Core)

Paper : C–10

(Physical Chemistry)

Full Marks : 53

Pass Marks : 21

Time : 3 hours

The figures in the margin indicate full marks for the questions

1. Choose the correct answer (any *five*) : 1×5=5

(a) The value of molar conductivity of KCl solution

(i) increases linearly with the increase in concentration

(ii) decreases linearly with the increase in concentration

(iii) increases non-linearly with the increase in concentration

(iv) decreases non-linearly with the increase in concentration

(b) The Debye-Hückel-Onsager equation is not valid for

(i) CH_3COOH

(ii) HCl

(iii) KCl

(iv) KNO_3

(c) The correct statement for an electro-chemical cell is

(i) it converts electrical energy into chemical energy

(ii) oxidation takes place on cathode

(iii) oxidation takes place on anode

(iv) the two electrodes are set up in the same electrolytic solution

(d) Which is not true about standard hydrogen electrode (SHE)?

(i) Potential of SHE is arbitrary taken as zero

(ii) It always acts as cathode with other half-cell electrodes

(iii) Platinized platinum is used as electrode material for electrical conductivity

(iv) Hydrogen gas at 1 atm pressure should be supplied

(Continued)

(e) For a diamagnetic substance

(i) magnetic permeability, $\mu = 1$

(ii) magnetic permeability, $\mu < 1$

(iii) magnetic permeability, $\mu > 1$

(iv) magnetic permeability, $\mu = 0$

(f) The values of magnetic moment for the complexes $[Fe(CN)_6]^{3-}$ and $[FeF_6]^{3-}$ are

(i) 5·91 BM and 5·91 BM respectively

(ii) 1·73 BM and 1·73 BM respectively

(iii) 5·91 BM and 1·73 BM respectively

(iv) 1·73 BM and 5·91 BM respectively

2. Answer the following questions : 2×5=10

(a) What do you mean by ionic mobility? Write its unit.

(b) Ionic mobility of Li^+ ion is more than Na^+ and K^+ ions. Explain.

(c) Describe the construction of standard hydrogen electrode (SHE).

(d) What are reference electrodes? Give examples.

(e) The dipole moment of a halo-benzene is 1·55 D. The bond distance of X—C_6H_5 is 2·8 Å. Calculate the percentage of ionic character of the bond.

(Turn Over)

3. Answer the following question [either *(a)* or *(b)*] : 3

(a) Discuss the effect of dilution on specific conductance and equivalent conductance. 3

(b) Define molar conductance and specific conductance. Write the relationship between specific conductance and molar conductance. 2+1=3

4. Answer any *three* of the following questions : 4×3=12

(a) What is meant by abnormal transport number of an ion? Discuss the effect of concentration on the transport number of Cd^{2+} ion in aqueous solution of CdI_2. 2+2=4

(b) What is cell constant? Write its unit. How is cell constant determined? 1+1+2=4

(c) Define transport number of an ion. How is it related to the ionic mobility of the ions? State and explain the Hittorf's rule. 1+1+2=4

(d) Draw and explain the conductometric titration curves for *(i)* NH_4OH is titrated against HCl and *(ii)* HCl is titrated against NH_4OH. 2+2=4

(e) Write short notes on the following : 2+2=4

(i) Asymmetric effect

(ii) Electrophoretic effect

5. Answer the following question [either (a) or *(b)*] : 3

(a) Describe how the hydrogen electrode can be used for the determination of pH of a solution. 3

(b) Discuss with diagram, the variation of the e.m.f. during the potentiometric titration of a strong acid with a strong base. How can the exact equivalence point in a potentiometric titration be detected? 2+1=3

6. Answer any *three* of the following questions : 4×3=12

(a) Deduce the Nernst equation for cell potential of a reversible cell represented by the general equation

$$aA + bB + \ldots\ldots = xX + yY + \ldots\ldots$$ 4

(b) Write the cell reaction and calculate the e.m.f. of the following cell :

$$Zn\left|Zn^{2+}(0{\cdot}001\,M)\right\|Ag^{+}(0{\cdot}1\,M)\left|Ag\right.$$

Given, $E^{\circ}_{Zn^{2+}/Zn} = -0{\cdot}76\ V$ and $E^{\circ}_{Ag^{+}/Ag} = 0{\cdot}80\ V$. 1+3=4

(c) What is liquid junction potential? How can it be eliminated? 1+3=4

(d) Write the half-cell reaction for the calomel electrode. Using the Nernst equation, show that the cell potential depends on chloride ion concentration at fixed temperature. 1+3=4

(e) Write the cell reactions of the following cells : 2+2=4

(i) $Zn(s)\left|Zn^{2+}(aq)\right\|I^{-}(aq), CuI\left|Cu(s)\right.$

(ii) $Al(s)\left|Al^{3+}(aq)\right\|Ag^{+}(aq)\left|Ag(s)\right.$

7. Answer any *two* of the following questions : 4×2=8

(a) Discuss a method for the determination of magnetic susceptibility of a material. 4

(b) Define magnetic permeability and magnetic susceptibility. Deduce the relationship between them. 2+2=4

(c) What do you mean by polarizability of a molecule? Explain different types of polarization that may take place when a molecule is placed in an electric field. 1+3=4

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