

Total number of printed pages-7

3 (Sem-4/CBCS) CHE HC 1

2023

CHEMISTRY

(Honours Core)

Paper : CHE-HC-4016

(Inorganic Chemistry-III)

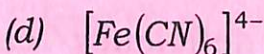
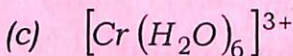
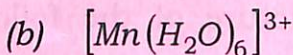
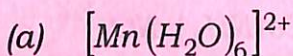
Full Marks : 60

Time : Three hours

The figures in the margin indicate full marks for the questions.

1. Answer the following : 1×7=7

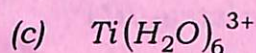
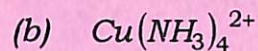
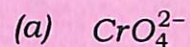
(i) The compound which exhibits Jahn-Teller distortion is



(Choose the correct answer)

Contd.

- (ii) Which metal helps in blood clotting ?
(iii) For which of the following ions, colour is not due to a d-d transition ?



(Choose the correct answer)

- (iv) What is the main iron storage protein in biological system ?
(v) What type of isomerism is exhibited by the complex $[\text{Co}(\text{NH}_3)_5\text{NO}_2]^{2+}$?
(vi) Draw the structure of the following complex :
Tri- μ -hydroxo bis
[triammine chromium(III)]
(vii) Which metal deficiency causes pernicious anemia ?

2. Answer the following : $2 \times 4 = 8$

(i) Explain why Ce^{+3} and Tb^{+3} are colourless but show strong absorption in UV region.

(ii) How does mercury cause toxicity in living system ?

(iii) Why do transition metals show variable oxidation states ?

(iv) Determine the crystal field splitting energy Δ_0 of a d^6 complex having $10 Dq = 25,000 \text{ cm}^{-1}$ and $P = 15,000 \text{ cm}^{-1}$. Consider low spin complex.

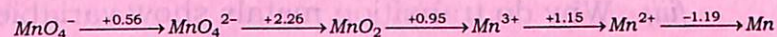
3. Answer **any three** questions from the following : $5 \times 3 = 15$

(i) Using crystal field theory explain the difference in magnetic property of $[\text{CoF}_6]^{3-}$ and $[\text{Co}(\text{CN})_6]^{3-}$.

(ii) Comment on the spectral and magnetic properties of actinide elements compared to lanthanides.

(iii) What is Na/K pump? Write the mechanism of action of Na/K pump.

(iv) Given below is the Latimer diagram of manganese in acidic medium : 2+3=5



(a) Which species are likely to disproportionate and why?

(b) Calculate standard reduction potential for the couple $\text{MnO}_4^{2-}/\text{Mn}^{3+}$

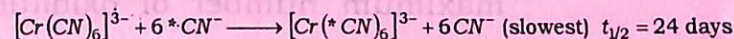
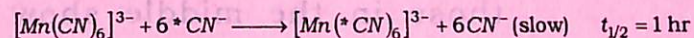
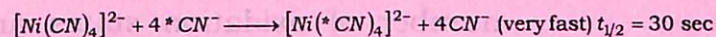
(v) Discuss the mechanism of binding of dioxygen with hemoglobin.

4. Answer **any three** questions from the following : $10 \times 3 = 30$

(i) Explain the bonding of $[\text{Co}(\text{NH}_3)_6]^{3+}$ with the help of molecular orbital theory. Draw the energy level diagram and also predict the magnetic property of the complex. $6+3+1=10$

(ii) (a) Explain the evidences in favour of the covalency of metal-ligand bonding in complexes. 5

(b) What inferences can be drawn from the following reactions? 5



(iii) Write about the use of chelating compounds in medicinal chemistry.

(iv) Answer the following questions regarding oxidation states exhibited by the first transition series elements :

(a) List the oxidation states shown by each element indicating the unstable states within bracket.

(b) All the elements except scandium exhibits $a + 2$ oxidation state whereas scandium exhibits $a + 3$ oxidation state only. Explain.

(c) Why do the elements at each end of the series exhibit minimum number of oxidation states and those in the middle show a maximum number of oxidation states ?

(d) Why are the higher oxidation states stabilised by oxide or fluoride ? $3+2+3+2=10$

(v) What is lanthanide contraction and what is its cause ? Discuss the separation of lanthanides using ion exchange method. Explain why La^{3+} is colourless but Lu^{4+} is orange red.

$1+2+5+2=10$

(vi) What special feature of Zn^{2+} makes it an excellent candidate for different enzymes ? Write the structure and function of carbonic anhydrase enzyme with suitable diagram. $2+2+6=10$

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3 (Sem-4/CBCS) CHE HC2

2023

CHEMISTRY

(Honours Core)

Paper : CHE-HC-4026

(Organic Chemistry-III)

Full Marks : 60

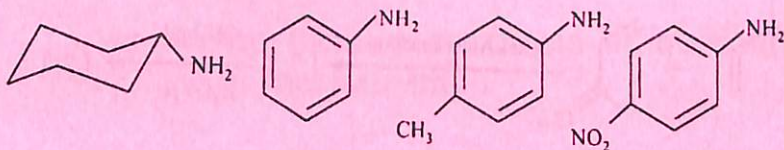
Time : Three hours

The figures in the margin indicate full marks for the questions.

1. Answer the following questions : 1×7=7

(i) Draw and name the isomer of nitromethane.

(ii) Arrange the following in the decreasing order of basicity :

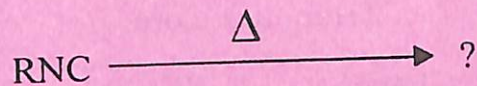


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(iii) Mention one medicinal importance of hygrine.

(iv) Draw the Z-form of citral.

(v) Write the product of the following :



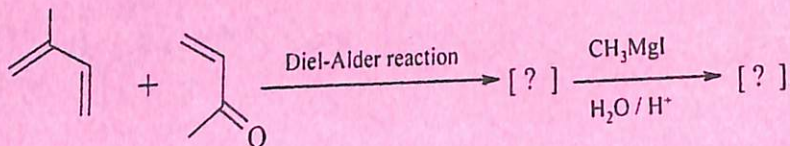
(vi) What happens when a mixture of acetylene and HCN is passed through red hot tube ?

(vii) What class of alkaloid does nicotine belong to ?

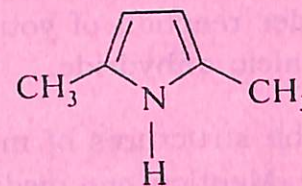
2. Answer the following questions : $2 \times 4 = 8$

(a) Define terpenoids using special isoprene rule.

(b) Identify the products :



(c) Write down the Paal-Knorr synthesis of the following :



(d) Define and classify PAH.

3. Answer **any three** questions from the following : $5 \times 3 = 15$

(a) How will you prepare $\text{CH}_3\text{CH}_2\text{NH}_2$ by Gabriel synthesis ? Elaborate Hinsberg test to distinguish 1° , 2° and 3° amine.

$2 + 3 = 5$

(b) Alkylhalide reacts with KCN to give alkylcyanide while it reacts with AgCN to give alkylisocyanide. Explain with mechanism.

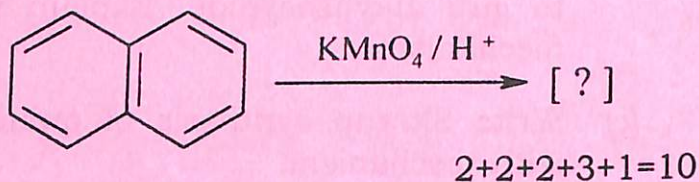
(c) Write Skraup synthesis of quinoline with mechanism.

(d) Give the structure and name of a 5-membered heterocyclic compound which shows Diel-Alder reaction. Write Diel-Alder reaction of your compound with maleic anhydride. $2+3=5$

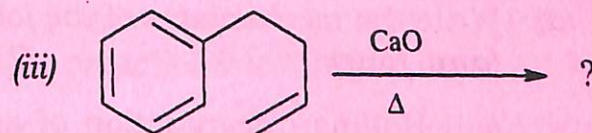
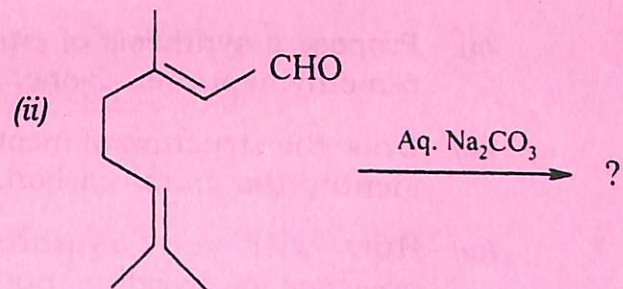
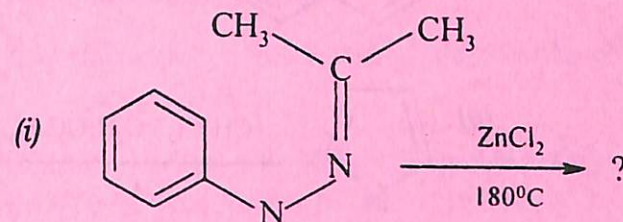
(e) Write the structures of morphine and cocaine. Mention *one* medicinal use in each case. $2+2+1=5$

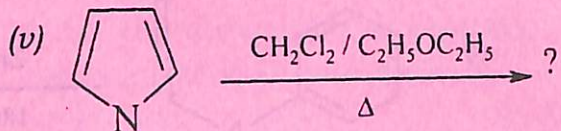
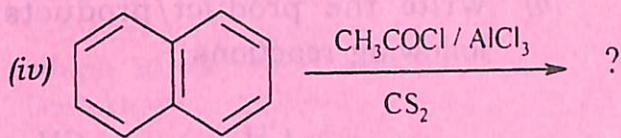
4. Answer **any three** questions from the following: $10 \times 3 = 30$

(a) Mention a method of synthesis of naphthalene. Draw the resonating structures of naphthalene and apply Fries rule to identify the most stable structures. Explain why naphthalene undergoes electrophilic substitution reaction preferably at α -position. Write down the product of the following reaction:



(b) Write the product/products of the following reactions: $2 \times 5 = 10$





- (c) (i) How will you confirm that citral contains an aldehydic group ? 2
 (ii) Propose a synthesis of citral from 6-methylhept-5-en-2-one. 4
 (iii) Draw the structure of nicotine and identify the chiral carbon. 1
 (iv) How will you establish the presence of pyridine nucleus in nicotine. 3

(d) Write the mechanisms of the following :
(any four) $2\frac{1}{2} \times 4 = 10$

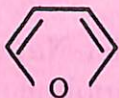
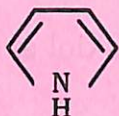
- (i) Hoffman degradation of amide
 (ii) Reaction of diazotised aniline with alkaline β -naphthol
 (iii) Chichibabin reaction

- (iv) Hydrolysis of alkyl cyanide
 (v) Conversion of indole into quinoline
 (vi) Mannich reaction
 (vii) Bischler-Napieralskiol synthesis of isoquinoline

(e) Starting from Ph-NO₂ (Nitrobenzene), how will you prepare the following ?
 $2 \times 5 = 10$

- (i) Ph-OH
 (ii) Ph-COOH
 (iii) Ph-H
 (iv) Ph-Br
 (v) Sym-tribromobenzene
- (f) (i) How can you detect the presence of amino group in aniline using the diazotisation process ? Write the reactions involved. 3
 (ii) What product is obtained when naphthalene is sulphonated at 80 °C ? What will happen if the temperature is raised to 165 °C ? 2

- (iii) Arrange the following in order of decreasing reactivity towards electrophiles and explain : 2



- (iv) How are terpenoids classified ?
Give *one* example each of the different class of terpenoids. 3

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3 (Sem-4/CBCS) CHE HC3

2023

CHEMISTRY

(Honours Core)

Paper : CHE-HC-4036

(Physical Chemistry-IV)

Full Marks : 60

Time : Three hours

The figures in the margin indicate full marks for the questions.

1. Answer the following questions : $1 \times 7 = 7$

(a) What weight of AlF_3 salt be dissolved in 100 ml of solution so as to make the solution containing 1 eq/L ?

(b) Define equivalent conductance.

(c) What is cell constant ?

(d) What is transport number ?

Contd.

(e) Ionic product of water at 25°C is approximately equal to

(i) $1 \times 10^{-7} (\text{mol L}^{-1})^2$

(ii) $2 \times 10^{-14} (\text{mol/L})^2$

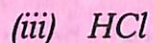
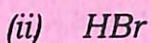
(iii) $1 \times 10^{-14} \text{ mol}^2 \text{ L}^{-2}$

(iv) $1 \times 10^{-7} \text{ mol}^2 \text{ dm}^{-6}$

(Choose the correct answer)

(f) Write *two* categories of electrochemical cell.

(g) Which of the following hydrogen halides has most polar bond ?



(Choose the correct answer)

2. Answer following questions : $2 \times 4 = 8$

(a) Find the relationship between molar conductance and specific conductance in SI unit.

(b) A perfectly cubical conductivity cell holds 0.94 cm^3 of a solution between its electrodes. Determine its cell constants.

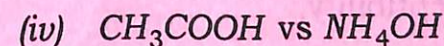
(c) What is relaxation effect ?

(d) Write precisely on potentiometric titration.

3. Answer **any three** questions from the following : $5 \times 3 = 15$

(a) Discuss the Arrhenius theory of electrolytic dissociation. Give evidence in support of the dissociation theory. $3 + 2 = 5$

(b) Write the principle of conductometric titrations. Discuss the characteristics of curves obtained in the titration of *any two* given below : $1 + (2 + 2) = 5$

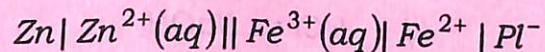


(c) (i) What is ionic mobility ? What is the effect of temperature on ionic mobility ? 2

(ii) A potential of 12.0 volts was applied to two electrodes placed 20 cm apart. A dilute solution of NH_4Cl was placed between the electrodes when NH_4^+ is found to cover a distance of 1.6 cm in one hour. What is the mobility of NH_4^+ ion ? 3

(d) (i) Derive a mathematical relation between the electrical energy of reversible galvanic cell and in free energy of the cell reaction. 3

(ii) What is half cell reaction ? Write the half cell reaction of the following cell : 2



(e) Briefly explain Gouy's method for the measurement of magnetic susceptibility.

4. Answer **any three** questions from the following : 10×3=30

(a) (i) How can you measure electrolytic conductance, specific conductance, equivalent conductance and molar conductance ? Write the unit of cell constant (K) in SI unit.

(ii) The resistance of 0.01 M solution of an electrolyte was found to be 210 ohm at 25 °C. Calculate the molar conductance of the solution at 25 °C.

(Given : cell constant = 0.88 cm^{-1})

(iii) Specific conductance of an electrolyte solution decreases with dilution. Explain.

5+3+2=10

(b) (i) State and explain the Kohlrausch's law of independent migration of ions.

(ii) For the strong electrolytes NaOH , NaCl and BaCl_2 the molar ionic conductance at infinite dilution are 248.1×10^{-4} , 126.5×10^{-4} and 280.0×10^{-4} $\text{S m}^2 \text{mol}^{-1}$ respectively. Calculate Λ_m^0 for $\text{Ba}(\text{OH})_2$.

(iii) Illustrate the application of Kohlrausch's law. $5+2+3=10$

(c) (i) Illustrate how the solubility product of a sparingly soluble salt can be determined with the help of conductance measurement.

(ii) What is Ostwald dilution law? Write its verification, importance and limitations. $5+5=10$

(d) (i) Find the mean ionic activity of a uni-univalent electrolyte.

(ii) How can you calculate the equilibrium constant of a cell reaction of the type



(iii) Calculate the equilibrium constant of the cell reaction



occurring in the $\text{Zn}-\text{Ag}$ cell at 25°C when $[\text{Zn}^{2+}] = 0.10\text{M}$ and $[\text{Ag}^+] = 10\text{M}$. The EMF of the cell is found to be 1.62 volts.

$$2+5+3=10$$

(e) (i) State and explain the Nernst equation.

(ii) Find out whether Zn and Ag would react with dilute H_2SO_4 acid or not.

Given :

$$E_{el}^0 = 0 \text{ for } 2\text{H}^+, \text{H}_2(\text{g}); \text{Pt}$$

$$E_{el}^0 = -0.76 \text{ V for } \text{Zn}^{2+}; \text{Zn}$$

$$E_{el}^0 = +0.80 \text{ V for } \text{Ag}^+; \text{Ag}$$

$$4+(2 \times 3)=10$$

(f) (i) How can you apply the dipole moment of a molecule to study its molecular structure ?

- (ii) Find the percentage of ionic character of HCl molecule using SI unit.

Given :

Internuclear distance (r) = 127 pm

Electronic charge = $1.6 \times 10^{-19} C$

Actual dipole moment =

3.44×10^{-30} coulomb metre.

- (iii) How can you distinguish diamagnetic substances and paramagnetic substances depending on the behaviour in a magnetic field ?

(iv) Explain polar and nonpolar covalent bonds.

(v) Explain the variation of molar polarization with temperature.

$$2+2+2+2=10$$