

Total number of printed pages-4

3 (Sem-6/CBCS) CHE HC 1

2023

**CHEMISTRY**

(Honours Core)

Paper : CHE-HC-6016

**(Inorganic Chemistry-IV)**

Full Marks : 60

Time : Three hours

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

1. Answer the following:

1×7=7

(a) What are fluxional organometallic compounds?

(b) The most suitable route to prepare the *trans*- isomer of  $[PtCl_2(NH_3)(PPh_3)]$  is :

(i)  $[PtCl_4]^{2-}$  with  $PPh_3$  followed by reaction with  $NH_3$

(ii)  $[PtCl_4]^{2-}$  with  $NH_3$  followed by reaction with  $PPh_3$

Contd.

- (iii)  $[P(NH_3)_4]^{2+}$  with  $HCl$  followed by reaction with  $PPh_3$
- (iv)  $[P(NH_3)_4]^{2+}$  with  $PPh_3$  followed by reaction with  $HCl$
- (c)  $[Ni(CN)_4]^{2-}$  is kinetically \_\_\_\_\_ but thermodynamically \_\_\_\_\_.
- (d) 'Low spin complexes are labile but prefer associative mechanism'.  
[True or False]
- (e) How many metal-metal (M-M) bonds are there in  $Ir_4(CO)_{12}$ ?
- (f) Why metal-carbonyl complexes always obey 18 electron rule?
- (g) Why interfering radicals do not interfere till group II in the analysis of basic radicals?

2. Explain why/how :

$$2 \times 4 = 8$$

- (a) Square planar complexes are generally labile.
- (b) Solubility product plays an important role in qualitative analysis.
- (c) Direct nitration of ferrocene is not possible.
- (d) Ferrocene undergoes electrophilic substitution  $10^6$  times faster than benzene.

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

(a) Discuss the dissociative nucleophile substitution reaction in the light of CFT.

(b) Discuss the methods of removal of fluoride and phosphate ions during the qualitative analysis of salt mixtures.  $2\frac{1}{2} + 2\frac{1}{2} = 5$

(c) Explain the mechanism of inner sphere redox reaction of coordination compounds.

(d) Write the plausible mechanism for the catalytic hydrogenation of alkenes using Wilkinson's catalyst,  $\text{ClRh}(\text{PPh}_3)_3$ . Identify the reaction type of each step.

(e) Discuss the bonding in M-CO fragments. How, IR spectra can be used to distinguish between terminal and bridging CO groups?  $3 + 2 = 5$

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

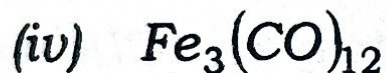
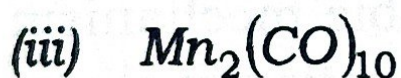
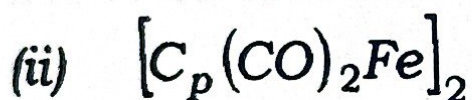
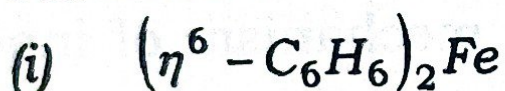
(a) Write notes on the following:  $5 \times 2 = 10$

(i) Multicenter bonding in methyl-lithium.

(ii) Stepwise and overall formation constants of a reaction.

(b) The compound  $W(\eta^5-C_5H_5)((H)(CO)_3)$  reacts with  $C_3H_6$  to give three products A, B and C. Identify and draw the structure of compounds A, B and C. Each compound obeys the 18-electron rule.

(c) For the following species, calculate the number of electrons in the valence shell, give their reasonable structures and comment on their relative stabilities.  $2\frac{1}{2} \times 4 = 10$



(d) Discuss the preparation and structure of ferrocene. Explain the mechanism of acetylation reaction.  $2\frac{1}{2} + 2\frac{1}{2} + 5 = 10$

(e) On the basis of VBT, how will you explain lability and inertness of transition metal complexes? Discuss how the following factors affect the lability of a complex:  $4 + (2 \times 3) = 10$

(i) Geometry of the complex

(ii) Oxidation state of the metal ion

(iii) Ionic radius

(f) What are metal alkyls? Discuss the structural features of methyl lithium and trialkyl aluminium.  $2 + 4 + 4 = 10$

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3 (Sem-6/CBCS) CHE HC 2

2023

**CHEMISTRY**

(Honours Core)

Paper : CHE-HC-6026

**(Organic Chemistry-V)**

Full Marks : 60

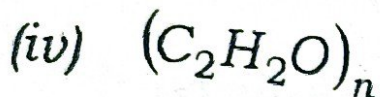
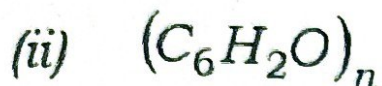
Time : Three hours

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

1. Answer the following questions :  $1 \times 7 = 7$
- (a) What do you mean by fingerprint region ?
- (b) Which of the following is a chromophore ?
- (i)  $-SO_3H$
  - (ii)  $-OH$
  - (iii)  $-COOH$
  - (iv)  $-NO_2$

Contd.

(c) The general formula of carbohydrate 2. is—



(d) Which of the following compounds do not absorb light above  $200m\mu$ ?

(i) Ethanol

(ii) Diethyl ether

(iii) 2-Butanone

(iv) Benzene

(e) At what wavelength range the coloured compounds absorb?

(f) Give one example of a thermosetting plastic.

(g) What are the expected products of hydrolysis of Lactose?

ate 2. Give answer of the following :  $2 \times 4 = 8$

(a) What are the different types of electronic transitions that occur in an organic molecule?

(b) Find out the products A and B in the following reaction :



(c) What is a mordant dye? Give one example.  $1+1=2$

(d) Give one example of each of the following polymers :  $1+1=2$

(i) Polyamides

(ii) Polyesters

3. Answer **any three** of the following :

$5 \times 3 = 15$

(a) (i) How can you distinguish between intra and inter-molecular hydrogen bonding with the help of IR spectroscopy? 3

(ii) How can you distinguish the following pair of compounds using IR spectroscopy Propanone and Propanal? 2

(b) Fructose contains a keto group, but still it gives silver mirror test on treatment with Tollen's reagent. Explain by showing the rearrangement reactions involved. What is the name of the rearrangement reaction?  $2+2+1=5$

(c) Match the following in 'A' with those given in 'B' :  $1 \times 5 = 5$

**'A'**

**'B'**

- |                      |                      |
|----------------------|----------------------|
| (i) D-Sorbitol       | (a) Anomeric carbon  |
| (ii) L-Ascorbic acid | (b) A disaccharide   |
| (iii) Glycoside      | (c) A sugar lactone  |
| (iv) C-L of glucose  | (d) Sugar alcohol    |
| (v) Maltose          | (e) A reducing sugar |

(d) Write the synthesis of Congo red dye. Show the structural changes involved due to which it changes color from red to blue in acid solution.  $2+3=5$

(e) (i) Write the full form of the following terms : 2

(i) PAN

(ii) PTFE

(iii) PCTFE

(iv) BSR

- (ii) What are polyolefins and polydienes? Give one example of each.  $1+2=3$

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

(a) (i) Draw the Fisher's Projection formula of *D*-glucose.

(ii) What do you mean by the term anomerization? Show the mechanism of anomerization of *D*-glucose.

(iii) Draw the chair conformers of both the  $\alpha$ -*D*(+) and  $\beta$ -*D*(+) glucopyranose.

(iv) How do you explain the greater stability of  $\beta$ -*D*(+)-glucopyranose from their conformers?

$$1+3+3+3=10$$

(b) (i) How will you bring the following conversions?  $3 \times 2 = 6$

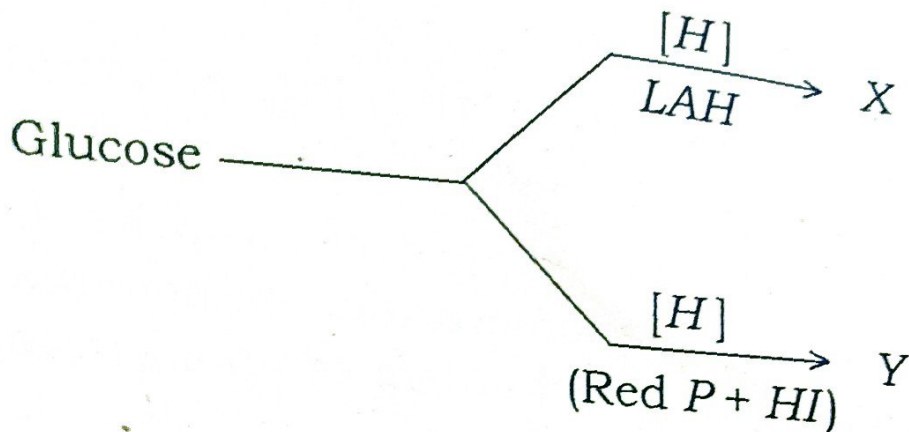
(A) An aldopentose to an aldohexose

(B) *D*-fructose to *D*-glucose

Contd.

(ii) How many stereoisomers are possible for both aldohexoses and 2-ketohexose? 2

(iii) Find X and Y in the following reactions : 2



(c) (i) Give the classification of dyes on the basis of their functional group or chemical constitution. 5

(ii) What are acid and basic dyes? Give one example of each dye. Name the fabric to which they can be applied. 5

d) (i) What are the two monomers of Dacron? 2

(ii) Give two differences between linear polymers and branched chain polymers. 2

(iii) Write polym

(iv) Fill (A)

(iii) Write a note on biodegradable polymers. 2

(iv) Fill in the blanks : 1×4=4

(A) Polymers which have (—COO—) linkages are known as \_\_\_\_\_.

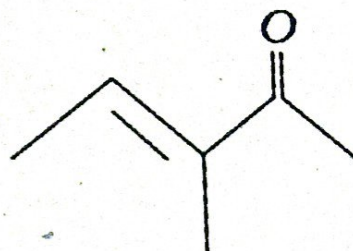
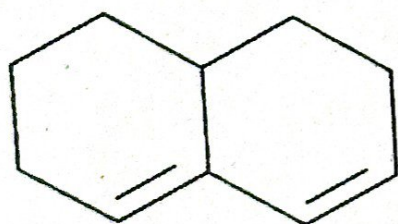
(B) Polyethene is obtained by the polymerisation of \_\_\_\_\_.

(C) Polystyrene is obtained by the polymerisation of styrene in presence of \_\_\_\_\_ as initiator.

(D) Proteins are the examples of \_\_\_\_\_ polymers.

(e) (i) How many electronic transitions are expected for benzene? 1

(ii) Use Woodward-Fieser rule to determine the  $\lambda_{max}$  of the following compounds : 2+2=4



Handwritten: Total number of protons

(iii) Predict the chemical shift positions for the protons in 1-bromoethane and hence draw a rough sketch of the  $^1\text{H}$  NMR spectrum. 3

(iv) In a  $^1\text{H}$  NMR spectrum, the protons of ethene appear at a more downfield region than expected. Why? 2

f) (i) Explain the basic principle of NMR spectroscopy. 5

(ii) Explain, why ESR spectrum is recorded in derivative mode? 2

(iii) Predict and draw the hyperfine structure of  $\text{CH}_3$  using ESR spectroscopy. 3



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**3 (Sem-6/CBCS) CHE HE 1/2/3**

**2023**

**CHEMISTRY**

(Honours Elective)

**Answer the Questions from any one Option.**

**OPTION - A**

**(Green Chemistry)**

Paper : CHE-HE-6016

**OPTION - B**

**(Industrial Chemicals and Environment)**

Paper : CHE-HE-6026

**OPTION - C**

**(Inorganic Materials of  
Industrial Importance)**

Paper : CHE-HE-6036

*Full Marks : 60*

*Time : Three hours*

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

*Contd.*

## OPTION - B

Paper : CHE-HE-6026

### (Industrial Chemicals and Environment)

1. Answer the following questions :

(a) Which of the following chemicals is used in wound treatment ? 1×7=7

- (i) Bleaching powder
- (ii) Caustic soda
- (iii) Hydrochloric acid
- (iv) Hydrogen peroxide

(b) Which of the following pair of gases is toxic to humans ?

- (i)  $N_2$  and  $CO_2$
- (ii)  $CO_2$  and  $CH_4$
- (iii)  $CO$  and  $COCl_2$
- (iv)  $Ar$  and  $N_2$

(c) Zone refining is a method to obtain :

- (i) Very high temperature
- (ii) Ultra-pure gases
- (iii) Ultra-pure metals
- (iv) Ultra-pure oxides

(d) The global environmental issue of ozone layer depletion is associated with

- (i) Sulphur dioxide
- (ii) Carbon dioxide
- (iii) Methane
- (iv) Chlorinated hydrocarbons

(e) Which of the following are the primary causes of water pollution ?

- (a) Plants (b) Animals
- (c) Human activities (d) None of these

Choose the most appropriate answer from the options given below :

- (i) (a) and (b) only
- (ii) (b) and (d) only
- (iii) (d) only
- (iv) (a), (b) and (c) only

(f) Which of the following is a type of non-renewable resource ?

- (i) Nuclear energy
- (ii) Solar energy
- (iii) Geothermal energy
- (iv) Hydrogen and fuel cells

(g) The most used method for measuring the dissolved oxygen content in a water sample is

- (i) Winkler method
- (ii) Roger method
- (iii) Tittler method
- (iv) Johnson method

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

- (a) Give *two* uses of industrial oxygen gas.
- (b) Give *one* method (with reaction) for the industrial production of concentrated hydrochloric acid.
- (c) Mention *two* major sources of air pollution.
- (d) What is nuclear fusion? Give an example.

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

- (a) Write briefly about the industrial production of fluorine gas. Mention *one* use of the gas.  $4 + 1 = 5$
- (b) Write a note on the biogeochemical cycle of nitrogen.
- (c) Write briefly about the various types of water pollutants.

(d) Write briefly about the process of reverse osmosis for the treatment of water.

(e) What are the sources of oxides of nitrogen in atmosphere? How these oxides deplete ozone layer? Write briefly.

1+4=5

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

(a) Describe the method with appropriate diagrams and reactions for the commercial production of common salt. Draw a neat diagram showing the portion of the crystal lattice of common salt. Why is common salt iodized for human consumption? Why is common salt used for de-icing of roads?

6+2+1+1=10

(b) Describe the major regions of the atmosphere by covering their temperature variations.

(c) Describe briefly the hydrological cycle. Why the "Ganga-Brahmaputra-Meghna" river system is called the largest resource of water in India? Mention *three* initiatives taken by the Government of India for the rejuvenation of Ganga.

5+2+3=10

(d) (i) What is nuclear fission? Describe this process by taking  ${}^{235}_{92}\text{U}$  as an example. Give suitable diagram showing the chain reaction.

1+4=5

(ii) What is nuclear pollution? Describe briefly about the management of nuclear disaster.

1+4=5

(e) What is green chemistry? Describe the principles of green chemistry. Why is a greener chemical reaction more desirable than a conventional chemical reaction?

1+8+1=10

(f) What is chemical oxygen demand (COD) and how does it differ from biological oxygen demand (BOD)? Describe the laboratory methods for the determination of COD and BOD. Give a source of common interference in the determination of COD.

2+7+1=10