

2M/CHE-150 (Th) Syllabus-2023

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(May-June)

FYUP : 2nd Semester Examination

CHEMISTRY

(Major)

Part-A (Theory)

(Introductory Chemistry—II)

(CHE-150)

Marks : 56

Time : 3 hours

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

UNIT—I

(Inorganic Chemistry—II)

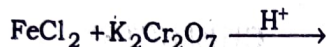
(Marks : 19)

1. (a) What is packing fraction? How does it account for nuclei stability? Calculate packing fraction, mass defect and energy released in the formation of Argon atom $^{40}_{18}\text{Ar}$. Isotopic mass of Ar = 39.96238 a.m.u. 1+1+2=4

(2)

(b) What are 'nuclear particles'? Give examples. 1

(c) Complete and balance the following redox reaction by ion-electron method : 1



(d) Define the term 'equivalent weight' for an oxidizing agent. Calculate the equivalent weight of KMnO_4 in acidic, slightly alkaline and strongly alkaline media. 2

(e) Identify the 'oxidizing' and 'reducing agent' in the following redox reaction : 1



OR

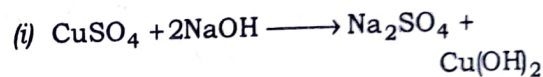
2. (a) Define the term 'nuclear fission' reaction with example. Why is ${}_{92}^{238}\text{U}$ not suitable for nuclear fission reaction? 1+1=2

(b) What do you understand by the term 'half-life' of a radioactive substance? The half-life of radium (molar mass 226 g mol^{-1}) is 1580 years. Show that 1 g of radium gives 3.70×10^{10} disintegration per second. 1+1=2

(3)

(c) What are the different kinds of radioactive disintegration possible for a radioactive element? 1

(d) What are 'redox reactions'? State whether the following is/are redox reaction or not? 1+1=2



(e) Calculate the oxidation number of Fe in FeCl_3 and FeSO_4 . 1

(f) Complete and balance the following redox reaction by ion-electron method : 1



3. (a) Explain how Ca^{2+} , Sr^{2+} and Ba^{2+} ions are selectively precipitate from a solution in the presence of Mg^{2+} ions. 2

(b) What is dichrometry? Give example. What types of indicator are used by this method? 1+1=2

(c) What do you understand by the term 'equivalence point' of a titration? 1

(4)

- (d) Define acid and base on the basis of Bronsted-Lowry concept. Write down the conjugate acid-base for CH_3COOH and NH_3 . 1+1=2
- (e) Explain the phenomenon of 'levelling effect' using a suitable solvent. 2
- (f) What is 'symbiosis'? Give example. 1

OR

4. (a) Define 'normality' for a standard solution. How would you prepare a standard solution of 0.5 N $\text{K}_2\text{Cr}_2\text{O}_7$ in a 250 ml solution? 1+1=2
- (b) How do you estimate the amount of oxalic acid by permanganometry method? 2
- (c) What do you understand by the term 'end point' of a titration? 1
- (d) Taking a suitable solvent, define acid and base according to Franklin solvent system concept. 2
- (e) Which among the following is a stronger Lewis acid? 2
- (i) Fe^{2+} or Fe^{3+}
- (ii) K^+ or Na^+
- (f) Predict whether NH_3 is a soft base or a hard base in the following reaction : 1
- $$\text{CH}_3\text{Hg}^+\text{NH}_3 + \text{H}^+ \longrightarrow \text{NH}_4^+ + \text{CH}_3\text{Hg}^+$$

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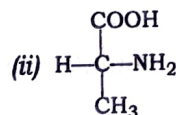
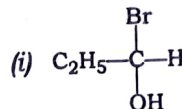
UNIT—II

(Organic Chemistry—II)

(Marks : 18)

5. (a) Predict whether 3-chlorohexane will be optically active or not? Give reasons for your answer. 2

- (b) Write the R- and S-configurations of the following molecules : 1+1=2



- (c) What is meant by racemic modification? Illustrate with the help of an example. 1
- (d) Give two points of differences between E_1 and E_2 mechanisms. 2
- (e) When 1-chlorobutane is heated with alc KOH, the formation of the product is not governed by Saytzeff's rule. Justify. 1

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(Turn Over)

(6)

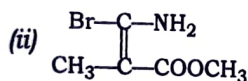
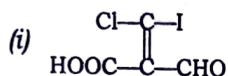
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6. (a) Draw the Newman projection formula of—

(i) eclipsed 2,3-dichlorobutane;

(ii) anti 2,3-dibromobutane. 1+1=2

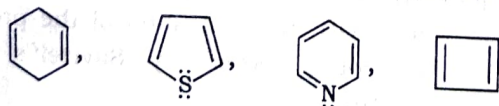
(b) Write *E* and *Z* configurations of each of the following : 1+1=2



(c) What are 'meso' compounds? Explain with a suitable example. 1

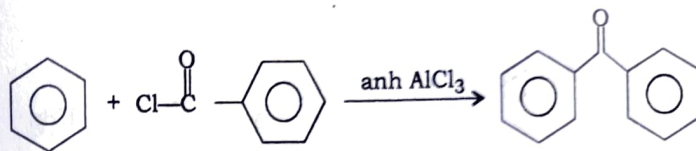
(d) Discuss the mechanism of a reaction which follows E_{CB}^1 pathway. Why is the reaction known as E_{CB}^1 ? 2+1=3

7. (a) Predict which of the following systems will be aromatic and which is not? $\frac{1}{2} \times 4 = 2$



(7)

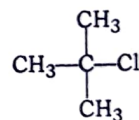
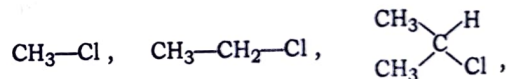
(b) Write the mechanism of the following reaction : 2



(c) What is a nitrating mixture? 1

(d) Why are nucleophilic substitution reactions of chlorobenzene difficult? 2

(e) Arrange the following molecules in order of increasing reactivity towards S_N2 reactions. Give reasons : 1+2=3



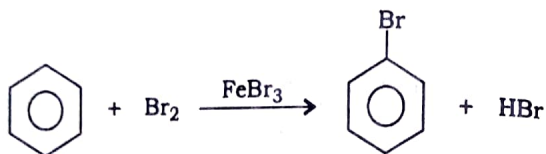
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8. (a) Why is phenol *ortho*- and *para*-directing towards electrophilic substitution reaction? 2

(8)

- (b) Write the mechanism of the following reaction :

2

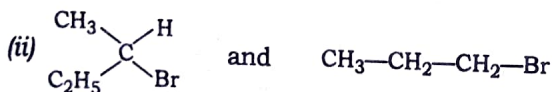
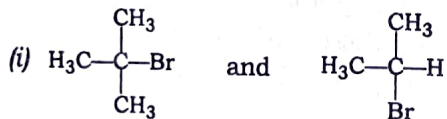


- (c) State Hückel's rule of aromaticity.

1

- (d) Which among the following pairs will react faster during $\text{S}_{\text{N}}1$ reaction? Give reasons.

$1\frac{1}{2} + 1\frac{1}{2} = 3$



- (e) Taking a suitable example, show the mechanism of $\text{S}_{\text{N}}1$ reaction.

2

(9)

UNIT—III

(Physical Chemistry—II)

(Marks : 19)

9. (a) Define the following terms :

$1 \times 3 = 3$

- (i) Spontaneous process
- (ii) State function
- (iii) Inversion temperature

- (b) Derive the necessary relation and calculate the difference between C_p and C_v for 3 moles of an ideal gas. $2 + 1 = 3$

- (c) How many calories of heat are required to heat 1 mole of argon from 40°C to 100°C at—

- (i) constant volume;
- (ii) constant pressure?

Molar heat capacity of Ar at constant volume = $3 \text{ cal } \text{K}^{-1}$

Molar heat capacity of Ar at constant pressure = $5 \text{ cal } \text{K}^{-1}$

$2 + 2 = 4$

OR

10. (a) State the first law of thermodynamics and derive its mathematical equation.

$1 + 2 = 3$

(10)

- (b) Calculate the pressure-volume work performed by the system during reversible isothermal expansion of 5 moles of an ideal gas from 5 litres to 10 litres at 20 °C. 3

- (c) Deduce the relationship

$$\mu = \frac{1}{C_P} \left(\frac{\partial H}{\partial P} \right)_T$$

where μ is the Joule-Thomson coefficient. 4

11. (a) Prove that

$$\left\{ \frac{\partial(\Delta H)}{\partial T} \right\}_P = \Delta C_P$$
 3

- (b) What are adsorption isotherms? Give two assumptions used in the derivation of Langmuir adsorption isotherm. 1+2=3

- (c) Define the following and give examples : 1½×2=3

(i) Enthalpy of combustion

(ii) chemisorption

OR

12. (a) State Hess' law of constant heat summation. 2

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(11)

- (b) Deduce the Langmuir adsorption isotherm. 4

- (c) Calculate the heat change accompanying the transformation of C (graphite) to C (diamond). Given that the heat of combustions of graphite and diamond are 393.5 kJ mol⁻¹ and 395.4 kJ mol⁻¹ respectively. 3
