

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

2026

(May-June)

FYUP : 2nd Semester Examination

CHEMISTRY

(Major)

Part—A

(Introductory Chemistry—II)

(CHE-150)

(Theory)

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) Define group displacement law.
Differentiate between nuclear reaction
and chemical reaction. 1+2=3

- (b) Calculate the binding energy per nucleon in $^{35}_{17}\text{Cl}$ nucleus. Given that mass of neutron = 1.00893 a.m.u., mass of proton = 1.007825 a.m.u., mass of $^{35}_{17}\text{Cl}$ = 34.980 a.m.u., 1 a.m.u. = 931 MeV.

2

- (c) Evaluate equivalent weight of KMnO_4 for its reduction reaction in acidic and basic solutions. (Given Molecular weight of KMnO_4 = 158.034 g/mol)

2

- (d) Complete and balance the following equation by ion-electron method :

1



- (e) Find oxidation number of (i) Cu in CuSO_4 and (ii) C in $\text{H}_2\text{C}_2\text{O}_4$.

1

OR

2. (a) Derive the first-order rate equation of a radioactive disintegration.

2

- (b) How does a nuclear stability attain when the n/p ratio is too high?

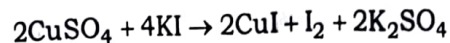
2

- (c) Write the relation between average life period and half-life period for the disintegration of a radioactive substance.

1

- (d) Identify the oxidant and reductant in the following reactions. Calculate the equivalent weight of oxidant :

2

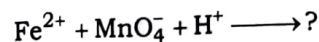


(Molecular weight of CuSO_4
= 159.61 g/mol)

Molecular weight of KI
= 166.0028 g/mol)

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

2



3. (a) What are the basic requirements for a solution to be termed as primary and secondary standard solution? Give examples for each.

2

- (b) " H_2S is used as group reagent in group II and group IIIB in the analysis of cations in systematic group separation." Why are Group IIIB cations not precipitated in Group II, all precipitates being in the form of their sulphides?

1

- (c) Distinguish between iodometry and iodimetry. Write one redox reaction showing iodometric method.

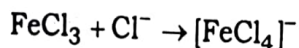
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- (d) Give the conjugate acids of H_2O and NH_3 .

1

(4)

- (e) Identify Lewis acid and Lewis base in the following reaction :



- (f) Explain the levelling and differentiating effect of acids and bases with appropriate examples.

OR

4. (a) The solubility of CaF_2 in water at 18°C is 2.05×10^{-4} mol/litre. Calculate its solubility product.

- (b) Explain Arrhenius concept of acids and bases. What are its limitations?

- (c) What is SHAB principle?

- (d) 20 ml of 0.001 M AgNO_3 solution is added to 100 ml of 0.002 M K_2CrO_4 solution. Will there be any precipitation? (K_{sp} of Ag_2CrO_4 is 2.4×10^{-12})

- (e) What is permanganometry? Give example. Which acid is used in permanganometry and why?

- (f) How are $\text{p}K_{\text{a}}$ and $\text{p}K_{\text{b}}$ values related to strength of acids and bases? Among H_3PO_4 , H_2PO_4^- and HPO_4^{2-} , which one is expected to have the lowest value of $\text{p}K_{\text{a}}$?

1+1=2

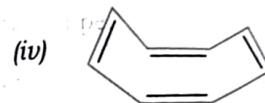
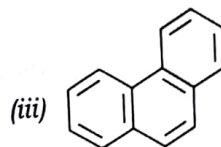
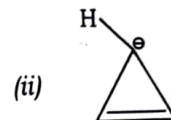
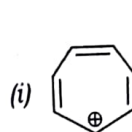
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UNIT—II

(Organic Chemistry—II)

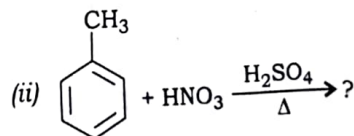
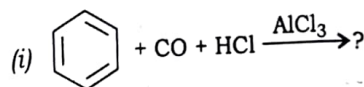
(Marks : 18)

5. (a) Draw all the possible conformers of *n*-butane. Sketch the energy diagram and from it deduce the stable conformers.
- (b) Which of the following species exhibit aromatic character?



- (c) Write the products of the following reactions with appropriate mechanisms :

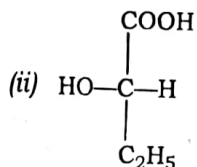
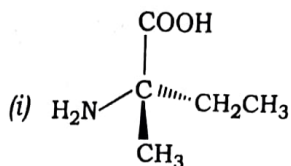
1½×2=3



(6)

- (d) Assign *R/S* configuration to the following molecules :

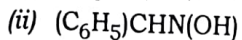
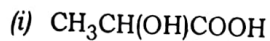
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OR

6. (a) What type of isomerism is shown by the following compounds? Draw the isomers of each :

2

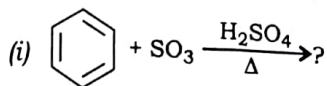


- (b) Why does benzene undergo electrophilic substitution more readily than nucleophilic substitution?

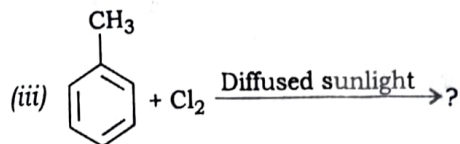
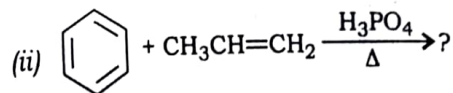
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- (c) Suggest the products with suitable mechanisms for the following reactions :

$$1\frac{1}{2} \times 3 = 4\frac{1}{2}$$

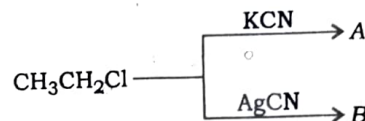


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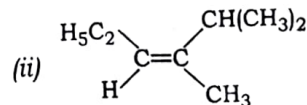
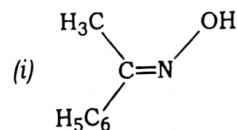
- (d) A compound $\text{C}_4\text{H}_{10}\text{O}$ shows optical activity. Identify the compound and write the possible stereoisomers. $1\frac{1}{2}$

7. (a) Complete the following reactions with proper justification for the formation of products : $1+1+1=3$



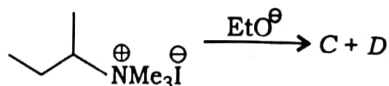
- (b) Assign *E/Z* configuration to the following molecules :

1



(8)

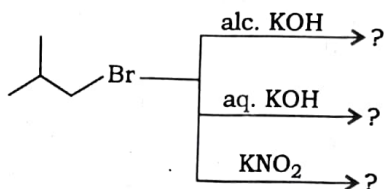
- (c) Predict the products in the following reaction. Which one is the major product and why? 3



- (d) Explain the stereochemistry of an $\text{S}_\text{N}2$ reaction by giving a suitable example. 2

OR

8. (a) Write the products of the following reactions : 3



- (b) Explain the stereospecific nature of $\text{E}2$ reaction by giving a suitable example. 2
- (c) *tert*-butyl bromide reacts with aqueous NaOH by $\text{S}_\text{N}1$ mechanism while *n*-butyl bromide reacts by $\text{S}_\text{N}2$ mechanism. Explain why. 3
- (d) What are diastereomers? Give example. 1

(9)

UNIT—III

(Physical Chemistry—II)

(Marks : 19)

9. (a) State the zeroth law of thermodynamics. What is the significance of this law? 1+1=2
- (b) Derive an expression for the work done in isothermal reversible expansion of an ideal gas. 3
- (c) Define the following terms : 1+1=2
- Molar heat capacity
 - Inversion temperature
- (d) Calculate the value of ΔE and ΔH on heating 0.064 kg of oxygen from 273 K to 373 K. C_V and C_P on an average are $20.93 \text{ J mol}^{-1} \text{ K}^{-1}$ and $29.31 \text{ J mol}^{-1} \text{ K}^{-1}$ respectively. 3

OR

10. (a) What is Joule-Thomson effect? Show that Joule-Thomson coefficient is zero in an ideal gas. 1+2=3
- (b) Derive the relationship $\Delta H = \Delta E + \Delta nRT$, where the terms have their usual meanings. 2

- (c) Distinguish between state function and path function. 2
- (d) Calculate the work done when 2 moles of an ideal gas expand isothermally from 0.002 m^3 to 0.005 m^3 against a constant pressure of 101325 Pa at 298 K . 3
11. (a) Derive Kirchoff's equation in terms of ΔE of a reaction. 2
- (b) Define the following terms with examples : $1\frac{1}{2} \times 2 = 3$
- (i) Standard heat of formation
- (ii) Enthalpy of dilution
- (c) Physical and chemical adsorption respond differently to a rise in temperature. What is this difference and why is it so? $1 + 1\frac{1}{2} = 2\frac{1}{2}$
- (d) Give the applications of Langmuir adsorption isotherm. $1\frac{1}{2}$

OR

12. (a) Explain any one application of Hess' law. 2
- (b) The heat of combustion of methane is $-890.65 \text{ kJ mol}^{-1}$ and heats of formation of CO_2 and H_2O are -393.5 and $-286.0 \text{ kJ mol}^{-1}$ respectively. Calculate the heat of formation of methane. 3

- (c) Write the mathematical expressions for Gibbs' adsorption isotherm and Langmuir adsorption isotherm. Explain the term involved. $1\frac{1}{2} + 1\frac{1}{2} = 3$
- (d) Why does adsorption take place only at the interface? 1
