

1/CHE-100 (Th) Syllabus-2023

2024

(December)

FYUP : 1st Semester Examination

MINOR

CHEMISTRY

Part-A (Theory)

(Introductory Chemistry—I)

CHE-100

Marks : 56

Time : 3 hours

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

UNIT—I

(Inorganic Chemistry—I)

(Marks : 18)

1. (a) Derive de Broglie's equation. Calculate the wavelength of an electron moving with a velocity of $2.5 \times 10^7 \text{ m-s}^{-1}$.
($h = 6.63 \times 10^{-34} \text{ J-s}$, mass of an electron = $9.11 \times 10^{-31} \text{ kg}$) $1\frac{1}{2} + 1\frac{1}{2} = 3$

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(Turn Over)

(2)

- (b) Calculate the effective nuclear charge felt by 1s and 2p electrons of a nitrogen atom. 2
- (c) Write down the electronic configurations of P and S. Compare the stability of their electronic configurations. 2
- (d) Arrange the following sets of atoms/ions according to their increasing atomic/ionic radii : 2
- (i) Li, K, Rb, Na
- (ii) Mn^{2+} , Mn^{7+} , Mn^{5+} , Mn^{3+}
- (e) State Hund's rule of maximum multiplicity. 1

OR

2. (a) Predict the shapes of 2s and 2p orbitals by applying probability distribution curve. 3
- (b) Calculate the uncertainty of velocity of an electron if the uncertainty of its position is 5×10^{-10} m. ($h = 6.63 \times 10^{-34}$ J-s, mass of an electron = 9.11×10^{-31} kg) 2

(c) Explain why the first ionization energy $(IE)_1$ of Be is $899.3 \text{ kJ mol}^{-1}$ and that of B is $800.1 \text{ kJ mol}^{-1}$. 2

(d) What is diagonal relationship? Why do Li and Mg show diagonal relationship? 2

(e) From the following sets of values of quantum numbers, identify which one is correct : 1

(i) $n = 1; l = 0, 1; m_e = +1, 0, -1$

(ii) $n = 2; l = 0, 1; m_e = +1, 0, -1$

(iii) $n = 3; l = 0, 1, 2; m_e = +1, 0, -1$

3. (a) On the basis of hybridization, discuss the geometry and hybridization states of the central atom, and draw the orbital structures of the following molecules : $1\frac{1}{2} + 1\frac{1}{2} = 3$

(i) BF_3

(ii) PCl_5

(b) Point out two limitations of valence bond theory. 2

(4)

- (c) What is Born-Haber cycle? Draw the Born-Haber cycle for the formation of NaCl and mention the terms involved. 2
- (d) Account for the fact that the dipole moment of NH_3 is 1.49 D and that of CH_4 is 0 D. 1

OR

4. (a) On the basis of molecular orbital (MO) theory, write down the molecular orbital configurations of N_2 and N_2^{2+} . Calculate the bond orders and mention the nature of the bonds in each case. 3
- (b) Predict the shapes of the following molecules using VSEPR theory : 2
- (i) SF_4
- (ii) SF_6
- (c) Write down the factors affecting polarizability of the anion. Arrange the following in increasing order of polarizability : 2
- LiF , LiBr , LiCl , LiI
- (d) Between LiF and CaF_2 , which will have higher value of lattice energy and why? 1

(5)

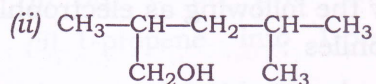
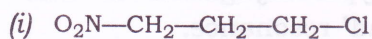
UNIT—II

(Organic Chemistry—I)

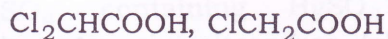
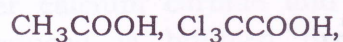
(Marks : 19)

5. (a) Give the IUPAC names of the following :

1×2=2



- (b) Arrange the following in order of decreasing acid strength. Give reason : 2



- (c) Carboxylic acids show much higher boiling points compared to alcohols of comparable molecular mass. Explain. 2
- (d) Which of the following is more acidic and why? 2



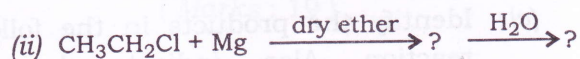
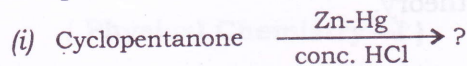
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6. (a) *o*-nitrophenol is less soluble than its *p*-isomer. Explain giving suitable reasons. 2
- (b) Taking suitable examples, explain why hyperconjugation is also called 'no-bond' resonance. 2
- (c) Classify the following as electrophiles or nucleophiles : $\frac{1}{2} \times 4 = 2$
- (i) SnCl_4
 - (ii) R_3N
 - (iii) $\text{NO}_2^{\oplus}$
 - (iv) $\text{NH}_2^{\ominus}$
- (d) Allyl carbocation is more stable and less reactive than simple carbocation. Explain. 2
7. (a) Why does cyclopropane undergo ring opening more easily than cyclobutane or cyclopentane? $1\frac{1}{2}$
- (b) HBr gives anti-Markownikoff's addition reaction in presence of peroxide but not HCl and HI . Explain. $1\frac{1}{2}$

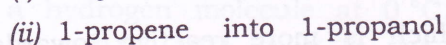
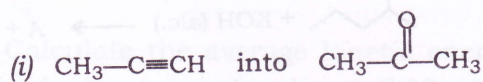
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(c) Complete the following reactions : $1 \times 2 = 2$



(d) How will you carry out the following conversions? Give suitable reactions :

$1 + 1 = 2$



(e) Write a suitable mechanism for the preparation of $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$ by Corey-House method.

2

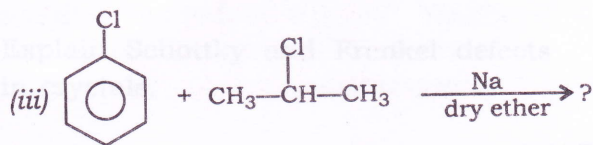
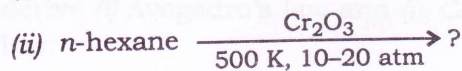
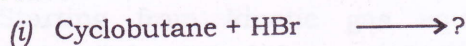
(f) What happens when water is dropped over calcium carbide and the gas so produced is bubbled through dilute H_2SO_4 containing HgSO_4 ? Write chemical equations.

$1 + 1 = 2$

OR

8. (a) Write the product of the following reactions :

$1 \times 3 = 3$

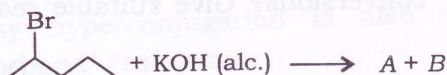


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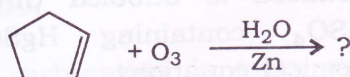
(b) Write the postulates of Bayer's strain theory. 2

(c) Identify the products in the following reaction. Also, indicate the major product : 1½



(d) Which is more reactive towards the addition of HBr, ethylene or propylene? Explain. 1

(e) Write the product(s) with mechanism for the following reaction : 2



(f) How is propanone obtained from propyne? Give reaction. 1½

(9)

UNIT—III

(Physical Chemistry—I)

(Marks : 19)

9. (a) Derive van der Waals' equation for n moles of a gas and write down the units of van der Waals' constants. 2+1=3
- (b) Calculate the average kinetic energy of a hydrogen molecule at 0 °C. Given, $R = 8.314 \times 10^{-7}$ erg K⁻¹mol⁻¹. 2
- (c) What are the reasons for the deviation of real gases from ideal behaviour? 2
- (d) Derive Bragg's equation. 3

OR

10. (a) Give the assumptions of the kinetic theory of gases. 3
- (b) Starting from kinetic gas equation, derive (i) Avogadro's law and (ii) Charles' law. 2+2=4
- (c) Explain Schottky and Frenkel defects in crystals. 3

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(Turn Over)

(10)

11. (a) Define the following : 2
- (i) Vapour pressure
 - (ii) Refractive index
- (b) How does the viscosity of a liquid change with temperature? 2
- (c) Derive an expression for the rate constant of a second-order reaction when the initial concentration is the same. 2
- (d) Show that for a first-order reaction, the time required for 99.9% completion is three times the time required for 90% completion. 3

OR

12. (a) What is surface tension of a liquid? 10
Give the unit of surface tension. 1+1=2
- (b) What are the important factors that affect the vapour pressure? 2
- (c) Show that the half-life of a first-order reaction is independent of the reactant concentration. 2

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- (d) If the rate constant of a reaction is $2.0 \text{ mol}^{-1} \text{ L s}^{-1}$ at 700 K and $32 \text{ mol}^{-1} \text{ L s}^{-1}$ at 800 K , what is the activation energy?

3

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CHEMISTRY

Part-A (Theory)

(Introductory Chemistry-I)

CHE-100

Marks : 25

Time : 3 hours

The figure in the margin indicates full marks for the questions.

Part-B

(Inorganic Chemistry-I)

(Marks: 15)

1. (a) Derive de Broglie's equation. Calculate the wavelength of an electron moving with velocity of $2.5 \times 10^7 \text{ m s}^{-1}$.
 (b) Calculate the mass of an electron if its kinetic energy is $1.6 \times 10^{-16} \text{ J}$.