2025

(Nov–Dec)

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 the de Broglie's equation for the wave-duality of electron. 2

(b) Mention the important postulate of Bohr's atomic theory. 2

(c) What do you understand by iso-electronic species? Name the species that will be isoelectronic with the following (atoms) ions : 2

(i) F^-

(ii) Ca^{2+}

(d) Draw the shape of the following orbitals : 1

(i) $2py$

(ii) $3dx^2 - y^2$

(e) Mention at least two limitations of Aufbau principle. 1

(f) Explain why the electronegativity of element increases on moving from left to right in a periodic table. 1

(g) The atomic radii decreases as we move from left to right in the second period. However the radii of Ne (10) is larger than F (9). Explain. 1

OR

2. (a) Write down the Schrödinger wave equation. Mention the significance of ψ and ψ^2. 2

(b) State Pauli's exclusion principle. What is its importance? 2

(c) The first ionization enthalpy value (in kJ mol^{-1}) of group 13 elements are—

B	Al	Ga	In	Te
801	577	579	558	589

How will you explain the deviation in the trend? 2

(d) What is the effective nuclear charge felt by 1s electron of He atom? 1

(e) Which of the following sets of quantum numbers are not allowed and why? 1

(i) $n=2 \quad l=1 \quad m=0 \quad s=+\frac{1}{2}$

(ii) $n=2 \quad l=2 \quad m=-1 \quad s=-\frac{1}{2}$

(iii) $n=2 \quad l=1 \quad m=+1 \quad s=-\frac{1}{2}$

(iv) $n=3 \quad l=2 \quad m=+1 \quad s=0$

(f) Write the general outer electronic configuration of *p* block and *d* block elements. 1

(g) What is meant by periodicity of element? 1

3. (a) State Fajans' rules. Explain why cation with smaller size have high polarizing power and anions with larger size have high polarizability. 2

(b) Draw the molecular orbital diagram of O_2^- ion. Calculate its bond order. 2

(c) Although both CO_2 and H_2O are triatomic molecule, their shape and dipole moment are not the same. Account for the observations. 2

(d) Determine the geometry of the following molecules using VSEPR theory : 2

(i) BF_3

(ii) H_2O

OR

4. (a) What is lattice energy? What are the factors on which it depends? 2

(b) Arrange the compounds CH_4, CCl_4 and $CHCl_3$ in order of increasing dipole moment. Justify your answer. 2

(c) Discuss the geometry of the following molecules on the basis of VSEPR theory. Mention the hybridization of the central metal atom. 2

(i) BeF_2

(ii) SF_6

(d) What is Born-Haber cycle? Draw the Born-Haber cycle for the formation of NaCl and mention the term involved. 2

(Continued)

UNIT—II

(Organic Chemistry—I)

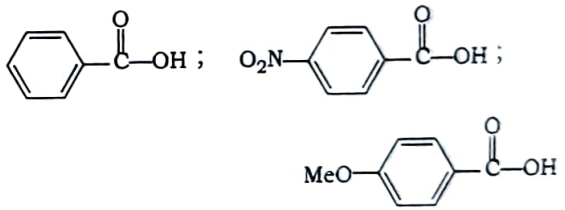
(*Marks* : 19)

5. (a) Draw the molecular orbital picture and give the hybridization, shape and bond angle of the following molecules : 1½×2=3

(i) $R-NH_2$

(ii) C_2H_4

(b) Arrange the following molecules in order of increasing acidity. Give reasons. 1+1½=2½



(c) Account for the stability order of the following free radicals : 1½

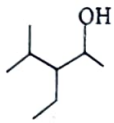
$(CH_3)_3\dot{C} > (CH_3)_2\dot{C}H > CH_3\dot{C}H_2$

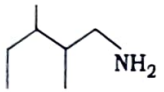
(d) Why does methanol have higher boiling point than ethane? 1

(Turn Over)

OR

6. *(a)* Give the IUPAC names of the following : 1×2=2

(i) 

(ii) 

(b) Classify the following into electrophiles and nucleophiles : 2

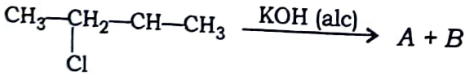
BF_3, $CN^{\ominus}$, $NO_2^{\oplus}$, CH_3NH_2

(c) 2,4,6-trimethylaniline is more basic than 2,4,6-trinitroaniline. Explain. 2

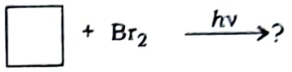
(d) What are the conditions for a molecule to undergo hyperconjugation? Draw the hyperconjugation structure of toluene. 2

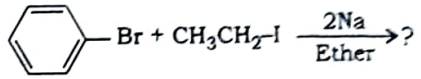
7. *(a)* Give the method of preparation of alkanes by Würtz reaction. Give one of its limitations. 1½+½=2

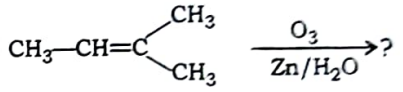
(b) Predict the major and minor products of the following reaction : 1+1=2

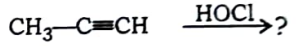


(c) Predict the correct products of the following reactions : 1×4=4

(i) 

(ii) 

(iii) 

(iv) 

(d) Give one method for the preparation of cyclohexane. 1

(e) What happens when—

(i) acetylene is treated with HBr;

(ii) acetylene is passed through red hot copper tube? 1+1=2

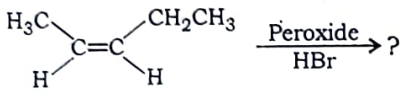
OR

8. *(a)* What are the limitations of the Baeyer's strain theory? Describe its modification. 1+1=2

(b) What is cracking? What happens when *n*-hexane is heated at 500 °C? 1+1=2

(c) Complete the following reactions : 1×3=3

(i) $(CH_3)_3CH \xrightarrow{KMnO_4} ?$

(ii) 

(iii) $CH_3—C\equiv C—CH_3 \xrightarrow[Zn/H_2O]{O_3} ?$

(d) How can you obtain 1-propanol and 2-propanol from propene? 2

(e) Write the products of the following reactions : 2

(i) $3CH_3—C\equiv CH \xrightarrow{500\ °C}$

(ii) $CH_3—C\equiv C—H \xrightarrow[\text{Ammonical } AgNO_3]{Ag^{\oplus}}$

UNIT—III

(Physical Chemistry—I)

(*Marks* : 19)

9. (a) Deduce Charles' law and Boyle's law from the kinetic gas equation. 1½+1½=3

(b) At what temperature will the root-mean-square velocity of SO_2 be the same as that of O_2 at 27 °C? 2

(c) Out of N_2 and NH_3, which one will have greater value for van der Waals' constants *a* and *b*? 2

(d) Derive the relation $n\lambda = 2d\sin\theta$, where the terms have their usual meanings. 3

OR

10. (a) Derive the van der Waals' equation of state for real gases. 3

(b) Define the following : 1+1=2

(i) Liquefaction of gases

(ii) Compressibility

(c) The van der Waals' constants for two gases are as follows :

Gas	a (atm L^2 mol^{-2})	b (L mol^{-1})
X	1·39	0·0391
Y	3·59	0·0427

Which of them is more easily liquefiable and which has greater molecular size? 1+1=2

(d) Discuss point defects in crystals. 3

11. (a) What is vapour pressure? What is the effect of temperature on vapour pressure? 1+1=2

(b) "Water wets glass but mercury does not." Explain. 2

(c) Derive the integrated rate expression for a first-order reaction. 3

(d) Show that for a first-order reaction, the concentration of the reactant A after n-half-life times is given by $[A]_n = [A]_0\left(\frac{1}{2}\right)^n$. $[A]_0$ is the initial concentration. 2

(Continued)

OR

12. (a) Define coefficient of viscosity. Mention its SI units. 1+1=2

(b) What is surface tension? How does it vary with temperature? 1+1=2

(c) What is meant by activation energy of a reaction? Explain how it is determined with the help of Arrhenius equation. 1+2=3

(d) A first-order reaction is 40% complete in 50 minutes. Calculate the value of the rate constant. In what time will the reaction will be 80% complete? 1+1=2

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