

1/CHE-100 (Th) Syllabus-2023

2 0 2 4

(December)

FYUP : 1st Semester Examination

MAJOR

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) Mention the important postulates of the Bohr's atomic theory. 2

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(Turn Over)

(2)

- (b) A cricket ball weighing 100 g is to be located within $0.1 \text{ \AA}$. What is the uncertainty in its velocity? Comment on your result. 2
- (c) What is the effective nuclear charge felt by 1s electron of helium atom? 1
- (d) Discuss the Hund's rule of maximum multiplicity. 1
- (e) What are the main defects of the long form of periodic table? 1
- (f) Define ionization enthalpy. Discuss the factors affecting the magnitude of ionization enthalpy. 2
- (g) Write down the atomic number and electronic configuration of chromium (Cr). 1

OR

2. (a) Write down the de Broglie's wave equation. What are the significance of this concept? 2
- (b) For principal quantum number $n = 2$, write down the number of electrons in this main shell. 1

(3)

- (c) Write down the Schrödinger wave equation. Mention the significance of ψ and ψ^2 . 1+1=2
- (d) Beryllium (Be) shows similar properties to that of aluminium (Al). How would you explain this occurrence? 2
- (e) How does the electronegativity of the elements varies down the group for group IA and group IIA? 1
- (f) Draw the shape of p -orbitals. 1
- (g) Write down the general outer shell electronic configuration of f -block elements. 1
3. (a) Using VSEPR theory, predict the shape of the following molecules : 1+1=2
- (i) BF_3
- (ii) O_3
- (b) Discuss the observed bond length, bond angle and hybridization state of the following : 1+1=2
- (i) AlCl_3
- (ii) I_3^-

(4)

(c) Draw the molecular orbital energy level diagram for N_2^{2-} molecule and comment on its magnetic properties. 2

(d) The dipole moment of BH_3 is zero while that of NH_3 is 1.47 D. Comment on the above observation. 2

OR

4. (a) What is lattice energy? Discuss the Born-Haber cycle for the determination of the lattice energy of NaCl. 2

(b) The bond angle in NH_3 is higher than in PCl_3 although both have sp^3 hybridization. Account for the above observation. 2

(c) What is polarization of ions? Mention the factors affecting the polarization power of cation. 2

(d) The bond dissociation of O_2^+ is greater than O_2 . Explain using the molecular orbital theory. 2

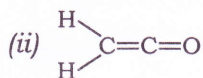
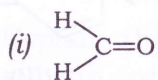
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UNIT—II

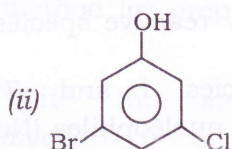
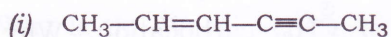
(Organic Chemistry—I)

(Marks : 19)

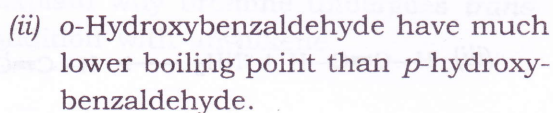
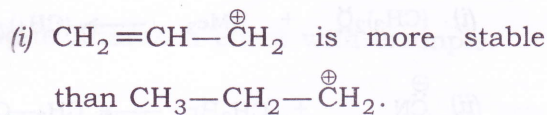
5. (a) Draw the molecular orbital picture of the following molecules, mentioning the type of hybridization, shape and bond angles : $1\frac{1}{2} \times 2 = 3$



- (b) Give the IUPAC names of the following compounds : $\frac{1}{2} \times 2 = 1$



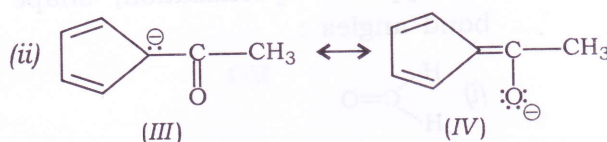
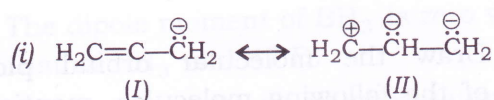
- (c) Account for the following : $1+1=2$



(6)

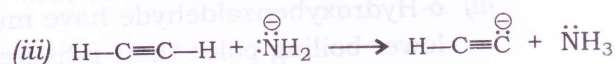
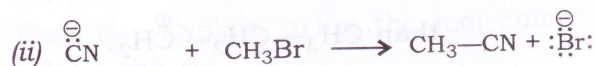
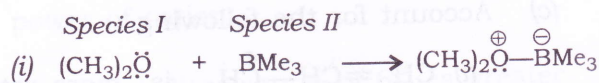
- (d) Indicate which of the following pairs of resonance structures is less stable. Give reason for your answer in each case :

2



OR

6. (a) What are carbocations? Predict the shape of $\overset{\oplus}{\text{CH}}_3$ carbocation. Why are carbocations highly reactive species? 2
- (b) Identify the species I and II as electrophiles (E) or nucleophiles (Nu) in the reactions : 1½



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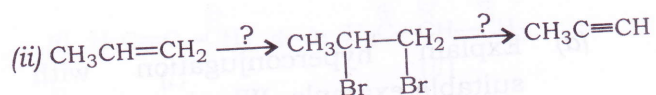
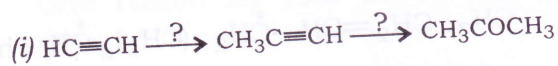
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(7)

- (c) Arrange the following radicals in order of increasing stability : 1
 $\dot{\text{C}}\text{H}_3$, $\text{CH}_2=\text{CH}-\dot{\text{C}}\text{H}_2$, $(\text{CH}_3)_2\dot{\text{C}}\text{H}$, $\text{Ph}_2\dot{\text{C}}\text{H}$
- (d) Explain hyperconjugation with a suitable example. Why is it also known as no-bond resonance? 2
- (e) Explain the role of inductive effect in substituted carboxylic acids. 1½
7. (a) Explain why cyclopentane does not undergo ring-opening reactions. 1½
- (b) Why is the Wurtz synthesis not a good method for preparing propane? 1½
- (c) Write the steps for the chain mechanism of the chlorination of methane. 2
- (d) State Kharasch effect with example. 2
- (e) Explain why bromine undergoes *trans*-addition with an alkene. 2

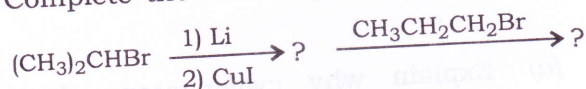
(8)

(f) How can each of the following transformations be carried out? 1+1=2



OR

8. (a) Complete the following reaction : 1

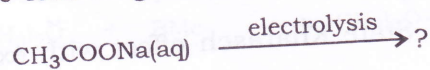


(b) Calculate the angle strain of the following molecules. State which one is more stable : 2

(i) Cyclopropane

(ii) Cyclopentane

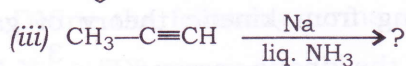
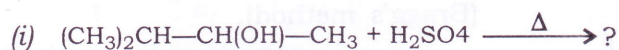
(c) Write the products and mechanism for the following reaction : 2



(d) Which will add bromine more readily? 1-butene or 2-butene. Give reason for your answer. 2

(Continued)

(e) Write the products of the following reactions : 1×3=3



(f) Explain the acidic nature of the C—H bond in acetylene. 1

UNIT—III

(Physical Chemistry—I)

(Marks : 19)

9. (a) Find the root mean square velocity of O_2 at 27°C . 2
- (b) Derive the van der Waals' equation of state for real gases. Mention the significance of the parameters in the equation. 3
- (c) Discuss the derivation of real gases from Boyle's and Charles' law in terms of compressibility factor, Z . 2

(10)

- (d) Describe investigation of internal structure of solid of X-ray diffraction (Bragg's method). 3

OR

10. (a) Starting from kinetic theory of gases, derive the kinetic energy $(KE) = \frac{3}{2} K N_A T$. 2
- (b) What is meant by average kinetic energy? 2
- (c) Describe Andrew's experiment on critical phenomenon of carbon dioxide. 3
- (d) What is meant by space lattice and unit cell of a crystal? Mention one significance of crystal defects. 1+1+1=3
11. (a) Discuss the effect of addition of ethanol on surface tension and viscosity of water. 1+1=2
- (b) What is viscosity? Discuss the effect of temperature on viscosity. 1+1=2
- (c) Define rate constant. What do you mean by rate of reaction? 1+1=2

- (d) What is a first-order reaction? Derive $k = \frac{2.303}{t} \log \frac{c_0}{e_t}$, where the terms have their usual meanings. 3

OR

12. (a) Define the following terms : 1×2=2
(i) Vapour pressure
(ii) Refractive index
(b) Give a brief qualitative description of the structure of liquids. 2
(c) Explain the increase in reaction rate with rise in temperature. 2
(d) Derive the expression for rate constant of second-order reaction involving same type of reactants. 3
