

2024/FYUG/ODD/SEM/
CHMDSM-101T/186

FYUG Odd Semester Exam., 2024

CHEMISTRY
(1st Semester)

Course No. : CHMDSM-101T

(Fundamentals of Chemistry—I)

Full Marks : 70

Pass Marks : 28

Time : 3 hours

The figures in the margin indicate full marks
for the questions

UNIT—I

1. Answer any *two* from the following : $2 \times 2 = 4$

(a) (i) Which quantum number determines
the size of an orbital? 1

(ii) How many orbitals are possible in
a sub-shell for which $l = 2$? 1

(b) (i) How many unpaired electrons are
present in nitrogen atom? 1

(ii) "Macroscopic bodies have no
de Broglie wavelength." Justify. 1

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(2)

- (c) (i) What is meant by degenerate orbital? 1
(ii) Calculate the product of uncertainty in position and velocity of an electron of mass 9.1×10^{-31} kg. 1
2. (a) Write the possible quantum numbers for an electron present in $3p$ orbital. 2
(b) Write the stable electronic configuration of chromium ($Z = 24$). 1
(c) Write the expression for the time independent Schrödinger wave equation in one dimension. 1
(d) Write the significance of ψ and ψ^2 with respect to Schrödinger wave equation in one dimension. 2
(e) What do you mean by exchange energy? 2
(f) What is meant by the term 'dual nature of electrons'? 2
- OR**
3. (a) Explain how Pauli's exclusion principle rules out the existence of more than two electrons in an orbital. 3
(b) The mass of a moving electron is 9.11×10^{-31} kg and its wavelength is 727 pm. Find out its velocity. 3
(c) Write the electronic configurations of N and O; and explain with reasons which of them has more stable configuration. 4

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(3)

UNIT—II

4. Answer any two from the following : $2 \times 2 = 4$
- (a) (i) Which of the following molecules possess(es) regular geometry?
 $\text{NH}_3, \text{H}_2\text{O}, \text{CH}_4, \text{H}_2\text{S}$ 1
(ii) Fill in the blank : 1
Bonding MO has energy _____ than anti-bonding MO.
- (b) (i) Identify the hybridization state of carbon in CHCl_3 and CO_2 . 1
(ii) Which of the following hybridizations lead(s) to (1) a square planar and (2) an octahedral shape?
 $sp^3, sp^2d, sp^3d, sp^3d^2$ 1
- (c) Which has shorter bond length— H_2 or H_2^+ ? Justify your answer. $1 + 1 = 2$
5. (a) How does the VSEPR theory explain the following? 4
(i) Pyramidal structure of ammonia
(ii) Distorted trigonal bipyramidal structure of SF_4
- (b) What is meant by bonding and anti-bonding molecular orbital? Explain taking example of H_2 . 3
- (c) What is resonance energy? Write its significance. 3

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OR

6. (a) Draw the resonance structure of the following : 1+1=2
- (i) CO_3^{2-} ion
- (ii) NO_3^- ion
- (b) What do you mean by LCAO? Write the three conditions of LCAO to form MO. 3
- (c) On the basis of VSEPR theory, explain the structure of PCl_5 . 2
- (d) Arrange N_2 , N_2^+ and N_2^- in order of increasing stability. 3

UNIT—III

7. Answer any two from the following : 2×2=4
- (a) Write two important postulates of kinetic molecular theory of gases. 2
- (b) (i) Write down the van der Waals' equation of state for n moles of a gas. 1
- (ii) Write the SI unit of van der Waals' constants a and b . 1
- (c) Justify Boyle's law on the basis of kinetic theory of gas. 2
8. (a) What are the causes of deviation of real gases from ideal behaviour? 3
- (b) How does mean free path of a gas molecule change with (i) temperature and (ii) pressure? 2

- (c) State the conditions under which a gas shows ideal behaviour. 3
- (d) Calculate the RMS velocity of molecules of nitrogen gas at 280 K in SI unit. 2

OR

9. (a) Derive the kinetic gas equation in terms of density. 3
- (b) Show from kinetic gas equation that kinetic energy of gas molecules is directly proportional to temperature in Kelvin scale. 2
- (c) Derive a relationship between the most probable velocity and average velocity of a gas. 2
- (d) Calculate the most probable velocity of CO_2 molecule at 27 °C. 2
- (e) Will the average kinetic energy of a mole of CO_2 and a mole of H_2 gas at 300 K be same? Justify. 1

UNIT—IV

10. Answer any two from the following : 2×2=4
- (a) What is surface tension of a liquid? Write its SI unit. 1+1=2
- (b) Define unit cell and give an example. 2
- (c) Define coefficient of viscosity. What is its SI unit? 1+1=2

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11. (a) Under what condition surface tension of a liquid becomes zero? 1
- (b) Why does water have a concave meniscus? $1\frac{1}{2}$
- (c) What are ionic crystals? Write a few important characteristics of ionic crystals. $1+2=3$
- (d) What are the different types of unit cells in crystal systems? Explain them. 3
- (e) A cubic solid is made up of two atoms A and B. Atoms A are present at the corners and B at the centre of the body. What is the formula of the unit cell? $1\frac{1}{2}$

OR

12. (a) Why are ionic solids conducting in the molten state and not in the solid state? 2
- (b) What is a lattice point? Write its significance. 2
- (c) What do you mean by point defects in a crystal? 1
- (d) How is density of a crystal affected by (i) Schottky defect and (ii) Frenkel defect? 2
- (e) What is crystal lattice? 1
- (f) Calculate the number of points present in the bcc unit cell. 2

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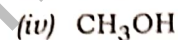
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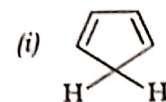
UNIT—V

13. Answer any two from the following : $2 \times 2 = 4$

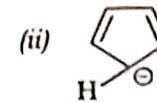
(a) Pick up electrophiles and nucleophiles from the following : $\frac{1}{2} \times 4 = 2$



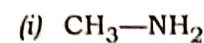
(b) Which of the following is aromatic? Give reason. $\frac{1}{2} + 1\frac{1}{2} = 2$



Or



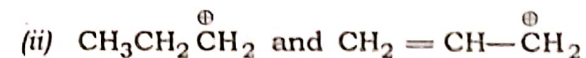
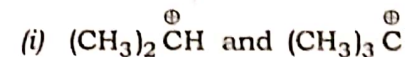
(c) Which of the following is a stronger base? Justify your choice. $\frac{1}{2} + 1\frac{1}{2} = 2$



Or



14. (a) What are carbocations? Compare the stability of the following pairs of carbocations and give reasons for your choice : $1 + 1 + 2 = 4$

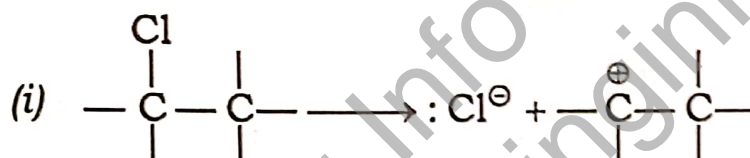


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- (b) What are ambident nucleophiles? Give one example to illustrate. 1+1=2
- (c) Explain the term 'resonance hybrid'. 2
- (d) Use curved arrows to show the electron flow in each of the following. Identify the type of bond cleavage in each type : 1+1=2



OR

15. (a) Why is hyperconjugation called 'no bond resonance'? 2
- (b) Explain Hückel's rule of aromaticity with an example. 4
- (c) Methanoic acid is more acidic than ethanoic acid. Justify this observation. 2
- (d) Write the types of electrons involved in the following processes : $\frac{1}{2} \times 4 = 2$
- (i) Inductive effect
 - (ii) Resonance
 - (iii) Hyperconjugation
 - (iv) Electromeric effect
