

2025

(November-December)

CHEMISTRY

Paper: CHM-M-101

Time: 2 Hours

Total Mark: 45

Pass Marks: 14

(The figures in the right margin indicate full marks of the questions)

Write the answers to the separate sections in separate answer scripts.

SECTION A: Inorganic Chemistry

1. Choose the correct answer:

a. Square planar complexes have the hybridization of 1

i) sp^3d^2

ii) sp^2

iii) sp^3

iv) dsp^2

b. Which of the following has the highest lattice energy? 1

i) MgO

ii) BaO

iii) CaO

iv) SrO

2. Answer any **two** from the following questions: 2×2=4

a. What do you mean by polarizing power of a cation? Among the following compounds which is most covalent? 2

NaI, NaF, NaBr, NaCl

b. Using VSEPR theory, predict the structure of the following compounds) 2

i) XeO_2F_2

ii) SF_6

- c. Define Slater's rule. Calculate the effective nuclear charge for periphery of Cu atom. 2
- d. An atom of an element contains 30 electrons and 35 neutrons. Find the atomic number, atomic mass and write the electronic configuration of the element. 2
- e. What is lattice energy? Which of the following has more lattice energy? 2
NaCl or CsCl Give reason.
3. Answer any **three** from the following questions: 3×3=9
- a. Define ionisation energy. What is its unit? The first ionisation energy of N is more than O. Give reason. 3
- b. Draw the resonating structures for the following ions: 3
CO₃²⁻, NO₃⁻
- c. On the basis of Born-Haber cycle, how is the lattice energy of an ionic crystal determined? 3
- d. Explain the hybridisation and geometry of XeF₆ molecules with the help of VBT. 3

SECTION B: Physical Chemistry

4. Choose the correct answer: 1×2=2
- a. 2 moles of an ideal gas are kept in a 100 dm³ container at 298 K. The potential energy of the molecules of the ideal gas is- 1
i) 200 J ii) 100 J
iii) 0 J iv) Equal to the internal energy
- b. The rate of evaporation of a liquid depends upon- 1
i) Surface area ii) Temperature
iii) Nature of the liquid iv) All of the above
5. Answer any **two** from the following questions: 2×2=4
- a. Write two postulates of kinetic theory of gases which are responsible for deviation of real gases from ideal gas behaviour. 2
- b. What do you mean by most probable speed of gas molecules?

- Calculate the most probable speed of CO₂ gas molecules at 27 °C. 1+1=2
- c. What is surface energy of liquid? Show that both surface energy and surface tension have same dimensions. 1+1=2
- d. Define vapour pressure of a liquid. Explain two factors upon which the vapour pressure of a liquid depends. 1+1=2
- e. Define coefficient of viscosity of a liquid. How does the viscosity of a liquid vary with temperature? What is the principle used for the determination of coefficient of viscosity of a liquid in the laboratory by ostwald viscometer. 1+ $\frac{1}{2}$ + $\frac{1}{2}$ =2
6. Answer any **three** from the following questions: 3×3=9
- a. Define molar heat capacities C_p and C_v of a gas. Show that for an ideal gas $\frac{C_p - C_v}{RT_c} = \frac{3}{8}$. 1+2=3
- b. What do you mean by critical temperature of a gas? Show that 1+2=3
- c. What do you mean by mean free path, collision diameter and collision frequency of a gas molecule? Explain the effect of temperature on mean free path. 3
- d. Define surface tension of a liquid. Describe the method for determining the surface tension of a liquid in the laboratory. 1+2=3

SECTION C: Organic Chemistry

7. Choose the correct answer: 1×2=2
- a. What is the hybridisation of the carbon atoms present the molecule H₂C=C=CH₂ 1
i) All sp² ii) sp³, sp², sp³
iii) sp³, sp, sp³ iv) sp², sp, sp²
- b. Which alkane has highest boiling point? 1
i) n-heptane ii) n-hexane
iii) 2,2-dimethylpropane iv) 3-methylpentane
8. Answer any **two** from the following questions: 2×2=4
- a. Starting from ethyl iodide, how can you synthesize n-butane? 2

- b. Why iodination of alkane is carried out in presence of oxidizing agents such as iodic acid or dil. HNO_3 ? 2
- c. Why chloroacetic acid is stronger acid than ethanoic acid? Explain in terms of inductive effect. 2
- d. Benzyl carbocation is more stable than ethyl carbocation. Explain 2
9. Answer any **three** from the following questions: $3 \times 3 = 9$
- a. Define electrophile and nucleophile. Find out the electrophiles and nucleophiles from the given compounds (*any four*) $1+2=3$
 H_2O , BF_3 , $\ddot{\text{C}}\text{H}_2$ (Carbene), Cl^+ , NH_3 , CH_3^-
- b. What do you mean by hyperconjugation effect? Draw the hyperconjugation structures of tertiary butyl carbocation, $(\text{CH}_3)_3\text{C}^+$. $1+2=3$
- c. Discuss the mechanism of chlorination of methane. 3
- d. What is carbene? How is it classified? $1+2=3$

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