

(This question paper contains 4 printed pages)

ASME-21-CHEM-(I)

Roll Number

CHEMISTRY (PAPER-I)

Time Allowed : 3 Hours]

[Maximum Marks : 100

QUESTION PAPER SPECIFIC INSTRUCTIONS

Please read each of the following instructions carefully before attempting questions.

1. This question paper contains **EIGHT** questions.
2. Attempt any **FIVE** questions.
3. Question No. 1 is compulsory.
4. *Four* questions are to be attempted out of the remaining seven questions.
5. Attempt all four parts of each question.
6. Each question carries **20** marks.
7. Write answer in legible handwriting. Each part of the question must be answered in sequence and in the same continuation.
8. Re-evaluation/Re-checking of answer-book is not allowed.

Some useful fundamental constants and conversion factors :

$$N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$$

$$\text{Rydberg constant} = 2.178 \times 10^{-18} \text{ J}$$

$$c = 2.998 \times 10^8 \text{ ms}^{-1}$$

$$k_B = 1.38 \times 10^{-23} \text{ JK}^{-1}$$

$$m_e = 9.109 \times 10^{-31} \text{ kg}$$

$$F = 96485 \text{ C mol}^{-1}$$

$$R = 8.314 \text{ JK}^{-1} \text{ mol}^{-1}$$

$$h = 6.626 \times 10^{-34} \text{ Js}$$

$$1 \text{ amu} = 1.66 \times 10^{-27} \text{ kg}$$

$$1 \text{ cal} = 4.184 \text{ J}$$

$$1 \text{ J} = 1 \text{ kg m}^2 \text{ s}^{-2}$$

$$1 \text{ \AA} = 10^{-8} \text{ cm} = 10^{-10} \text{ m} = 0.1 \text{ nm} = 100 \text{ pm}$$

$$1 \text{ atm} = 760 \text{ torr} = 1.01325 \times 10^5 \text{ Pa}$$

$$1 \text{ bar} = 1 \times 10^5 \text{ Pa} = 0.9869 \text{ atm}$$

$$1 \text{ eV} = 1.602 \times 10^{-19} \text{ J}$$

$$1 \text{ L atm} = 101.34 \text{ J}$$

$$1 \text{ L bar} = 100 \text{ J}$$

1.
 - (a) What are the radial and probability wave functions? Draw and compare the radial plots for 3p and 3d orbitals.
 - (b) Explain Rayleigh, Stokes and anti-Stokes lines. Is the intensity of Stokes lines different from that of the anti-Stokes lines ?
 - (c) Draw ESR spectrum and calculate the number of ESR lines for the following molecules :
 - (i) 1, 4-Benzosemiquione radical anion
 - (ii) Anthracene.
 - (d) Draw the normal modes of vibration of H₂O and CO₂ and explain which of them are Raman and IR-active.
2.
 - (a) What is Lanthanide Contraction ? Discuss its reason, importance and consequences.
 - (b) What is trans-effect ? Explain the trans-effects of various ligands for substitution in square planar complexes ?
 - (c) Which of the following pair is expected to have the larger bond angle and why ?
 - (i) NH₃ and NF₃
 - (ii) BF₃ and BF₄
 - (iii) SF₂ and BeF₂
 - (iv) PH₃ and NH₃
 - (d) Explain the structure and bonding in Zeise's salt.

- (3. (a) Show that in a first order reaction there is following relation between the time for 75% reaction, $T_{75\%}$ and half life period of the reaction, $T_{50\%}$, $T_{75\%} = 2 \times T_{50\%}$.
- (b) Discuss Freundlich adsorption isotherm and its advantages and limitations.
- (c) Discuss acidic and alkaline buffer solution with suitable examples.
- (d) Derive Bragg's equation and discuss its application and importance.
4. (a) Derive de-Broglie equation and explain Heisenberg's uncertainty principle with its significance.
- (b) Draw the molecular orbital diagram of O_2 , O_2^- , O_2^{2-} , and NO the basis of MO theory. Find out the bond order and the magnetic character of these species.
- (c) Discuss the structure and function of Haemoglobin in biological system.
- (d) Write down the Postulates of Quantum mechanics.
5. (a) Discuss and explain Joule-Thomson effect. What is the Joule-Thomson coefficient ? Show that the Joule-Thomson coefficient for an ideal gas is zero.
- (b) Derive the integrated form of Clausius Clapeyron equation.
- (c) 1 mole of NH_3 gas at $27^\circ C$ is expanded in reversible adiabatic condition such that it expands 8 times its original volume. Calculate work done and final temperature acquired, for given $\gamma = 4/3$.
- (d) Explain ion transport number and its determination by any *one* method.
6. (a) State a detailed overview of Jablonski diagram.
- (b) Write a brief note on Stability of Colloids.
- (c) Derive Michaelis-Menten equation for enzyme catalysed reaction.
- (d) Draw and describe the phase diagram of sulphur in detail.

7. (a) Write the number of unpaired electrons in the central metal atom of the following :
- $K_2[Fe(CN)_6]$,
 - $(NH_4)_3[Cr(SCN)_6]$,
 - $[Ni(CO)_4]$,
 - $[Co(NH_3)_3Cl_3]$.
- (b) Describe Crystal Field Stabilization Energy and calculate it for d^6 octahedral complex with high spin and low spin configurations.
- (c) Calculate the magnetic moment of Gd^{3+} ($Z = 64$) and Tb^{3+} ($Z = 65$) complexes.
- (d) Write all the *four* quantum numbers of fourth electron of the Boron atom.
8. (a) What is resonance phenomenon ? Discuss by taking the example of CO_3^{2-} .
- (b) Complete the following reactions :
- $AgNH_2 + 2NH_3 \longrightarrow$
 - $Zn^{2+} + 4NH_2 \longrightarrow$
 - $NH_4(SCN) + SOCl_2 \longrightarrow$
 - $SbCl_3 + 3KCl \xrightarrow{Liq. SO_2}$
- (c) Write a note on biological fixation of nitrogen.
- (d) Write down IUPAC names of the following compounds :
- $K[Co(CN)(CO)_2NO]$
 - $[Pt(NH_3)_4][PtCl_4]$
 - $K_3[Fe(CN)_5CO]$
 - $[Co(NO_2)_4(NH_3)_2]NH_4$.