U.G. 1st Semester Examination - 2023

CHEMISTRY

[MAJOR]

Course Code : CHEM-MAT-1

[NEP-2020]

Full Marks : 40 Time : $2\frac{1}{2}$ Hours

The figures in the right-hand margin indicate marks.
Candidates are required to give their answers in their own words as far as practicable.

Write the answers of Group-A and Group-B in separate books.

GROUP-A

(Inorganic-1A)

[Marks : 20]

1. Answer any **one** question : $1\times1=1$

   a) Write down the significance of Ψ^2.

   b) How many radial nodes are there for 6f orbital?

2. Answer any **two** questions : $2\times2=4$

   a) Why do Li and Mg show similar behaviour?

   b) Explain inert pair effect with example.

   c) Draw the angular nodes of $3d_{xy}$ and $3d_{xz}$ orbitals.

3. Answer any **one** question: $5\times1=5$

   a) Explain electronegativity briefly in terms of Pauling's and Mulliken's scale. 3+2

b) Discuss the trends of variable valency in group and period of s and p block elements.

$2\frac{1}{2}+2\frac{1}{2}$

4. Answer any **one** question: $10\times1=10$

a) i) Explain how Aufbau principle is violated in the process of electron filling of lanthanum.

ii) What is shielding effect? How are the shielding effect and the size of the atom related?

iii) Using Slater's Rules calculate Z* for 4s electron in Sc and 3d electron in Mn.

iv) The atomic radius of noble gases are more than the halogens – Explain.

$2+(2+2)+2+2=10$

b) i) Write Schrödinger equation of hydrogen atom and explain various terms in it.

ii) State Hund's rules and hence find out the ground state terms of carbon atom.

iii) Discuss the Alred-Rochow's absolute electronegativity.

iv) The atomic radii of Zr and Hf are almost identical. Explain. $2+(2+2)+2+2=10$

GROUP-B

(Physical-1A)

[Marks : 20]

1. Answer any **one** question : $1\times1=1$

a) Define the mean free path of a gas.

b) State the law of corresponding states.

2. Answer any **two** questions : $2\times2=4$

a) Distinguish between reversible and irreversible processes.

b) Write down the Maxwell's distribution of molecular velocities in three dimensions explaining the meaning of the symbols used.

c) State the zeroth law of thermodynamics and give one use of it.

3. Answer any **one** question: $5\times1=5$

a) i) Show that the work done in a reversible isothermal process is greater than in an irreversible process.

ii) Calculate the van der Waal's constants of ethylene [Given T_c =282.8K, P_c=50 atm]

$3+2$

b) i) A gas is contained in a system under constant pressure. 450 Joules of work is done on the system. 45 Joules of heat is lost by the surroundings. Calculate the internal energy change of the system.

ii) Derive the expression for Boyle temperature of a van der Waal's gas.

2+3

4. Answer any **one** question: 10×1=10

a) i) State the principle of Equipartition of energy. Using this principle calculate the heat capacities of CH_4 and CO_2 in the high temperature limit.

ii) Calculate the work done on a closed system consisting of 50gm of Argon assuming ideal behaviour, when the Argon gas expands isothermally and reversibly from a volume of 5 litres to a volume of 10 litres, at a temperature of 298K.

(2+2+2)+4

b) i) State and explain Hess' Law of Constant Heat Summation with an example.

ii) Show that the heat change of a system at constant pressure is equal to the enthalpy change of the system.

iii) Write the relation between C_{rms}, $C_{average}$ and $C_{most\ probable}$ and define each of these.

4+4+2