63 (FY) SEM–5/MAJ/CHMMAJ3034

2025

CHEMISTRY

(Major)

Paper : CHMMAJ3034

(Physical Chemistry–3)

Full Marks : 50

Pass Marks : 20

Time : Two hours

The figures in the margin indicate full marks for the questions.

1. Choose the correct answer : 1×5=5

   (a) The $t_{1/2}$ of a reaction is doubled as the initial concentration of the reactant is doubled. The order of the reaction is

   (i) 1

   (ii) 0

   (iii) 2

   (iv) $1\frac{1}{2}$

(b) When the 1s orbital of two hydrogen atom combine to form a hydrogen molecule how many molecular orbitals are formed ?

(i) One

(ii) Two

(iii) Three

(iv) Four

(c) According to Valence Bond Theory, the magnitude of exchange energy for H_2 is

(i) $458 kJ\,mol^{-1}$

(ii) $365 kJ\,mol^{-1}$

(iii) $303 kJ\,mol^{-1}$

(iv) $279 kJ\,mol^{-1}$

(d) The electrode $Pt, H_2(g) \mid HCl$ is reversible with respect to—

(i) Cl^{-1} ions

(ii) HCl

(iii) H^+ ions

(iv) Both H^+ and Cl^{-1} ions

(e) The rate constant of a gaseous reaction is $2 \times 10^{-2}\ dm^3\ mol^{-1}s^{-1}$. Its value in $cm^3\ mol^{-1}s^{-1}$ is

(i) 2

(ii) 0·2

(iii) 20

(iv) 200

2. Answer the following questions : ***(any five)*** 2×5=10

(a) What do you understand by rate constant of a reaction? Are its units always the same? 1+1=2

(b) What is an activated complex according to transition state theory ?

(c) What happens when Hamiltonian operator is operated on a wave function ?

(d) Why $\psi\psi^*$ is taken instead of ψ^2 ?

(e) What is eigenfunction and eigenvalue ?

1+1=2

(f) What is meant by single electrode potential ?

(g) Differentiate between galvanic cell and electrolytic cell.

3. Answer the following questions : ***(any five)***

5×5=25

(a) What is a reversible electrode ? What type of reversible electrodes are commonly used ? Explain the electrode reaction in each case. 1+2+2=5

(b) Discuss the principle underlying potentiometric titrations. How would you titrate a solution of $AgNO_3$ against $NaCl$? 2+3=5

(c) What is liquid junction potential? Derive an expression for liquid junction potential. How liquid junction potential can be minimsed? 1+2+2=5

(d) Set up and solve the Schrödinger equation for a particle in one-dimensional box for wavelength and energy.

(e) State and explain the postulates of quantum mechanics. With the help of quantum mechanics describe the shape of s, p and d orbitals. 2+3=5

(f) What is Molecular orbital theory? Give the electron charge density diagram for bonding and antibonding molecular orbitals. 2+3=5

(g) Derive the expression for the rate constant of a first order reaction. Describe the characteristics of such reactions. 3+2=5

(h) Discuss Ostwald dilution method to determine the order of a reaction.

4. Answer the following questions : ***(any one)*** 10

(a) (i) Explain the bonding in *HF* and *LiF* on the basis of Molecular Orbital Theory (MOT). 3+3=6

(ii) Discuss the application LCAO-MO method to study the H_2 molecule. 4

(b) (i) Derive an expression for E_{cell} of an electrolyte concentration cell without transference and with transference. 3+3=6

(ii) Derive Nernst equation for the measurement of EMF of an electrochemical cell. 4