

24

M.Sc. CHEMISTRY
First Semester
PHYSICAL CHEMISTRY-I
(MSC - 103)

Duration: 3Hrs.

Full Marks: 70

Part-A (Objective) =20
Part-B (Descriptive) =50

(PART-B: Descriptive)

Duration: 2 hrs. 40 mins.

Marks: 50

Answer any *five* of the following questions:

1. (a) What do you mean by wave particle duality? Deduce the expression of de Broglie wavelength when an electron is accelerated through a potential difference of V volt. Calculate the de Broglie wavelength of an electron if the kinetic energy of the electron is 150eV.
(b) State Heisenberg uncertainty principle and establish it with the help of gamma ray microscope.

(2+2+2)+(2+2)=10
2. (a) Explain what do you mean by Hermitian operation. If the eigen functions of a Hermitian operator have different eigen values, then show that they are orthogonal.
(b) Write down the Schrodinger wave equation for a particle of mass "m" confined in a one dimensional well of length "a" moving along x direction such that the potential 'V' is zero within the well and $V = \infty$ outside the well. Calculate the wave function and the energy of the particle.

(2+3)+(2+2+1)=10
3. (a) What are the postulates of the kinetic theory of gases? Write down the Vander Waal's equation of state explaining the different terms in the equation.

(b) Define Boyle temperature. Calculate the expression of Boyle temperature.

Find the expression of root mean square velocity of a molecule.

$$(3+2)+(1+2+2)=10$$

4. (a) Explain what do you mean by molecular partition function. Deduce the expression for translational Partition function of a molecular. Calculate the translational partition function of an oxygen molecule confined to a 200 cm^3 vessel at 298k .

(b) Show that for one mole of gas $C_p - C_v = R$, where the symbols represent usual meaning.

$$(2+3+3)+2=10$$

5. (a) What is Zeigler – Natta Catalyst? Explain with mechanism about its catalytic role in co-ordination polymerization of ethane to produce polyethene.

(b) A Protein sample consist of equimolar mixture of hemoglobin ($M = 15.5 \text{ kg mol}^{-1}$), ribonuclease ($M = 13.7 \text{ Kg mol}^{-1}$) and myo globin ($M = 17.2 \text{ kg mol}^{-1}$).

Calculate the number average and mass-average masses. Which is greater?

(c) Write the name of two experimental techniques used for the determination of average molecular weight of polymer.

$$(1+4)+(2+1)+2=10$$

6. What are partial molar properties? Define chemical potential. Derive Gibb's D...cm equitation.

$$(2+3+5)=10$$

7. State Gibbs Phase rule. Define degrees of freedom, phase and components with one example. Derive Gibbs phase rule.

$$(2+3+5)=10$$

8. (a) What are the characteristics of smectic liquid crystal? Explain 'Swar Theory' of liquid crystals.

(b) Discuss the kinetics of free radical polymerization.

$$(2+3)+5=10$$

M.Sc. CHEMISTRY
First Semester
PHYSICAL CHEMISTRY-I
(MSC - 103)

Duration: 20 minutes

Marks – 20

PART-A (Objective)

Time: 20 mins

Total Marks: 20

I. Choose the correct option:

1×20=20

- (i) An orbital is:
a) a one electron wave function.
b) an elliptical path of the electron in an atom.
c) a circular path of the electron in an atom.
d) an observable property of the system.
- (ii) The lowest energy is zero for:
a) the hydrogen atom
b) the harmonic oscillator
c) a rigid rotor
d) particle in a one dimensional
- (iii) The degeneracy of a particle in a cubical box having four times the lowest energy is:
a) 1 b) 3 c) 6 d) zero
- (iv) The mean free path (λ) of gas is proportional:
a) directly to temperature
b) directly to pressure
c) inversely to temperature
d) inversely to square of pressure
- (v) The gas which has the lowest rate of diffusion is:
a) H_2 b) N_2 c) O_2 d) F_2
- (vi) The function that can be accepted as wave function is
a) $\Psi = x$ b) $\Psi = e^x$ c) $\Psi = \sin x$ d) $\Psi = \tan x$
- (vii) The wave function in quantum mechanics represents:
a) a state of a system
b) energy of the system
c) probability of a system
d) angular momentum of a system
- (viii) Inter molecular force in liquids are collectively called:
a) hydrogen bonding
b) van der waals forces
c) covalent bond
d) ionic bond
- (ix) The value of the critical volume (V_c) in terms of Vander Waals constants is:
a) $2b/R$ b) $3b$ c) $a/27b^2$ d) $8a/27Rb$

- (x) Which is not an example of linear operator?
 a) x^2 b) d/dx c) d^2/dx^2 d) $\sqrt{\quad}$
- (xi) The triple point of water is:
 a) 273.16K and 760 atm b) 273.16K and 760 torr
 c) 273.16k and 4.58 torr d) 273.16K and 4.58 atm
- (xii) The liquid crystals have:
 a) properties of super cooled liquid.
 b) properties of amorphous solids.
 c) the fluidity of liquid and optical properties of a solid.
 d) all of these.
- (xiii) For a two component system in a single phase, the degree of freedom is:
 a) zero b) one c) two d) three
- (xiv) The correct increasing order of average molecular weight in polymer sample follows:
 a) M_z, M_w, M_n, M_v b) M_w, M_z, M_n, M_v
 c) M_z, M_w, M_v, M_n d) M_n, M_v, M_w, M_z
- (xv) Light scattering technique is used for the determination of:
 a) Mass average molecular weight.
 b) Number average molecular weight.
 c) Z – average molecular.
 d) All of these.
- (xvi) Which polymer is synthesized by free radical polymerization?
 a) Bakelite b) Natural rubber
 c) Polystyrene d) Polyester
- (xvii) The co-catalyst used in Ziegler-Natta Catalyst is:
 a) $TiCl_4$ b) Et_2AlCl
 c) $Mg Cl_2$ d) ethyne
- (xviii) A spontaneous reaction is not possible if:
 a) ΔH and $T\Delta S$ are both negative b) ΔH and $T\Delta S$ are both positive
 c) ΔH is +ve and $T\Delta S$ is -ve d) ΔH is -ve and $T\Delta S$ is +ve
- (xix) The equation $\frac{dP}{dT} = \frac{\Delta H}{T(V_2 - V_1)}$ is called:
 a) Gibb's Helmholtz equation b) Kirchoff's equation
 c) Clapeyron equation d) Clausius clapeyron equation
- (xx) Which out of the following is not a state function?
 a) Free energy b) Work function
 c) Entropy d) Work done
