M.Sc. CHEMISTRY
First Semester (Repeat)
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 *four* from *Question no.* 2 to 8
***Question no.* 1 is compulsory.**

1. Starting from the basic postulates of kinetic theory of gases, derive kinetic gas equation. Calculate the value of ideal gas equation. (10)
2. Write down the Schrodinger wave equation for a particle of mass "μ" confined in a one dimensional well of length "L" moving along *x* direction such that the potential V is zero within the well and V = ∞ outside the well. Calculate the wave function and the energy of the particle. (10)
3. Define average velocity, most probable velocity and root mean square velocity. Derive mathematical expression for three types of molecular velocity. (4+6=10)
4. (a) What are number average and weight average molecular weight of a polymer.
   (b) Equal numbers of molecules with M_1 = 10,000 and M_2 = 100,000 are mixed, calculate number average and weight average molecular weight of the polymer.
   (c) Equal masses of polymers molecules with M_1 = 10,000 and M_2 = 100,000 are mixed, calculate number average and weight average molecular weight of the polymer. (4+3+3=10)
5. Determine the kinetics of free radical polymerization. (10)

6. What is surface tension of a liquid? How surface tension of liquid can be determined by capillary rise method. (10)

7. (a) For one mole of an ideal gas show that $C_p - C_v = R$, where the symbols represent usual meaning. (4)

   (b) What are excess thermodynamic functions? Explain an example. (3)

   (c) Explain the physical significance of entropy. (3)

8. (a) Represent in a single plot the variation of free energy, entropy and enthalpy as a function of mole fraction of one of the component (say x_1) for the mixing of two ideal gases. (2)

   (b) Using the plot above, find the value of x_1 that the largest impact on the thermodynamic quantities on the final solution. (3)

   (c) Describe the viscosity method for the determination of molar masses of macromolecules. (5)

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Duration: 20 minutes **Marks – 20**

(PART A - Objective Type)

I. Choose the correct answer: **1×20=20**

1. An orbital is:
   (a) A circular tract of an electron in an atom.
   (b) A one electron wave function.
   (c) An observable property of the system.
   (d) A hermitian operator.

2. Which is not an example of linear operator?
   (a) x^2
   (b) d/dx
   (c) d^2/dx^2
   (d) √

3. The lowest energy is equal to zero for:
   (a) The hydrogen atom.
   (b) A rigid rotor.
   (c) A harmonic oscillator.
   (d) A particle in a three dimensional box.

4. A $2p_z$ orbital of hydrogen atom is an eigen function of:
   (a) H only
   (b) H and L2 only
   (c) H, L2 and Lz only
   (d) H, L2, Lz and Lx

5. Indicate which of the following functions is acceptable as wave function?
   (a) $\Psi = x$
   (b) $\Psi = e^x$
   (c) $\Psi = \sin x$
   (d) $\Psi = \tan x$

6. The product PV of a gas has the same units as:
   (a) Force
   (b) Force/area
   (c) Pressure
   (d) Energy

7. The average speed of H2, N2 and Cl2 gas molecules are in the order:
   (a) $H_2 > N_2 > Cl_2$
   (b) $Cl_2 > N_2 > H_2$
   (c) $H_2 > Cl_2 > N_2$
   (d) $N_2 > Cl_2 > H_2$

8. In a van der Waals gas the term which accounts for intermolecular forces is:
   (a) RT
   (b) V – b
   (c) $P + a/V^2$
   (d) $(RT)^{-1}$

9. The compressibility factor is defined as Z = PV/RT, hence find out the incorrect statement.
   (a) Z depends on pressure at a T.
   (b) Z is a measure of deviation for real gases.
   (c) Z is unity for an ideal gas.
   (d) Z has the unit of gas constant.

10. The average velocity of a gas is defined as:
    (a) $Ca = \sqrt{(8kT/\pi m)}$
    (b) $Ca = \sqrt{(3kT/m)}$
    (c) $Ca = \sqrt{(2kT/m)}$
    (d) None above

11. The number-average molar mass and weight-average molar mass of a polymer are obtained respectively by:
    (a) osmometry and viscosity measurements.
    (b) osmometry and light scattering measurements.
    (c) ultracentrifuge and viscosity measurements.
    (d) viscosity and light scattering measurements.

12. The correct expression of mass fraction distribution wk with probability p in step-growth polymerization is:
    (a) $w_k = kp^{(k-1)}(1-p)^2$
    (b) $w_k = kp^{(1-k)}(1-p)^2$
    (c) $w_k = kp^{(k-1)}(p-1)^2$
    (d) None is correct

13. The molar masses of monodisperse and polydisperse polymers obey respectively the conditions: (M_n = Number average molecular weight and M_w = Weight average molecular weight).
    (a) $M_n > M_w$ and $M_n < M_w$
    (b) $M_n = M_w$ and $M_n < M_w$
    (c) $M_n < M_w$ and $M_n < M_w$
    (d) $M_n = M_w$ and $M_n = M_w$

14. Increasing order of average molecular weight distribution among M_n, M_w, M_v and M_z is:
(a) $M_n < M_w < M_v < M_z$
(b) $M_n < M_v < M_w < M_z$
(c) $M_v < M_z < M_n < M_w$
(d) $M_n < M_w < M_z < M_v$

15. A process, at a particular T and P, will be spontaneous if:
(a) G is positive
(b) G is negative
(c) G is zero
(d) None above

16. When two ideal gases are mixed, the G_{mixing} would be minimum at mole fraction:
(a) $x_1 = 0.25$
(b) $x_1 = 0.50$
(c) $x_1 = 0.75$
(d) $x_1 = 1.0$

17. Pick the INCORRECT expression from the following equations for ideal gas and ideal solutions.
(a) $G_{mixing} = nRTx_i lnx_i$
(b) $S_{mixing} = nRx_i lnx_i$
(c) $V_{mixing} = 0$
(d) $H_{mixing} = 0$

18. In the system "liquid water in equilibrium with ice" find out the correct number of phases, components and degrees of freedom (P, C, F)
(a) (0, 1, 2)
(b) (1, 1, 2)
(c) (2, 1, 1)
(d) (1, 2, 1)

19. Identify the intensive variable.
(a) Volume
(b) Entropy
(c) Molar volume
(d) Heat capacity

20. Pick the WRONG statement from the following:
(a) Chemical potential is a state function.
(b) The reactions in which heat escapes from the system to the surroundings are termed exothermic.
(c) A system at equilibrium must have definite pressure, temperature and composition.
(d) If a change takes place with temperature remains constant throughout is called an adiabatic process.

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SESSION 2016-17

COURSE_____PAPER CODE:_____

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3. Write legibly on both sides of the paper
4. You may use some space for any rough notes or calculation on the answer booklet if you need. These rough notes, calculations must be scored out before submitting the answer booklet.
5. Do not bring any book or loose paper in the examination hall.
6. Do not tear any page from the answer booklet.
7. Do not write anything on the question paper or blotting paper or any pieces of paper while you are in the examination hall.
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For Objective Type Questions

Page No.	Marks
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Session: 2016-17

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