ST.JOSEPH'S COLLEGE (AUTONOMOUS), BANGALORE-27

M. Sc. CHEMISTRY – I SEMESTER

MIDSEMESTER TEST – AUGUST 2016

CH 7315 – PHYSICAL CHEMISTRY-I

Time: 90min **Maximum Marks: 35**

This question paper has **ONE** printed page and **THREE** parts

PART – A

Answer any **THREE** of the following: **(3 x 2 = 6)**

1. Explain triple ion formation.
2. Write the general expression for calculating thickness of the ionic atmosphere. Explain the terms in it.
3. What is (i) an electrocapillary curve and (ii)electrocapillary maxima?
4. Evaluate $\left[x, \frac{d^n}{dx^n}\right]$
5. Plot the wave functions corresponding to n=1 and n=2 of a particle in a 1-D potential well. Indicate the number of nodes in each of these functions.

PART – B

Answer any **TWO** of the following: **(2 x 12 = 24)**

6. (a) Derive an expression for the determination of surface excess of a positive ion.
   (b) Starting from $\Psi = \frac{z_i \epsilon}{Dr} - \frac{z_i \epsilon x}{D}$, prove that $\ln\gamma_i = \frac{-N z_i^2 \epsilon^2 \chi}{2DRT}$
7. (a) Explain qualitative verification of Debye-Hückel equations. (6+6)
   (b) What is quantum mechanical tunneling? Give any one example where it is observed.
   (c) Show that the eigen functions of a Hermitian operator are orthogonal. (6+3+3)
8. (a) State the postulates of quantum mechanics and show why we do not need the time-dependent Schrödinger equation for obtaining the energy and probability of finding the particle.
   (b) Solve the Schrödinger equation for a particle in a 1-D potential well and obtain the expressions for the energy of the particle and wave functions (normalization of the wave functions is not needed). (6+6)

PART – C

Answer any **ONE** of the following: **(1 x 5 = 5)**

9. Evaluate the Debye-Hückel constants, A and B, for ethanol at 25° C, taking the dielectric constant to be 24.3. (ϵ= 4.803×10^{-10}esu ; R=8.314×10^{7} erg K^{-1} mol^{-1}; N_A=6.023×10^{23})
10. (a) Given the Hamiltonian operator (along x) is $\frac{-h^2}{8\pi^2 m}\frac{d^2}{dx^2} + V$ find the operator for linear velocity along x, v_x.
    (b) Plot the energy level diagram of the first 7 states of a particle in a cubic potential well. What changes would be there in this diagram if one of the sides of the cubic well is doubled without any change in the other two sides.
