Bago University
Department of Chemistry
Second Semester Examination, September 2019

Fourth Year BSc
(Chemistry Specialization)
Answer *any six* Questions

Chem 4108
Physical Chemistry VI
Time Allowed: (3) hours

1. (a) Fill in the blanks with the correct word(s), unit(s), and etc., as necessary.
   (i) Passage of current through a solution can produce an ——— reaction.
   (ii) Molality measures the number of solute particles in a given amount of ———.
   (iii) The conductance depends on the presence of ———.
   (iv) The expression for the activity dependence of emf is known as ——— equation.
   (v) Wave function for hydrogen like atoms are called ———.
   (vi) The free energy change for the cell reaction is related to the cell ———.

   (b) Select the correct statement(s), word(s), unit(s) and etc., given in the followings.
   (i) The electrolytes which lead to essentially linear plots are classed as (weak, strong, non) electrolytes.
   (ii) At the anode, electrons are removed and (redox, reduction, oxidation) reaction occurs.
   (iii) The colligative properties of solutions depend only on the (molarity, molality, normality).
   (iv) The cell emf depends only on the (electrolyte, electrode, cell)concentration.
   (v) The glass membrane of the glass electrode separates (four, three, two) different solutions.
   (vi) The (amplitude, wavelength, wave number) of an orbital depends on the coordinates of one and only one electron.

2. (a) State the difference between electronic conductors and electrolytic conductors.
   (b) Define: ionic atmosphere, ionic strength and ionic mobility.
   (c) A conductivity cell has a resistance of 740.5 Ω when it is filled with 0.01 M KCl solution and a resistance of 886 Ω when it is filled with 0.05 M $CaCl_2$ solution, both at 25°C. Calculate the specific conductance and molar conductance of $CaCl_2$ solution. The specific conductance of 0.01 M KCl is 0.14114 $\Omega^{-1}m^{-1}$.

3. (a) Define the following.
   (i) Amalgam electrodes (ii) Metal-Insoluble salt electrodes (iii) Gas electrodes
   (b) Show that the given standard emf's are consistent with the fact that iron (III), Fe^{3+}, can be reduced to iron (II), Fe^{2+}, by the action of zinc in acid solution.
   ($E^0_{Fe^{3+},Fe^{2+}} = +0.771$ V, $E^0_{Zn^{2+},Zn^-} = -0.7626$ V)

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4. (a) Describe the following.
   (i) Amalgam electrodes
   (ii) Gas electrodes
   (iii) Oxidation-Reduction electrodes
   (b) Calculate the reversible emf for the following cell at a temperature of 25°C. Then calculate the free energy change for the reaction that occurs in the cell.
   $Pt / Tl^{+} (a = 1), Tl^{3+} (a = 1) / Cl^{-} (a = 1) / Hg_2Cl_{2(s)} / Hg$
   $(E^{0}_{Hg_2Cl_2,Hg} = +0.2674V, E^{0}_{Tl^{3+},Tl^{+}} = +1.25V)$

5. (a) Prove that the emf of electrochemical cell depends on the concentration of electrode material.
   (b) Write short note on calomel electrode with suitable diagram.

6. (a) (i) Give Schrodinger equation for the inter particle motion of the nucleus and electron in hydrogen like atoms and Bohr radius.
   (ii) Write down the potential energy between an electron and a nucleus in mathematical expression.
   (b) The Bohr radius of a hydrogen atom is 52.9pm. Calculate the potential energy at this distance. ($\varepsilon_0 = 8.854 \times 10^{12} J^{-1}C^2m^{-1}$, $e = 1.602 \times 10^{-19}C$).
   (c) Sketch the radical distribution function for principle quantum number 1, 2, 3, 4.

7. (a) Write the procedure for secular determinant.
   (b) In a certain theory the basis set is the orthonormal functions ϕ_1 and ϕ_2. The necessary integrals are $H_{11} = -10$ eV, $H_{22} = -1.0$ eV, $H_{12} = -\sqrt{10}$ eV. Find the energies and the wave functions for the system.

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