Bago University
Department of Chemistry
Second Semester Examination, September 2019

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

Chem 3110
Analytical Chemistry II
Time Allowed: (3) hours

1. (a) Fill in the blanks with the correct word(s), unit(s), and etc., as necessary.
   (i) The strength of an acid or base depends upon its extent of ———.
   (ii) Titration curves are helpful in judging the feasibility of titration and in ——— the proper indicator.
   (iii) Calomel reference electrode depends only on the ——— concentration.
   (iv) The electrode at which a reduction reaction occurs is called ———.
   (v) Standard electrode potential is ——— moles of reactant and product.
   (vi) The most widely used indicator electrode for hydrogen ions is the ——— electrode.

   (b) Select the correct statement(s), word(s), unit(s) and etc., given in the followings.
   (i) In solution having pH = 4.2 and above, methyl orange indicator shows the (yellow, red, orange) colour.
   (ii) The salt solution of ammonium formate is neutral if ($K_a > K_b$, $K_a = K_b$, $K_a < K_b$).
   (iii) Electromotive force depends on the (concentration, pressure, temperature) of ions of the electrode surface.
   (iv) The (E, E^0, ε) value can be determined by a buffer solution of which the pH is known.
   (v) When lead storage battery is used to operate the headlights, the radio or the ignition, its cells are (galvanic, electrolytic, potential).
   (vi) (Hydrogen, Silver, Copper) ions are substantially more mobile than chloride ions.

2. (a) Explain the autoprotolysis of water clearly.
   (b) How much sodium acetate should be added to 500 cm^3 of 0.1 M acetic acid solution to produce a buffer solution of pH 5? (K_a of acetic acid = 1.75×10^{-5}) (C =12, O = 16, H = 1, Na = 23)

3. (a) Define the following terms.
   (i) Acid base indicator (ii) Buffer capacity (iv) Potentiometer
   (b) Calculate the pH of a buffer solution, which results from the addition of 10 cm^3 of 0.1 M HCl to 100 cm^3 of the buffer solution. The buffer solution contains 0.100 M acetic acid and 0.100M sodium acetate.
   (K_a of acetic acid = 1.75×10^{-5})

P.T.O

4. (a) Differentiate between an electrode of the first kind and an electrode of second kind.
   (b) How could you construct a typical commercial saturated calomel electrode? Explain with diagram.

5. (a) Write down the corresponding Nernst equation for each of the following half-reactions.
   (i) $2Cl^- \rightleftharpoons Cl_2 + 2e^-$
   (ii) $C_2O_4^{2-} \rightleftharpoons 2CO_2 + 2e^-$
   (iii) $MnO_4^- + 8H^+ + 5e^- \rightleftharpoons Mn^{2+} + 4H_2O$
   (iv) $Fe^{3+} + e^- \rightleftharpoons Fe^{2+}$

   (b) If the electromotive force of the galvanic cell – Pt, H_2 (0.5 atm) / solution of unknown pH // $Hg_2Cl_2(s)$, KCl(s) / Hg + is 0.366 V, calculate the pH of the unknown solution, neglecting the liquid junction potential.
   E_{Hg,Hg_2Cl_2} = -0.2415 V vs NHE, $E^0_{H_2,H^+}$ = 0.0 V

6. (a) A glass/ calomel electrode system was found to develop a potential of 0.0620 V when used with a buffer of pH 7.00. With an unknown solution, the potential was observed to be 0.279 V. Calculate the pH and $[H^+]$ of the unknown solution.
   (b) Draw the schematic diagram of the electrolytic cell and then write down the half equation and the net equation.

7. (a) With diagram explain clearly how liquid junction potential develops.
   (b) Calculate the equilibrium constant for the reaction.
   $2Fe^{3+} + 3I^- \rightleftharpoons 2Fe^{2+} + I_3^-$
   $E^0_{Fe^{3+},Fe^{2+}} = +0.771V, E^0_{I_3^-,I^-} = +0.536V$

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