NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
DEPARTMENT OF APPLIED CHEMISTRY
SUPPLEMENTARY EXAMINATIONS – AUGUST 2014
PHYSICAL CHEMISTRY II-SCH 2204 FOR SCH AND TTE
TIME: (3) THREE HOURS

INSTRUCTIONS TO CANDIDATES

Answer ALL questions
Answer each question on a FRESH page.

$R = 8.314\ JK^{-1}mol^{-1} = 0.08205\ dm^3atm^{-1}\ K^{-1}mol^{-1}$.
$F = eN_A = 96\ 485\ C\ mol^{-1}$

1.

N_2O_5decomposes according to the following equation

$$2N_2O_5(g) \rightarrow 4NO_2(g) + O_2(g)$$

Based on the following mechanism, and using the rate of formation of NO_2,devise the rate law for the decomposition process.

$N_2O_5 \rightarrow NO_2 + NO_3$	k_a
$NO_2 + NO_3 \rightarrow N_2O_5$	k_a''
$NO_2 + NO_3 \rightarrow NO_2 + O_2 + NO$	k_b
$NO + N_2O_5 \rightarrow 3NO_2$	k_c

[25 marks]

2.

a. A voltaic cell is set up at 25°C with the following half-cells: Al^{3+} (0.0010M)|Al and Ni^{2+}(0.50M)|Ni. Write an equation for the reaction that occurs when the cell generates an electric current, and determine the cell potential and calculate the equilibrium constant. [12 marks]

b. Silver bromide is a sparingly soluble salt. The salt dissolves to give the following equilibrium: $AgBr_{(s)} \rightleftharpoons Ag^+_{(aq)} + Br^-_{(aq)}$. Form a cell that gives this net reaction and calculate its solubility product, $K_{sp}$and $\Delta_R G^0$ at 298K. [13 marks]

3.

a. Compare and contrast *Chemisorption* and *Physisorption.* Discuss procedures that you need to carry out to distinguish chemisorption from Physisorption. [15 marks]

b. Discuss the assumptions of the Langmuir adsorption isotherm. [10 marks]

4. Discuss what you understand by model fitting procedures and using examples explain their importance in chemical kinetics. [25 marks]

END OF QUESTION PAPER!!!

ATTACHMENT: STANDARD REDUCTION POTENTIALS AT 25°C

Half-reaction			E^o (V)
$MnO_4^-(aq) + 8H^+(aq) + 5e^-$	→	$Mn^{2+}(aq) + 4H_2O(\ell)$	+1.51
$Au^{3+}(aq) + 3e^-$	→	$Au(s)$	+1.50
$ClO_4^-(aq) + 8H^+(aq) + 8e^-$	→	$Cl^-(aq) + 4H_2O(\ell)$	+1.39
$Cl_2(g) + 2e^-$	→	$2Cl^-(aq)$	+1.36
$Cr_2O_7^{2-}(aq) + 14H^+(aq) + 6e^-$	→	$2Cr^{3+}(aq) + 7H_2O(\ell)$	+1.33
$2HNO_2(aq) + 4H^+(aq) + 4e^-$	→	$N_2O(g) + 3H_2O(\ell)$	+1.30
$O_2(g) + 4H^+(aq) + 4e^-$	→	$2H_2O(\ell)$	+1.23
$MnO_2(s) + 4H^+(aq) + 2e^-$	→	$Mn^{2+}(aq) + 2H_2O(\ell)$	+1.22
$Br_2(aq) + 2e^-$	→	$2Br^-(aq)$	+1.07
$Hg^{2+}(aq) + 2e^-$	→	$Hg(\ell)$	+0.85
$ClO^-(aq) + H_2O(\ell) + 2e^-$	→	$Cl^-(aq) + 2OH^-(aq)$	+0.84
$Ag^+(aq) + e^-$	→	$Ag(s)$	+0.80
$NO_3^-(aq) + 2H^+(aq) + e^-$	→	$NO_2(g) + H_2O(\ell)$	+0.80
$Fe^{3+}(aq) + e^-$	→	$Fe^{2+}(aq)$	+0.77
$O_2(g) + 2H^+(aq) + 2e^-$	→	$H_2O_2(\ell)$	+0.70
$I_2(s) + 2e^-$	→	$2I^-(aq)$	+0.54
$O_2(g) + 2H_2O(\ell) + 4e^-$	→	$4OH^-(aq)$	+0.40
$Cu^{2+}(aq) + 2e^-$	→	$Cu(s)$	+0.34
$SO_4^{2-}(aq) + 4H^+(aq) + 2e^-$	→	$H_2SO_3(aq) + H_2O(\ell)$	+0.17
$Sn^{4+}(aq) + 2e^-$	→	$Sn^{2+}(aq)$	+0.15
$S(s) + 2H^+(aq) + 2e^-$	→	$H_2S(aq)$	+0.14
$AgBr(s) + e^-$	→	$Ag(s) + Br^-(aq)$	+0.07
$2H^+(aq) + 2e^-$	→	$H_{2(g)}$	0.00
$Pb^{2+}(aq) + 2e^-$	→	$Pb(s)$	-0.13
$Sn^{2+}(aq) + 2e^-$	→	$Sn(s)$	-0.14
$AgI(s) + e^-$	→	$Ag(s) + I^-(aq)$	-0.15
$Ni^{2+}(aq) + 2e^-$	→	$Ni(s)$	-0.26
$Co^{2+}(aq) + 2e^-$	→	$Co(s)$	-0.28
$PbSO_4(s) + 2e^-$	→	$Pb(s) + SO_4^{2-}(aq)$	-0.36
$Se(s) + 2H^+(aq) + 2e^-$	→	$H_2Se(aq)$	-0.40
$Cd^{2+}(aq) + 2e^-$	→	$Cd(s)$	-0.40
$Cr^{3+}(aq) + e^-$	→	$Cr^{2+}(aq)$	-0.41
$Fe^{2+}(aq) + 2e^-$	→	$Fe(s)$	-0.45
$NO_2^-(aq) + H_2O(\ell) + e^-$	→	$NO(g) + 2OH^-(aq)$	-0.46
$Ag_2S(s) + 2e^-$	→	$2Ag(s) + S^{2-}(aq)$	-0.69
$Zn^{2+}(aq) + 2e^-$	→	$Zn(s)$	-0.76
$2H_2O(\ell) + 2e^-$	→	$H_2(g) + 2OH^-(aq)$	-0.83
$Cr^{3+}(aq) + 3e^-$	→	$Cr(s)$	-0.91
$Se(s) + 2e^-$	→	$Se^{2-}(aq)$	-0.92
$SO_4^{2-}(aq) + H_2O(\ell) + 2e^-$	→	$SO_3^{2-}(aq) + 2OH^-(aq)$	-0.93
$Al^{3+}(aq) + 3e^-$	→	$Al(s)$	-1.66
$Mg^{2+}(aq) + 2e^-$	→	$Mg(s)$	-2.37
$AgCl(s) + e^-$	→	$Ag(s) + Cl^-$	+0.22