UNIVERSITY OF YAOUNDE I

ECOLE NORMALE SUPERIEURE ANNEXE DE BAMBILI

COMMON ENTRANCE EXAMINATION JULY 2008 SESSION

FIRST CYCLE ENS ANNEX BAMBILI

SERIES : CHEMISTRY PAPER :CHEMISTRY Duration:3hrs Coeff:4

I- 1) Write the equation of the dissociation of each of the following in aqueous solution: AgBr; $Mg(OH)_2$.

2) Compare the solubilities of each in pure water and in acidic solution. Explain your reasoning.

II-1) Give the electronic structures of $^{32}_{16}S$, $^{16}_{8}O$, $^{12}_{6}C$.

2) Deduce the Lewis structures of CO_2 and SO_2 and the shapes of the molecules.

3) Give the number of electrons, protons and neutrons in SO_4^{2-}.

III- 1) Write the equations of the two successive ionizations of sulphuric acid H_2SO_4 in water. Ka1, the acidity constant of the first ionization is very large, and Ka2, the acidity constant of the second is 1.3×10^{-2}.

2) Calculate the concentrations of H_3O^+, HSO_4^- and SO_4^{2-} in a solution of sulphuric acid O.O2M. Deduce the pH of the solution.

3) What would have been the concentration of H_3O^+ and the pH if sulphuric acid were considered completely ionized in solution?

4) Compare the two concentrations of H_3O^+ of 2) and 3) and conclude if the acid can be considered completely ionized in solution.

IV- The first two steps of the uranium decay series are the emission of an alpha particle by $^{238}_{92}U$ to give thorium Th which then emits a negative beta particle to produce protactinium Pa.

1) Write the equation of each radioactive desintegration above.

2) Uranium $^{238}_{92}U$ emits a number of x alpha particles and a number of y beta particles to transform into $^{206}_{82}Pb$. Give the over-all equation of the transmutation as a function of x and y.

3) Calculate x and y.

V- An aqueous acidified potassium permanganate is added dropwise into an aqueous solution containing Fe^{2+} and Co^{2+} ions.

1) Predict the redox reaction that takes place knowing that the standard reduction potentials are $E°(Fe^{3+}/Fe^{2+})$: 0.77V; $E°(MnO_4^-/Mn^{2+})$: 1.51V; $E°(Co^{3+}/Co^{2+})$: 1.82V.

2) Balance the folowing half-equation then give the over-all equation of the reaction that has taken place: $MnO_4^- + H_3O^+ + e^- \longrightarrow Mn^{2+} + H_2O$.

3) Explain how the equivalence point is detected.

4) At the equivalence point, the volume of potassium permanganate consumed is 12.4 ml. Calculate the molar concentration of the ion that has reacted in the Fe^{2+} and Co^{2+} solution knowing that its volume is 20 ml, the molar concentration of the solution of potassium permanganate being 0.01 M.

5) Fe^{2+} and Co^{2+} having the same molar concentration, calculate the mass of iron(II) sulphate hexahydrate that would have been weighed to prepare 100 ml of solution. Fe: 56 S: 32 O: 16 H: 1.

VI- The reaction between two compounds A and B is expressed by the equation :

$$A + B \longrightarrow C + D$$

1) Use the following data to determine the rate law $R = k \times [A]_o^x \times [B]_o^y$

Experiment	$[A]_o$	$[B]_o$	Rate ($mol.l^{-1}.s^{-1}$)
1	0.3	0.2	0.015
2	0.3	0.4	0.030
3	0.6	0.2	0.030

2) Calculate the rate constant(k). mol per litre per sec

VII- Consider the reactions given below and answer the questions.

$$CH_3\text{-}CH_2\text{-}CH{=}CH_2 \xrightarrow{H_2O,\ H_2SO_4} A + B$$

$$A \xrightarrow{K_2Cr_2O_7,\ H_2SO_4} C \qquad B \xrightarrow{K_2Cr_2O_7,\ H_2SO_4} D$$

$$A + C \longrightarrow H_2O + E$$

Blue bromothymol is turned yellow by C which gives no precipitate with 2,4-dinitrophenylhydrazine (2,4-DNPH). D has no effect on blue bromothymol and gives a yellow precipitate with 2,4-DNPH.

1) Propose structures to compounds A to E and give the corresponding names.

2) Considering their structures, A is supposed to be optically inactive while B is supposed to be optically active. Why?

3) B obtained from the reaction above is not optically active. How do you explain that?

4) The two compounds A and B obtained in the first reaction, are not in equal amounts in the mixture. One is more abundant than the other. Which one? State the rule that allows to predict the major product in such a reaction.