Uva Wellassa University, Sri Lanka
End Semester Examination – January 2010
SCT 233-1 Physical Chemistry (Repeat)

Time: One (01) hour

Total three **(03)** questions
Answer two **(02)** questions only

Universal gas constant, $R = 8.314\ J K^{-1} mol^{-1}$
Boltzmann constant, $k = 1.3807 \times 10^{-23}\ J K^{-1}$
Plank's constant, $h = 6.626 \times 10^{-34}\ m^2 kg\ s^{-1}$
Avogadro constant, $N_A = 6.022 \times 10^{23}\ mol^{-1}$
Faraday's constant, $F = 9.6485 \times 10^{4}\ C\ mol^{-1}$
Velocity of light, $c = 2.998 \times 10^{-34}\ m\ s^{-1}$

01) a. Define the following terms.
   i. Rate equation
   ii. Order of a reaction

(08 marks)

b At 300 K the numerical value of the rate constant for a certain first order gas phase reaction is 0.00125.
   i. If the pressure of the gas is measured in Torr and time in seconds, what unit does the rate constant have?
   ii. The activation energy for the reaction is 290 kJ mol^{-1}. At what temperature would the numerical value of the rate constant be 0.0025?

(12 marks)

c. The decomposition of gas-phase N_2O into its elements is catalyzed by gold surfaces. At low pressures of N_2O the reaction is first order with respect to N_2O, while at high pressures of N_2O it is zero order with respect to N_2O.
   i. Write a balanced equation for the decomposition of N_2O on a gold surface.
   ii. Write rate equation for the decomposition at low N_2O pressure and for the decomposition at high N_2O pressure.
   iii. A sample of N_2O at high pressure is sealed in a container with a gold surface to act as catalyst for the decomposition. Sketch a graph showing how the rate of reaction varies with time. Assume that the products of the reaction have no influence upon the rate of reaction. The diagram should show clearly how the rate varies both at the start of the reaction and when the reaction is nearly complete.

(30 marks)

02) a. Why does the rate of most chemical reactions increase as the temperature is raised?

(06 marks)

b. i. State the Arrhenius equation. Identify the terms therein.

ii. State what are the Arrhenius parameters.

(14 marks)

c. HI decomposes as follows;

$$2\,HI \longrightarrow H_2 + I_2$$

The rate constant for the HI decomposition, shows the following temperature dependence:

$k / dm^3\ mol^{-1}\ s^{-1}$	0.316×10^{-7}	7.90×10^{-5}	3.20×10^{-3}	0.10
T / K	550	625	700	830

Detemine the activation energy for the reaction, and the pre-exponential factor A in the Arrhenius equation using a suitable graph drawn for the above data.

(25 marks)

d. What is the overall order for the decomposition? What justification do the data in the table above lead you to the answer?

(05 marks)

03) a. Define the following terms.

i. Conductance

ii. Conductivity

iii. Mobility of an ion

(15 marks)

b. Sketch the variation of molar conductivity with concentration for the following solutions.

i. HCl

ii. CH_3COOH

(05 marks)

c. Silver chloride is a sparingly soluble salt in water.

$$AgCl_{(s)} \longrightarrow Ag^+_{(aq)} + Cl^-_{(aq)}$$

A saturated aquoues solution of silver chloride had a conductivity value of 1.36×10^{-4} S m^{-1} at 20°C. The conductivity of water used to prepare this solution is 1.0×10^{-5} S m^{-1} at the same temperature. Given that at 20°C, the limiting molar conductivities of $Ag^+_{(aq)}$ and $Cl^-_{(aq)}$ are 6.19 S m^2 mol^{-1} and 7.64 S m^2 mol^{-1}, respectively.

i. Write an expression for the solubiliy product for AgCl

ii. Calculate the solubility product of AgCl in water at 20°C

(30 marks)