KENYATTA UNIVERSITY

UNIVERSITY EXAMINATIONS 2010/2011
INSTITUTE OF OPEN LEARNING
EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE AND BACHELOR OF EDUCATION (SCIENCE)

SCH 305: CHEMICAL KINETICS

DATE: FRIDAY 4TH FEBRUARY 2011 **TIME:** 8.00 A.M – 10.00 A.M

INSTRUCTIONS
Answer ALL questions
R=8.314 $JK^{-1}mol^{-1}$ = 0.0821 *l*-atm K^{-1} mol^{-1} (Total Marks – 70)

Question 1
In the combustion of methane
$CH_4\ (g) + 2O_2\ (g) \rightarrow CO_2\ (g) + 2H_2O\ (g)$
The rate of consumption of oxygen was found to be $-\Delta[O_2] / \Delta t = 0.2$ mol s^{-1}

a) What is the average reaction rate with respect to combustion of methane?

b) What is the rate of production of gaseous CO_2?

c) If initially there were 10.00 mol of CH_4, how many moles of CH_4 would be present after 40 s?

Question 2
The formation of gaseous hydrogen iodide, HI (*g*), was monitored at a temperature of 298 K
$H_2\ (g) + I_2\ (g) \rightarrow 2HI\ (g)$

The following data on the rate of reaction were collected,

Initial conc $[H_2]$ / mol dm^{-3}	**Initial conc $[I_2]$ / mol dm^{-3}**	**Initial rate of reaction / mol dm^{-3} s^{-1}**
0.100	0.200	8.0×10^{-3}
0.200	0.200	16.0×10^{-3}
0.100	0.050	2.0×10^{-3}

a) Derive an expression for the rate law

b) Calculate k, the rate constant for this reaction at 298 K stating clearly its units

c) Predict the initial rate of reaction at 298 K if
Initial conc $[H_2] = 0.050$ mol dm^{-3}
Initial conc $[I_2] = 0.050$ mol dm^{-3}

Question 3

The dissociation of sulfuryl chloride, SO_2Cl_2, is first order with respect to SO_2Cl_2

$SO_2Cl_2\ (g) \rightarrow SO_2\ (g) + Cl_2\ (g)$

The reaction was performed at 298 K and the following data were obtained:

Time /s	**Conc. $[SO_2Cl_2]$ / mol dm^{-3}**
0	1.000
2500	0.947
5000	0.895
7500	0.848
10000	0.803

a) State the rate equation for the dissociation

b) Using a graphical method, calculate the value of the rate constant, *k*, giving its units

c) Calculate the half-life for the reaction

Question 4

In the decomposition of nitrogen dioxide, NO_2, nitrous oxide and oxygen are formed as products.

$2NO_2\ (g) \rightarrow 2NO\ (g) + O_2\ (g)$

The reaction was performed at various temperatures and the rate constants were found to be as follows:

T/°C	***k*/ dm^3 mol^{-1} s^{-1}**
100	1.1×10^{-9}
200	1.8×10^{-8}
300	1.2×10^{-7}
400	4.4×10^{-7}

a) Rearrange the Arrhenius equation, and, by plotting a graph, find the activation energy and Arrhenius factor for the decomposition of NO_2 (Check carefully your units for the temperature)

b) Hence predict the value of k at a temperature of 500°C

Question 5

a) Define the term *elementary step*, and describe the difference between a *unimolecular-* and *bimolecular- elementary step.*