KINETICS : ASSIGNMENT

1. For the following reaction $Hl_{(g)}$ —— $H_{2(g)} + l_{2(g)}$

Given that the activation energy for the forward reaction is + 180 kJ/mol and the activation energy for the reverse reaction is + 206 kJ/mol:

a) sketch a potential energy graph for this reaction and label all relevant parts
b) on the graph from part (a), show what would happen if a catalyst were used
c) determine the enthalpy for this reaction.

2. The one step decomposition of hydrogen peroxide is catalyzed by iodide ion ...

$$H_2O_{2(l)} \text{ —— } H_2O_{(l)} + O_{2(g)} + 98.2 \text{ kJ}$$

The catalyzed reaction is thought to proceed by a **<u>two-step</u>** mechanism ...

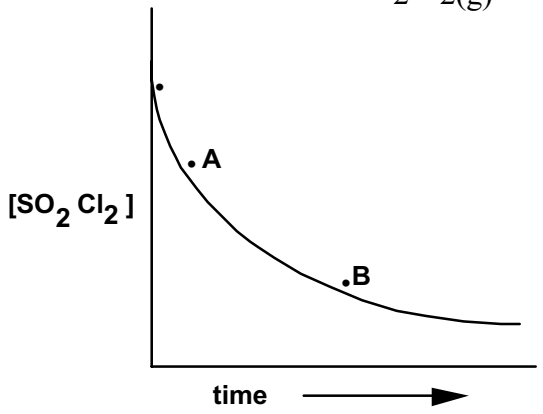
i) $H_2O_2 + I^- \text{ —— } H_2O + IO^-$ (slow)

ii) $IO^- + H_2O_2 \text{ —— } H_2O + O_2 + I^-$ (fast)

a) Make a sketch of the energy profile (curve) for the uncatalyzed decomposition of hydrogen peroxide and, on the same graph, for the catalyzed reaction that is consistent with the mechanism described above.
b) Explain why this reaction is considered to be catalysed by the iodide ion.
c) What is the intermediate in this reaction?

3. For the following reaction: $SO_2Cl_{2(g)}$ —— $SO_{2(g)} + Cl_{2(g)}$

A graph has been plotted showing the concentration of $SO_2Cl_{2(g)}$ over a period of time.



a) What could you do to find the rate of the reaction at A?
b) Compare the rate of the reaction at A and B. Explain in terms of collision theory.
c) Sketch the general shape of a graph showing the concentration of SO_2 vs time on the same graph.
d) How would you determine the order of this reaction? What order would you expect for this reaction? Write the rate law for this reaction. Explain what you would expect to happen if the concentration of $SO_2Cl_{2(g)}$ was tripled?

4. The mechanism for a reaction goes as follows:

I) A + B ——— C E_a = + 168 kJ/mol
ΔH = - 42 kJ/mol

II) C + B ——— E + F E_a = + 63 kJ/mol
ΔH = + 21 kJ/mol

III) F + B ——— G E_a = + 84 kJ/mol
ΔH = + 42 kJ/mol

a) on foolscap, draw an accurate energy curve to represent the steps of this reaction
b) what is the overall equation for this reaction
c) what is the ΔH (forward) for the overall or net reaction
d) which step would be the rate determining step
e) state the mathematical expression which would represent the rate of the overall reaction.

5. A certain chemical reaction can be represented by the following equation ...

$$2A(g) + B(g) \text{ -----> } C(g)$$

At a fixed temperature, the initial rate of the reaction was measured for various initial concentrations of A and B. The results were as follows:

Initial Concentration (mol/L)		**Initial Reaction Rate (mol/h)**
A	B	
0.50	0.50	2.0×10^{-3}
1.0	0.50	8.0×10^{-3}
1.0	1.0	8.0×10^{-3}
1.5	1.0	18×10^{-3}
1.0	1.5	8.0×10^{-3}

The **rate law expression** for this reaction is

i) (a) Rate = $k[A][B]$ (b) Rate = $k[B]^2$ (c) Rate = $k[A]^2[B]^2$ (d) Rate = $k[A]^2$

ii) Calculate the numerical value of the rate constant, k and its units.

iii) Calculate the rate of the reaction when the concentration of both A and B are 1.20 mol/L.