Review #1

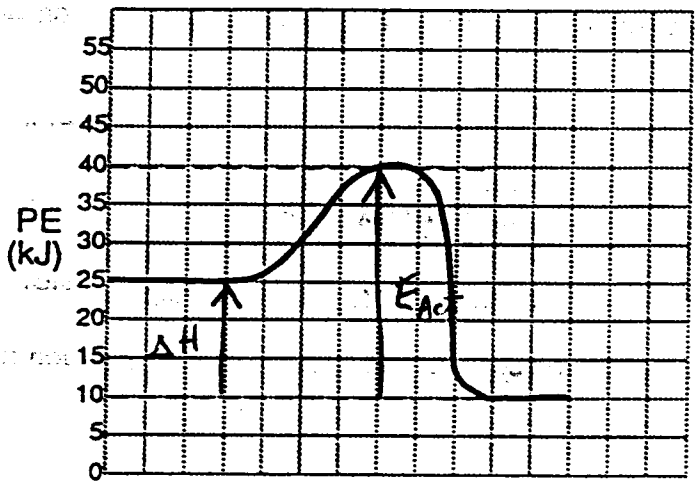
1. The following series of steps describes a reaction mechanism for a chemical reaction:

Step 1.	$H_2O_2 + H^+ \longrightarrow H_3O_2^+$	fast
Step 2.	$H_3O_2^+ + I^- \longrightarrow H_2O + HOI$	slow
Step 3.	$HOI + I^- \longrightarrow OH^- + I_2$	fast
Step 4.	$OH^- + H^+ \longrightarrow H_2O$	fast
Step 5.	$I_2 + I^- \longrightarrow I_3^-$	fast

Write the equation for the overall reaction and identify all the reaction intermediates. Increasing the concentration of which reactant will greatly increase the rate of the reaction? Explain. $H_2O_2 + 2H^+ + 3I^- \longleftrightarrow 2H_2O + I_3^-$

Intermediates are: $H_3O_2^+$, HOI, OH^- and I_2. Increasing conc. I^- will increase rate as it is a reactant for step 2 - the rate determining step.

2. Consider the following potential energy diagram:



(a) On the diagram, label the change in enthalpy and the activation energy for the reverse reaction.

(b) Give the values for:

i) the energy of the activated complex. 40 kJ

ii) ΔH for the forward reaction. −15kJ

3. Describe **TWO** ways, other than the use of a catalyst, to increase the rate of the following reaction:

$Zn_{(s)} + 2HCl_{(aq)} \longrightarrow ZnCl_{2(aq)} + H_{2(g)}$

increase [HCl]

heat up mixture

increase surface area of Zn(s)

Key

4. Consider the following uncatalyzed reaction which is a one-step (elementary) process:

$$2Ce^{4+} + Tl^{+} \longrightarrow 2Ce^{3+} + Tl^{3+}$$

When a catalyst is added to the above reaction, the following three step reaction mechanism takes place:

Step 1. $Ce^{4+} + Mn^{2+} \longrightarrow Ce^{3+} + Mn^{3+}$

Step 2. $Ce^{4+} + Mn^{3+} \longrightarrow Ce^{3+} + Mn^{4+}$

Step 3. $Mn^{4+} + Tl^{+} \longrightarrow Tl^{3+} + Mn^{2+}$

With reference to the above equation, use collision theory to explain why the catalyzed reaction mechanism is faster than the uncatalyzed reaction.

The catalyzed mechanism involves a rapid series of 2-particle collisions which require a lower activation energy than the slower 3 particle mechanism more particles have enough E_K to react and the rate increases

5. Consider the following reaction:

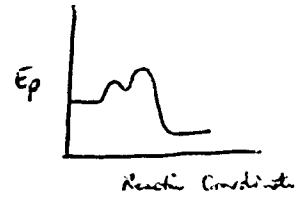
$$CO_{(g)} + NO_{2(g)} \longrightarrow CO_{2(g)} + NO_{(g)}$$

Using collision theory, explain why the rate of the reaction decreases as the reaction proceeds. As the reaction proceeds the concentrations of CO and NO_2 decrease, this decreases the collision frequency which results in a lower rate of reaction

6. Consider the following mechanism for an exothermic reaction:

Step 1. $NO_{(g)} + NO_{(g)} \longrightarrow N_2O_{2(g)}$ fast

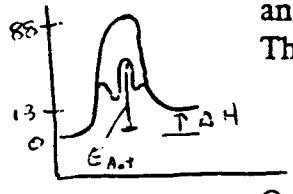
Step 2. $N_2O_{2(g)} + O_{2(g)} \longrightarrow 2NO_{2(g)}$ slow



Draw a PE diagram to represent the above two step reaction mechanism and write the net equation to represent the overall reaction.

$2NO_{(g)} + O_{2(g)} \rightarrow 2NO_{2(g)}$ slow

7. The uncatalyzed decomposition of methanoic acid, HCOOH, has a ▲H of +13 kJ and an activation energy of 88 kJ.



The reaction mechanism for the catalyzed decomposition of methanoic acid is:

Step 1:	$HCOOH + H^{+} \longrightarrow HCOOH_2^{+}$	(Fast)
Step 2:	$HCOOH_2^{+} \longrightarrow HCO^{+} + H_2O$	(Slow)
Step 3:	$HCO^{+} \longrightarrow H^{+} + CO$	(Fast)

On a graph draw a potential energy diagram for the catalyzed decomposition of methanoic acid. Label the ▲H and the activation energy for this reaction.

8. The following equations represent a proposed mechanism for the decomposition of ozone, O_3, in the atmosphere.

Step 1: $Cl + O_3 \longrightarrow ClO + O_2$

Step 2: $CLO + O \longrightarrow Cl + O_2$

(a) Write the equation for the overall reaction. $O_3 + O \rightarrow 2O_2$

(b) Identify the catalyst. Cl

(c) Explain how a catalyst increases the rate of a reaction.

provides an alternate mechanism with a lower activation energy