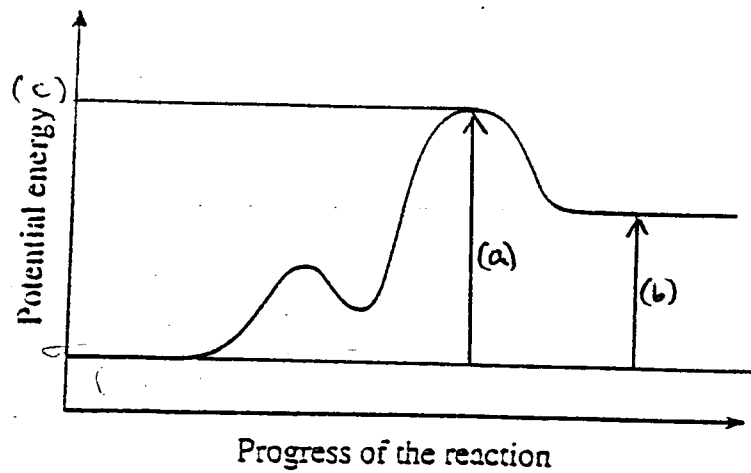


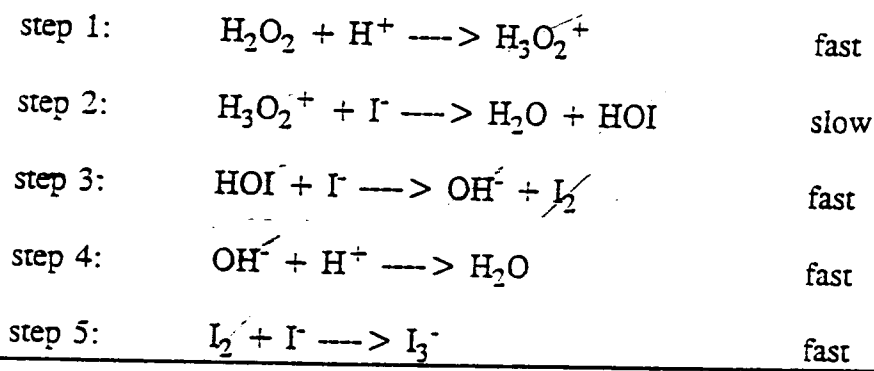
Rates of Reaction #4

Key.

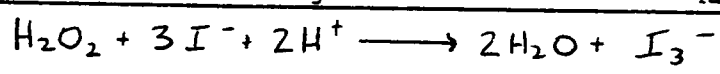
1. On the following diagram, clearly label the:
- (a) activation energy for the forward reaction
 - (b) heat of reaction
 - (c) energy of the activated complex in the rate determining step



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

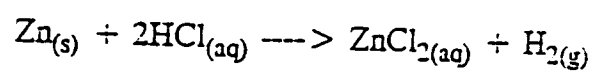


Intermediates:
 $H_3O_2^+$, HOI , OH^- , I_2



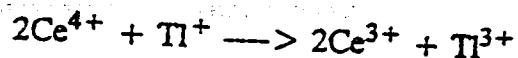
Write the equation for the overall reaction and identify all reaction intermediates. Increasing the concentration of which reactant will greatly increase the rate of the reaction? Explain. Increasing concentration of I^- will increase the rate because it is a reactant in step 2, the slow or rate determining step.

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

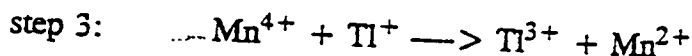
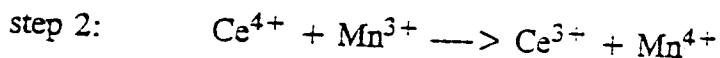
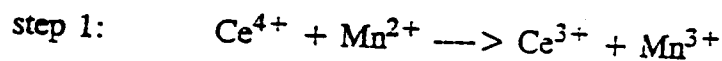


- any 2 of:
- ① powder the solid zinc
 - ② increase the concentration of $HCl_{(aq)}$
 - ③ heat the mixture

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

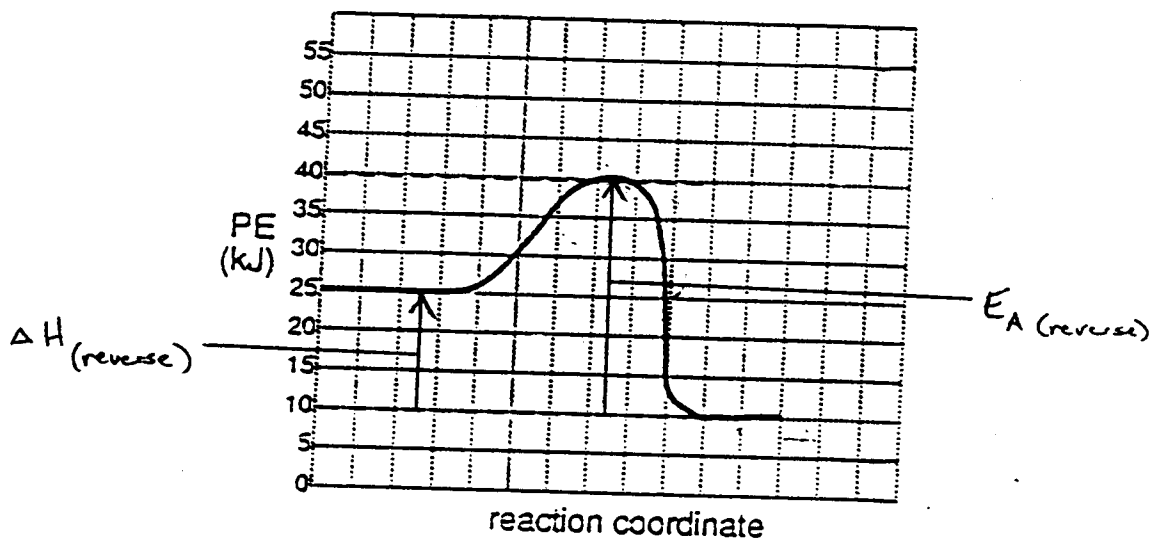


When a catalyst is added to the above reaction, the following three-step reaction mechanism takes place:



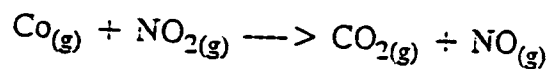
With reference to the above equation, use collision theory to explain why the catalyzed reaction mechanism is faster than the uncatalyzed reaction.

5. The catalyzed mechanism involves only 2 particle collisions which will be faster than the uncatalyzed 3 particle collision. Consider the following diagram:



- (a) On the diagram, label the change in enthalpy and the activation energy for the reverse reaction.
- (b) Give the values for the energy of the activated complex and the ΔH for the forward reaction.
 E_p (activated complex) = 40 kJ $\Delta H_{\text{(forward)}} = -15 \text{ kJ}$

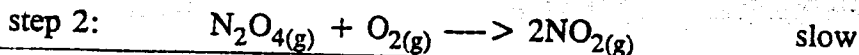
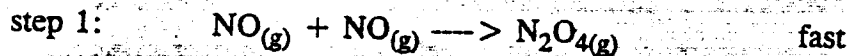
6. Consider the following reaction:



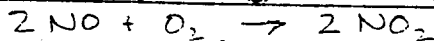
Using collision theory, explain why the rate of the reaction decreases as the reaction proceeds.

As the reaction proceeds the concentrations of CO and NO₂ decrease so the rate of the reaction decreases due to fewer particles of reactant available for collision.

7. Consider the following mechanism for an exothermic reaction:

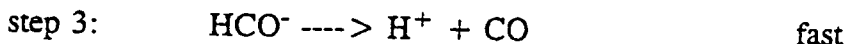
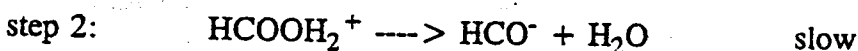
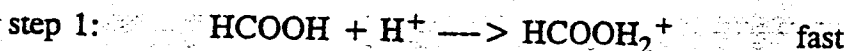


See below - Draw a PE diagram to represent the above two step reaction mechanism and write the net equation to represent the overall reaction.



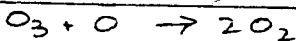
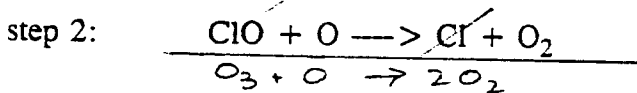
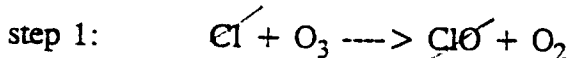
8. The uncatalyzed decomposition of methanoic acid, HCOOH , has a $\Delta H = 13 \text{ kJ}$ and the activation energy = 88 kJ .

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



See below right On a graph draw a PE diagram for the catalyzed decomposition of methanoic acid. Label the ΔH and the activation energy for the reaction.

9. The following equations represent a proposed mechanism for the decomposition of ozone:



Write the equation for the overall reaction.

Identify the catalyst. Cl

Explain how the catalyst increases the rate of this reaction.

The catalyst provides an alternative rx. mech with a lower E_a allowing particles with less energy to react. This allows more particles to collide leading to a higher rate of rx.

