CHEMISTRY 12 KINETICS REVIEW ANSWER SHEET

1. As the two H_2 and I_2 molecules approach each other during the collision process, their potential energy increases. This is due to the increase in repulsive force between their electron clouds as the molecules come nearer to each other. The increase in E_p results in a decrease of their kinetic energy, they slow down. If the molecules have sufficient initial E_k and a favorable collision geometry, they will be able to form a short lived intermediary species called the *activated complex* on collision.

Once the activated complex is formed, the cluster will break apart (new bonds form) and the particles separate, simultaneously lowering their E_p and increasing their E_k and speed. Since the products have more E_p than the reactants had, some energy is absorbed during this reaction and represented as a $\blacktriangle H$ in the equation for the reaction.

As the forward reaction proceeds, products form. When they collide, they react in a reverse reaction to produce H_2 and I_2. Eventually a situation will develop where both forward and reverse rates are equal and no further noticeable changes occur.

The activation energy is the energy required to reach the activated complex. For this The higher forward activation energy allows fewer molecules to react in the forward direction than will react in the reverse.

The $\blacktriangle H$ for a reaction is the difference in energy content between that of the products and that of the reactants.

For this endothermic case the products have more potential energy than the reactants so the $\blacktriangle H$ is positive for this reaction.

2. (a) The catalyst for this reaction is H_2O because it is the only particle which appears first as a reactant and is then regenerated as a product.

(b) OH^- would be called a reaction intermediate because it is produced in one step of the reaction and then used up in a later step. In this reaction there are two other reaction intermediates, HOCl and HOI.

3. i) Collision theory and Temperature

Only those particles whose E_k exceeds the threshold energy will have sufficient kinetic energy to react. The molecules with less than the threshold may collide, but these collisions will not lead to the formation of a product.

(1) At low temperature: few molecules have sufficient energy to collide effectively and react; few molecules exceed the threshold energy.

(2) At high temperature: the entire molecular distribution shifts to the right. More molecules exceed the threshold, the collision frequency is increased causing a higher rate of reaction.

However, of those particles that do exceed the threshold, some still don't react on collision. This is due to their improper collision geometry. Then, only those particles that both exceed the threshold and have favorable collision geometry will collide effectively and produce products.

ii) **Collision theory and Concentration**

The rate of reaction depends on the concentrations of reactants only. If either concentration increases, so will the rate increase. When the concentration of a reactant is increased, there are more particles capable of colliding. When more particles collide the collision frequency increases and more reactions can occur to increase the rate.

iii) **Collision theory and Surface area**

Increasing the surface area of a reactant in a heterogeneous reaction by grinding or powdering increases the reaction rate by increasing the number of reactant particles able to collide.

4. The best property to monitor in this reaction would be gas pressure because a gas would be formed. The conditions would be in a closed system at constant volume and temperature. As the reaction proceeded the pressure would be expected to increase until it becomes constant at equilibrium.

5. There will be no change in rate because the original mechanism, with a lower activation energy would still be available to allow the particles to react.

6. The reaction could be exothermic and the increase in temperature could cause the rate to increase. One of the reactants could be a solid which would crumble and expose a greater surface area as the reaction proceeds. One of the intermediates or products formed could act as a catalyst.

7. (i) $Br_2 + OCl_2 \text{ ----> } BrOCl + BrCl$
   (ii) Step 1 is a fast step, in order to increase the rate of reaction the substance must decrease the required KE of the slow, or rate determining step.

8. (i) $2\ NO_2 \text{ ---> } NO + NO_3$
   (ii) The proposed step would be slow because the overall reaction is slow and the other step is described as fast.