Experiment 23 – Factors Affecting Reaction Rates

Pre-Lab Hints

1. Refer to the bulleted items and the following paragraphs in the introduction.
   For 1c, the blood from the open wound contains enzymes.
2. Refer to Figure 23.2 and the paragraph to its right.
3. If n is the number of 10 ^{o}C rises, the factor is 2^{n}.
   Find n by taking the total temperature change, and dividing by 10.
4. Answer for part C, rather than part B.
   Read beginning of Part C in the procedure, and review Part C on the report sheet.
5. For HCl, moles are calculated as molarity (moles/liter) times volume (in liters).
   For Mg, moles are calculated as mass (g) divided by atomic mass (24.3 g/mole).
   Divide moles HCl by moles Mg to determine the ratio.
   Review part E on the Report Sheet following the pre-lab for the data plot.

6a. Use $M_1V_1 = M_2V_2$ to calculate M_2, the new concentration after mixing.
   M_1 is the initial molarity (moles/L) of HIO_3 and V_1 is its initial volume (ml).
   V_2 is the total combined volume after mixing all four solutions together.
   Use 20 drops = 1 ml to calculate the volumes of the solutions and their total.

6b. $[HIO_3]$ has decreased from its initial concentration in 6a to zero when the color changes. The color change time can be used as the time in the equation.
   So, find rate as $[HIO_3]_0 \div t$.

7. Do 7b only. Skip 7a and 7c. Read step E2.

Procedure Notes

Part A. Refer to Figures 23.3 and 23.4 as a guide for part A.
Use a well plate instead of test tubes.

Part B. Skip entire section.

Part C. Use two sets of three medium-sized test tubes. The first set (set A) will have a mixture of 1 ml $KMnO_4$ solution with 4 ml H_2SO_4 solution in each of the three test tubes. The second set (set B) will have 5 ml of $H_2C_2O_4$ only in each of the three test tubes. At each of the three temperatures, mix one test tube from set A with one test tube from set B. Room temperature and 40 ^{o}C (use hot plate) trials can be done simultaneously. The 60 ^{o}C trial can follow the 40 ^{o}C trial in the same water bath, after slowly increasing the temperature.
Use tap water for the water bath.

Part D. H_2O_2 decomposes into water and oxygen gas (bubbles). Use one small test tube.

Part E. Be sure to polish the Mg strips with steel wool prior to reactions.
Also, the results are more consistent if all Mg strips have nearly the same mass.
Use four small test tubes.

Part F. Skip entire section.

Report Sheet Information

Include graphs for parts C and E.
Also, attach all calculations on a separate sheet of paper.

A. Decreasing order means highest reactivity to lowest reactivity.
B. Skip.
D2. Write the reaction with 2 moles of H_2O_2 and balance the equation.
Do not include the catalyst as either a reactant or product.
Write the catalyst above the arrow.
E1. Refer to #5 on the pre-lab hints to calculate the moles and mole ratios.
E2. Calculate the moles of Mg, the moles of HCl, and the mole ratio.
Then, use your graph from part E1 to estimate the time from that ratio.
Include all calculations for parts E1 and E2 on a separate sheet of paper.
F. Skip.

Post-Lab Questions

1. Carefully study Figure 23.2 in the lab manual or Figures 13.13 and 13.17 in the text.
Note that the activated complexes are not identified on the curves in the lab manual.
Where is the activated complex on the uncatalyzed reaction's curve?
How does it compare with the activated complex on the catalyzed reaction's curve?

2. What happens to the potential energy of the activated complex when the catalyst is present? Explain why there is a change in energy in terms of what the catalyst does.

3. This change in potential energy results when the catalyst bonds with the reactant and stabilizes the activated complex. How does this catalyzed activated complex affect the activation energy and the rate of the reaction?

4. Read the section about catalysis at the end of chapter 13 in the class notes.
Will the catalyst still be bonded to a reactant or a product after the reaction?
Explain how the catalyst's bonding and debonding process happens as a series of steps.

5. What is the effect of the catalyst on the (overall) net chemical equation?
Explain how the catalyst is involved in the reaction mechanism's steps (which are elementary reactions), yet it cancels out of the net equation.