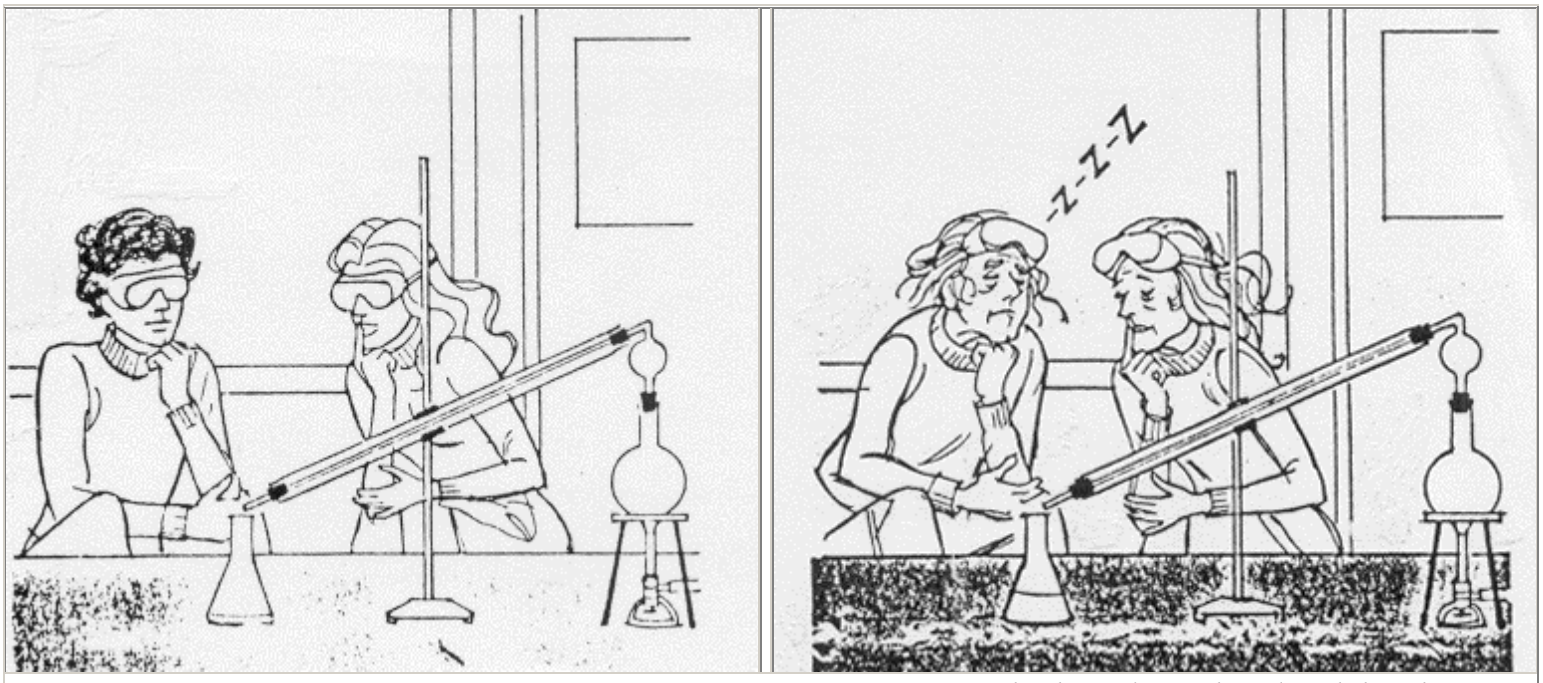
## PRE/POST-LAB ACTIVITIES FOR KINETICS LAB

Write complete qualitative answers to the following concept questions after you have finished the Kinetics Lab. Your source for answers may be in a chapter on Reaction Rate and Chemical Equilibrium in any chemistry book.




***Do you think we dare take a lunch break?***

1. Kinetics is from the Greek word kinein meaning "set in motion, or move." We have studied kinetics in terms of the gas laws, now we are applying kinetics to the rate of a chemical reaction, in this case decomposition.

What are the four factors that affect the rate of a chemical reaction? Describe in qualitative terms how each of those factors will affect the rate of either a synthesis or decomposition reaction.

2. Why are chemists interested in the study of chemical kinetics? Does the rate of a reaction have any application to our daily 1ives?

3. Pretend you are explaining the meaning of the "rate of a chemical reaction" to your little sibling or old grandma. In terms they would understand explain the term "rate of reaction."

4. Compare and contrast each of the following terms: thermodynamically stable and kinetically stable. Use at least two examples of each in your discussion.

5. Study your GC graph from section A-3 & B; compare and/or contrast the results. What can you determine from the graph about concentration of a catalyst versus increased temperature?

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Develop your teaching skills. This post lab on chemical kinetics will be done in groups of four and presented orally to the entire class. You may draw diagrams or charts on transparencies to help you in the presentation. Use your creative imaginations as to the presentation.

Group 1:
1. What is the function of KI in the decomposition of hydrogen peroxide?
2. What happened to the rate of decomposition of your substance when the KI was doubled?
3. Why is the volume of your total solution kept constant'?
4. Could you use another substance other than KI to function in a similar manner?

Group 2:
1. What is the the function of the leveling bulb?
2. How is the speed of a reaction determined?
3. Why do yo u not use the heat of the hot plate but, instead, add hot water to the plastic water bath?
4. List at least two physical methods for measuring the change of concentration of a reactant and/or production of a product.

Group 3:
1. What is the function of enzymes in biological mechanisms?
2. Why are catalysts so useful in chemical reactions. Describe at least two functions of a catalyst.
3. Catalase is what kind of a catalyst? Where can catalase be found in nature?
4. Write the rate of oxygen production as found in the experiment. What is $\boldsymbol{k}$ and what is $\boldsymbol{k}$ dependent on?

Group 4:

1. In this experiment, you kept the volume of solution constant but changed several factors, usually one at a time. What do you call these factors that change?
2. $H_2O_2 + 2H^+ + 2e^- \rightarrow 2H_2O$ $E0 = +1.77V$ shows that hydrogen peroxide is a strong oxidizing agent, only to be eclipsed by fluorine and ozone. Explain whether this compound is thermodynamically stable or kinetically stable?
3. If the total volume of the solution is kept constant, but the concentration of a species is doubled, and the product is doubled, the reaction is what order? Therefore if the concentration of product goes up by four the order of the reaction is _____?
4. If you were asked to solve for ***k*** in the reaction rate equation, could you use mL of $O_2$ produced or not? What would be the preferable units to use?

Group 5: Math analysis

1. Dalton's law of partial pressure is used in the final calculations of $O_2$ production. Why?
2. Graph the following data without the benefit of the computer. Find the slope of each graph.

| Time | Volume $O_2$ (mL) [5/20/5] | Volume $O_2$ (mL) [Incr. Temp] |
|---|---|---|
| 70 | 23.7 | 22.6 |
| 80 | 24.8 | 23.6 |
| 90 | 26.2 | 24.9 |
| 100 | 27.7 | 26.1 |
| 110 | 28.4 | 27.4 |
| 120 | 30.2 | 28.6 |
| 130 | 31.5 | 29.8 |
| 140 | 32.8 | 31.2 |
| 150 | 34.2 | 32.4 |
| 160 | 35.5 | 33.6 |
| 170 | 36.7 | 34.8 |
| 180 | 38.0 | 36.0 |
| 190 | 39.2 | 37.3 |
| 200 | 40.2 | 38.5 |
| 210 | 41.5 | 39.6 |
| 220 | 42.6 | 40.6 |
| 230 | 43.7 | 41.3 |
| 240 | 44.7 | 42.9 |

3. From observation of data and graph which produces the larger volume of O2, increased temperature or increased concentration of a reactant?

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Buffer solutions:

The Kinetics Lab uses a series of phosphate buffers at pH 5, 6, 7, & 8. The basic buffers are prepared in the TOPS labs by making a 0.1 M solution of $K_2HPO_4$ (which has a pH of about 9.5), and titrating with conc. $H_3PO_4$ or $H_2SO_4$ to the desired pH. The acidic buffers are prepared by making a 0.1 M solution of $KH_2PO_4$ (which has a pH of about 4.5) and titrating with conc. 1M KOH or NaOH to the desired pH. This process requires a pH meter to follow the titration. There is an equilibrium between the two compounds at various pHs. Thus, you can reach pH 7 or 8 by further titration of $KH_2PO_4$ with bases and you can reach pH 5 or 6 by further titration of $K_2HPO_4$ with acids, but you may need to compensate for the volume added. That is, use less than the full amount of water needed for a 0.1 M solution, and after titration, add the amount needed to bring the solution to the correct volume.

There are two other processes which may be easier for the high school teacher. Lange's Handbook of Chemistry and similar references give recipes for preparing buffers at various pHs:

pH 6.0 50 mL 0.1 M $KH_2PO_4$ + 5.6 mL 0.1 M NaOH + 44.4 mL $H_2O$

pH 7.0 50 mL 0.1 M $KH_2PO_4$ + 29.1 mL 0.1 M NaOH + 20.9 mL $H_2O$

pH 8.0 50 mL 0.1 M $KH_2PO_4$ + 46.1 mL 0.1 M NaOH + 3.9 mL $H_2O$

pH 5.0 50 mL 0.1 M KH Phthalate ($KHC_8H_4O_4$) + 22.6 mL 0.1 M NaOH + 27.4 mL $H_2O$

There are also commercially available buffers. These consist of a packet of salts which are dissolved in 100 mL of $H_2O$ to make a buffer solution of the specified pH. They sell for around $1.00 per packet.

Any of the above can be used for the Kinetics Lab.