**Determining the Evaporation Rate of Liquids Using Logger Pro**

When a liquid evaporates, the molecules absorb energy from their surroundings in order to break the attractive forces that hold them together. This results in a cooling effect on the surrounding environment. For example, when you exercise and your body starts to heat up, you begin to sweat so that the evaporation can lower your body's temperature. The faster a liquid evaporates, the greater the cooling effect will be. Liquids held together with weak attractive forces will evaporate faster because less energy is needed to break apart the molecules.

**Problem:** Can you determine which liquids have the greatest attractive forces based upon their rates of evaporation? Can you predict which liquids would evaporate slowest based upon their Lewis structures and types of intermolecular forces?

**Part 1 Procedure:**

1. In 4 separate test tubes, obtain 10 drops each of the following liquids: distilled water, acetone, ethanol and hexane. Cover the test tubes with parafilm or stoppers to prevent the liquid from evaporating away prematurely.

 Write the formulas for these molecules in the boxes below:

 water acetone ethanol hexane

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |

2. Set up the LabPro unit interfaced with a computer using the following steps:

1. Plug in the interfacing cable at the side of the LabPro and the USB or modem port of the computer to link them together. *Make sure the plug ends are pushed in all the way to make proper contact.*
2. Plug the four stainless steel temperature probes into CH1(channel 1), CH2(channel 2) , CH3(channel 3) and CH4(channel 4) of the LabPro unit.
3. Open the computer program called "**Logger Pro**" by double clicking on the icon on the desktop. The program should automatically recognize that 4 temperature probes are connected and set up a graph for collecting data. Note that each probe has a separate color code and is displayed across the bottom of the screen.
4. If any of the temperature probes are not displayed, go to the **Setup** pull down menu to select the interface and probes that are connected.

3. Wrap a 3 cm2 piece of paper towel around the end of each of the temperature probes to secure it in place. When everything is ready, click on the **Collect** button to begin collecting data.

4. As soon as you see the data points being graphed, pour the test tube with the distilled water onto the tip of one temperature probe to wet the paper toweling. ***At the same time***, pour the acetone, ethanol and hexane onto the other three probes in order to monitor all 4 liquids simultaneously.

1. A real-time graph of temperature *vs.* time will be displayed on the calculator screen during data collection for a period of 200 seconds at 1-second intervals.
2. Temperature readings (in °C) can also be monitored at the bottom of the graph.
3. Data collection will stop at the end of this run, and a graph of temperature *vs.* time will be displayed.
4. Under the **View** pull down menu, select the option to **Autoscale Once**.
5. Determine the portion of each plot which has the greatest slope and determine two temperatures from it: 1) the temperature of the initial part of the most linear portion, and 2) the minimum temperature of the most linear portion. Record these in your data table. Calculate the slope for these two points. This can also be done directly on the computer by highlighting this linear portion of the curve, then use the **Analyze** pull down menu to draw the **Linear fi**t line. The y = mx + b equation for the line will be displayed.
6. Click on the graph and select the enlarge option from the upper right corner to make a full page graph. Use the **Window** pull down menu to *change the name of the graph by adding your initials to the title*, then print out the graph to include in your lab report. This way you will be able to identify your graph from everyone else's. Save your data by using the File pull down menu to "**Save As**", then type **your name** followed by the letters "**evap”.**
7. Throw away the paper toweling and hand in all equipment to your instructor for final approval.

**Part 2:** The rate of evaporation of nonpolar liquids, such as hexane and pentane, can be also be measured in the same fashion. However, since the attractive forces between the molecules of these flammable liquids are very weak, you must work quickly! Collect the data and graph the results of the rates of evaporation for these liquids, as directed by your teacher.

Questions:

1. Arrange the four substances in part 1 from highest to lowest evaporation rate. Explain the intermolecular forces in each one that played a role in having their rates in that order.
2. For part 2 explain the differences in the evaporation rates.
3. Why does the temperature decrease as the substances evaporate?
4. How could we increase the evaporation rate? Explain using the KMT why that increases the rate.
5. What would you expect the rate to be of octanol compared to ethanol? Give two explanations as to why that should be the case.