

## Vernier LabPro Instructions (VernierSoftware2012)

The Vernier LabPro is a versatile data collection interface that can be used in many different ways in the classroom or in the field. Today you'll have it connected to a computer and use it to titrate a strong and/or weak acid with a strong base (0.1M NaOH). The titration can be studied by monitoring changes in pH (using a pH electrode). The interpretation of the differences in the shape of a titration curve and the information that can be determined from the equivalence point of a titration will enable you to find both the identification and concentration of an acid.

**Start-up:** Turn on the power to the power strip that is connected to the Vernier LabPro, a stir plate and a power supply for the DCU pump unit. A blinking green light occurs when the Vernier interface receives power. The Vernier system will complete a series of (7) beeps as the system completes a "self check". If no other beeping sounds are given by the interface, then the system is ready for use.

**How to Calibrate the Pump:** Doing this will let you find the volume delivered by the pump per pulse. Log in to a lab computer. Click on the **blue folder** to open the Vernier 2011-2012 folder. Wait for it to open then double click on "**pumpcalibration.cmb1**". You'll hear your pump click and a blinking green light will be visible on the Vernier interface. Note that the toggle switches on the pump should always be set on "**computer**" and "**DCU**" for the pump to be computer controlled. If prompted with a "Sensor Confirmation" window, click on the blue "**connect**" button. If the window is not displayed, continue on.

The main calibration window should be activated and the green "**Collect**" button will be found in the top menu bar. The table on the left side of the screen will record collected data in the appropriate columns. The smaller box below the table will count the pulses delivered by the pump. The graph will display a green colored signal for each pulse.

To prime the pump with deionized water, find the inlet tubing (marked as IN on the pump) and submerge the tubing into a deionized water bottle. To prevent air bubbles from entering the line, make sure that the line is secure and that the opening of the tubing is down below the water surface. Put the outlet tubing into an empty small beaker.

Click on the green "**Collect**" button. A window will appear that will ask what you would like to do: click on "**Erase and Continue**". The pump will run for 30 pulses. Click on "**Collect**" again and then "**Append to Latest**" to add another series of 30 pulses. It will take about 90 pulses to prime the pump with water. Check for bubbles in the tubing. If you see large bubbles, check your set up and then add another set of pulses. If no bubbles are apparent in the lines, then continue. To calibrate the pump (volume in uL delivered by each pulse) find the mass of a clean dry weigh vial (without its cover). Use a clean, dry Kimwipe to handle the vial because fingerprints and dirt will add to the mass and result in calibration error.

Set the outlet tubing into the weigh vial and deliver a total of 60 pulses of deionized water. Weigh the vial. Using the density of water at room temperature (0.9982 g/ml at 20C), convert the mass of the water delivered to the corresponding volume of water delivered. Calculate the volume of water delivered in a single pulse by the pump (in uL/pulse). Remove the inlet tubing from the water and put it into your NaOH bottle.

Prime the pump with the strong base for at least 90 pulses. Be sure that there are no bubbles in the line. Quit Logger Pro. If asked the following: "Do you want to save the current file before closing?" Click on "**Don't Save**". You now want to double click on "**acidbasetitration.cmb1**".

### **How to set up the Titration:**

If prompted by a "Sensor Confirmation" window, click on the blue "**connect**" button. The new window will show a table displayed on the left side of your screen. This will record collected data in columns labeled with color-coded headings. A small window under the table will display current pH readings. The larger graphing window will display your data as it is being recorded. The "X" axis is the volume (uL) delivered by the pump and is set from 0 to 20,000 uL. The "Y" axis is the sensor output and is set to record pH 0 to 12. If necessary, the axes may be rescaled at anytime by clicking on the minimum/maximum value and typing in the preferred value.

Click on "**Data**" from the top menu and slide down to "**Clear All Data**" to clear the window. To calibrate the volume ("X") axis, use the scroll bar at the bottom of the left hand table, to find the "Volume (uL)" column and double click on that heading. A "**Calculated Column Options**" window will appear. Go to the displayed **Equation** box and change ONLY the value in the equation to be the calibrated uL/pulse you calculated earlier. Click "**Done**".

NOTE: When clearing data and/or erasing and continuing between titrations, always check that the pump calibration volume (pulse volume) has not been changed to the default value. It should still be set to the volume that you have determined.

### **How to calibrate the pH electrode:**

Chose "**Experiment**" and then choose "**Calibrate**". Sliding to the right choose "**LabPro: 1CH1: Electrode Amplifier**". The **Sensor Calibration** window will appear. Make sure that the current calibration is set for "Electrode Amp pH<Sensor Page 1>". Click on the "**Calibrate Now**" button. This is a two buffer point calibration. Remove the pH electrode from the electrode storage solution, make sure that the blue ring collar is turned to open, rinse well with deionized water and place in the pH 4 (pink) buffer solution. Always make sure the ground glass frit is covered by solution and no bubbles are caught in the protective cage. Once the "volts" reading has stabilized, type "4.00" into the "**Reading 1**" box and press the "**Keep**" button. Repeat process to calibrate in pH 7 buffer solution and press the "**Keep**" button. Press "**OK**".

### **How to prepare the sample for automated titration:**

Add 50 ml of deionized water to a clean 100 ml beaker. Using a 10.0 ml volumetric pipet, add 10.0 ml of acid to the water. Place the beaker on the stir plate, add a stir bar, and begin stirring. Rinse and dry the pH electrode and carefully place it in the beaker. Rest the electrode on the extended portion of the lip of the beaker. You want to arrange the beaker so that the stir bar does not hit the electrode. Record the starting pH. Using the provided clip, attach the pump outlet tube to the titration beaker. Press the green **“Collect”** button to start the titration. The data will be recorded in the table and the titration and derivative plots will automatically be displayed on the graph. If this is not true, double click on the **“Sensor Output”** “Y” axis label and choose **“More”**. Then check the pH and dpH/dV boxes for the appropriate run. Remove the check for any unwanted data being displayed on the graph.

Press the red button found in the upper menu, when the pH has reached 11.5, to end the titration. The color of the curves will match the color of the headings to the columns (in the table to the left). To help with the interpretation of the data, the color of the titration and derivative plots should be the same for each titration experiment. If they are different, double click on the pH column heading and choose **“Options”** from the **“Column Options”** box. Choose a color from the color bar and press **“Done”**. Repeat this to make the derivative plot (dpH/dV) the same color for the run. Be careful to choose colors that will not be too dark to cover other runs that may be displayed on the chart.

Choose **“File”** from the menu bar and **“Save As”**. Fill in a unique name for ‘save as’, and then for ‘where’ choose the **Desktop** to assure that the data is not lost while preparing the next titration or analyzing the data. When the next sample is ready to be titrated, click the green **“Collect”** button, then choose **“Erase and Continue”** to begin a new titration.

When all of the titration experiments are completed, and have been saved, the graph can be printed by choosing **“File”** and **“Print Graph”**. Entering the information in the **“Printing Options”** window will provide a title to print on the graph as long as the **“Print footer”** box is checked. Press **“OK”**. Now a print window will appear and you’ll choose **“Keyes 4<sup>th</sup> floor hallway”** as the printer.

To analyze the data points of interest on the pH and derivative plots, click on the “**Examine**” button in the menu bar (it is a blue curve with a red vertical line) then scroll with your mouse to the point of interest. The color of the data values will match the color of the plotted data. Any point along the curves can be evaluated (also seen recorded in the table to the left). Record in your lab notebook the volume and pH data points that are important to your experiment. That would be both the equivalence point and the half equivalence point! Click on the “**Examine**” button again to exit data analysis. Save your work. Remember that you have a fileserver folder in CHEM, CH142, under your email name. Ask your lab instructor to help you save data if you don’t remember how to use the fileserver. Here are the steps to follow...[Go, Connect to Server, choose smb://fileserver1/Academics, Connect, CHEM, CH142, go to your email name]. To exit the program, choose “**Quit LoggerPro**”, after you have saved the work.

Now open “**pumpcalibration.cmb1**”, again. Place the inlet tubing back into deionized water. Use at least 90 pulses to run deionized water through the pump and tubing. Please rinse the pH electrode and place it in the electrode storage solution. The probe’s blue ring collar should be closed when you have finished for the day.