**Lab 6: Title**

**Your Name**

Your Major

Your Minor or Second Major (if applicable)

**ABSTRACT**

The usual stuff.

**METHODS**

1. Include a figure showing a system block diagram of the entire spirometer measurement system. Your diagram must include blocks for the *measurand*, *sensor*, *signal conditioning*, *data acquisition*, *signal processing*, and *display*. **The label for each block must include the basic function and the specific implementation**.
2. Include calculations (e.g. from PreLab) to explain why a gain resistor value of RG = 30 ohm was used for the instrumentation amplifier. You do not need to show all work – just show the important formulas, resulting values, and describe the rationale for choosing RG = 30 ohm. It is very strongly preferred that you type your calculations.

**EXPERIMENTS AND RESULTS**

1. Circuit: Include the two scope snapshots. Try to shrink them (each about 3 inches wide) to fit them side-by-side).
   * Explain the purpose of the low-pass filter.
   * How did you know it was working properly?
2. Arduino code: Briefly explain what your Arduino program was supposed to do.
3. MATLAB code:

* Include the equation that converts the measured voltage into flow. What was the value of your Ad, S, and R?
* How did you convert flow into volume (e.g. which MATLAB function, use of dt)?
* Explain the purpose and procedure of “zeroing” your system.
* Explain the purpose and procedure of “calibrating” your system.
* Include the flow vs time and volume vs time plots for your calibration experiment.
* Include the flow vs time, volume vs time, and flow vs volume plots of your lungs.
* What were your values for Vref, Calibration, PEF, and FVC?

**DISCUSSION**

1. You probably found that your Vref kept changing a little bit – super annoying! This was most likely due to the use of a long cable between the pressure sensor and the very high gain instrumentation amplifier (gain = 1648). **How would you modify the hardware to minimize this effect?** Hint: Recall the commercial spirometer unit used in the MiniLab (see course website) – where do you think the amplifier is located?
2. Even when the hardware is well designed, Vref can ever so slightly change with time. Fortunately, Vref correction can be done in software. **Conceptually, how would you modify the data processing code to compensate for slight drifts in Vref?** Hint: Suppose the patient is required to wait 2 seconds before exhaling into the spirometer – what should the data processing code be doing during this “wait” time?

**CONCLUSIONS**

This section is not simply “my setup worked”. **You should reflect on the concepts or any valuable lessons you learned in the lab.** If possible, discuss how they relate to other aspects of the course, or to the general field of biomedical instrumentation, or public health …

**REFERENCES (OPTIONAL)**

[1] Citation details (e.g. website info) go here.