the resistance values. (We have done this exercise before, but make sure you understand it.) Note that V_{out} will vary with the physical variable that we are measuring as R_{sensor} changes.

Some pre–lab questions:

1. Assuming that the sensor has a resistance that increases as the physical variable increases, does the output voltage of the circuit increase or decrease?
2. If the resistance decreases as the physical variable increases, how does the output voltage vary?
3. Devise a circuit in which the variation is the opposite of that in the above circuit.

Sometimes the sensor is exposed to only two values of the physical variable, and an instrument must distinguish between the two levels. For example, a light might shine or not shine on a photoresistor. Then we might want to design the circuit in order to obtain the largest *difference* between the two voltages produced. If the supply voltage V_s is 5 volts, and if we can make the output voltage close to 5 volts and 0 volts in the two conditions, then we have designed a circuit that produces levels close to the standard levels in digital logic.

More pre–lab questions:

4. Determine the resistance R_0 that gives the greatest difference between the output voltages when $R_{sensor} = R_{max}$ and $R_{sensor} = R_{min}$. (This is the problem that we formulated in class.) Try to include all of the steps that lead to the result that $R_0 = \sqrt{R_{min} R_{max}}$.
5. Consider an application of your result. Suppose that you have a sensor for which the resistance varies between R_{min} = 1000 ohms and R_{max} = 5000 ohms for two fixed conditions. In digital logic circuits, anything above 3.5 volts is sensed as logical ‘‘1’’, and anything below 1.5 volts is sensed as logical ‘‘0’’. However, the more you exceed these limits, the more reliable the circuit will be. Can you achieve reliable operation with this sensor?

Testing the Voltage Divider Circuits

Please review the *Exploring Electrical Engineering* lesson on voltage dividers that you studied last week in lab.

We will use the *thermistor* in your lab kit as R_{sensor} in the circuit on page 1. Measure the resistance of the thermistor at room temperature, and when you heat it by squeezing it between your fingers. Choose a value for R_0 so that a maximum difference in voltage is achieved between the “hot” and “cool” states. Set up the voltage divider circuit so that V_{out} is *larger* for the *higher* temperature and *smaller* for the *lower* temperature. (You may have to switch the locations of R_0 and R_{sensor}.) Measure V_{out} for the “hot” and “cool” cases, and compare with your expected results.

Bridge Circuits

Next, let us consider a bridge circuit, which is shown below. The bridge circuit is really just two voltage dividers. We will use the bridge circuit to check which lab partner has the higher body temperature.