Building circuits

Record all measurements made as part of the lab under the relevant section. Graphs of current or resistance versus voltage when relevant are encouraged.

Basic circuit:

1. Turn on the Raspberry pi (Rpi)
2. Connect one of the 5V pins on the Rpi to the + column on the breadboard
3. Connect one of the ground pins on the Rpi to the - column on the breadboard
4. Run a connector from the + column to one row on the main part of the breadboard
5. Run a connector from the - column to a different (but close) row on the main part of the breadboard
6. If we connected a 1Ω resistor between these two rows - so that it is in a closed loop with the 5V supply from the Rpi, how much current would this circuit attempt to draw across the resistor?
    - Attempt to draw 5 amps from the resistor
    a. The Rpi adaptor provides 5V and up to 2 Amps, is this current sufficient?
        - Yes, because it's less than 5
    b. What do you think might happen? Please don't actually do this.
7. Connect a resistor of more than at least 100Ω (Why might this be enough resistance?)
    a. If you have a multi-meter able to measure current evaluate the current across the resistor, is it what you expected?
        i. NOTE: to measure current, you have to put the meter in series with the rest of the circuit – it cannot measure current like it would voltage (connecting leads to +/- side of a component) – the current has to run through the meter
            - We were not able to get it to work.

LED in a circuit:

1. Add an LED to your circuit
    a. Put it in series with the resistor and move the +/- connectors to the RPi 5V supply as needed
        i. How does the diode need to be oriented? Which wire on the LED goes to the +5V side and which goes to the GND connector?
            - The longer side need to be connected to the higher potential, which is the positive side of the breadboard
    b. What is the voltage drop across the resistor? Was this what you expected?
        - The voltage drop is 1.08 volts.
    c. What is the voltage drop across the LED?
        - The led is drop is roughly 3.98 votls.
2. Try removing the resistor from the circuit, keeping the circuit closed - the LED is just in series with the 5V supply.
    a. What do you think will happen to the LED brightness?
        - The led will become brighter because there is more voltage going through the light.
3. Try including resistors of different values - how does LED brightness change vs resistor strength?
    - The higher the resistance, the lower the brightness of the led. Similarly, the lower the resistance, the higher the brightness of the led.
    - 220 ohms resistance: voltage drop is 1.5, led drop is 3.5
        i. Do the voltage drops across the resistors and LED change?
4. Using the configuration with the highest LED brightness now move the 5V connection on the RPi to one of the 3.3V pins.
    a. What do you expect to happen to the LED brightness?
    - The led will be less bright because there is a drop in total voltage.
5. Add a step-up circuit components to increase your RPi voltage from 5V to 10V but do not close your circuit yet
    a. Using the dimmest configuration for the LED explored previously (meaning select the appropriate resistor from those you tried previously) now
    b. How will the LED brightness change?
        - The led is brighter.
6. How would you quantify the LED brightness changes?

- The LED brightness increase by roughly ⅓ the brightness of the 5V LED brightness.

7. Do any of these results change with different color LEDs? Specifically do any voltage drop values change, is the relative brightness similar for different color LEDs, etc.

- No, these results stay the same when using different colored LED lights.

Photo-diode:

1. Replace the LED with a photo-diode (remove the step-up component as well if you had one included previously)
    a. NOTE: photo-diodes operate in reverse bias mode so you will need to orient the diode accordingly
2. What is the voltage across the resistor when you simply connect the 5V supply to close this circuit?
    - The voltage is 0.003 volts.
3. What happens if you cover the photo-diode? What happens if you change the +connector to go to the 3.3V pin on the Rpi?
    - When we cover the phot-diode, the voltage drops to zero. When we change the connector to 3.3V the results are the same as 5V.
    a. What is the dark current for this photo-diode? (Use the voltage across the resistor to determine diode current)
        - I = 0.002/200 = 0.00001 Amps
    b. Is 5V enough supply voltage to see a signal from this diode? Is 3.3V?
        - No the 5V and the 3.3V is not enough to see a signal.
    c. What happens if you attach the step-up circuit component to increase the supply up to 10V?
        - Nothing happened
4. What are the dark current and saturation current for the photo-diode?
    - Dark current = 0.00001 Amps and we were not able to saturate it due to our conditions.