Lab 1 – Electronics Introduction

Objective

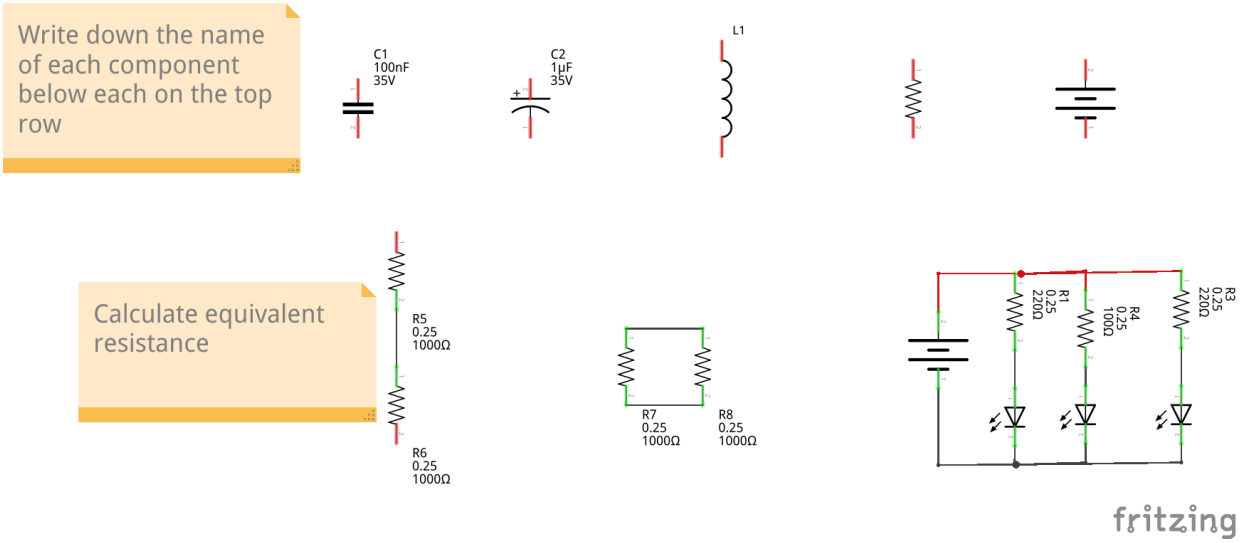
- Use test equipment to test and verify components
  - DMM
  - Power supply
  - Logic probe?
- Learn how breadboards connect circuits
- Use best practices to succeed in your lab
  - Test your components before you use them. It's much harder to diagnose once it's all hooked together
  - Try to test circuits in isolation as you build them, testing smaller pieces is much easier than testing the whole.
  - Cut wires to exact lengths
  - Color code correctly: red = high, black = 0V (ground)
  - Keep connections as short as possible: plan layout so parts to be connected are close together
  - Minimize the number of connections. Each one can go bad, so the fewer connections, the higher the chances your circuit will work
- Learn basic facts about resistors and LEDs for future labs

Materials

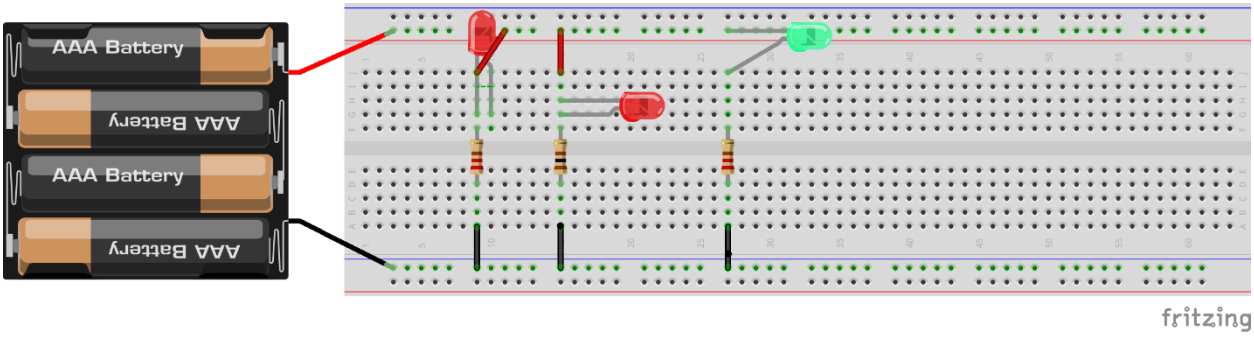
4 resistors of value 1
4 resistors of value 2
3 red LEDs
1 green LED
3 220 Ω resistor
1 100 Ω resistor

Pre-Lab Procedure

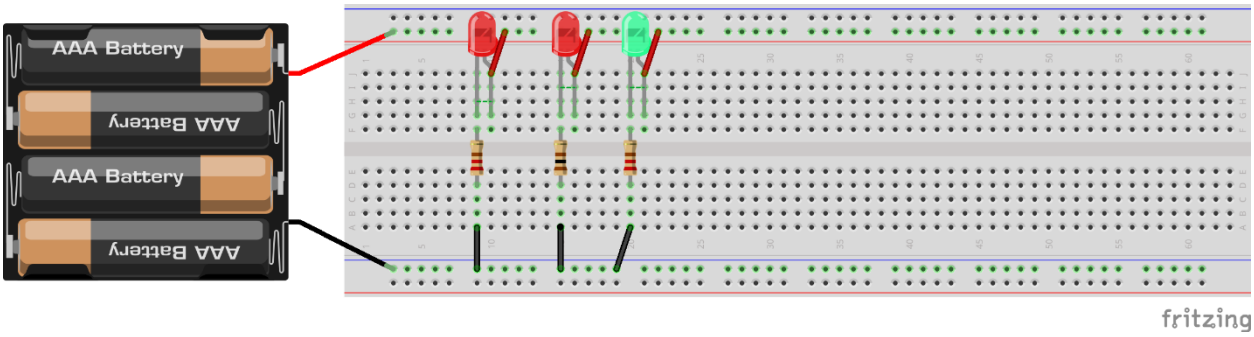
1. On the following schematic, identify each symbol
2. Calculate the equivalent resistance of the series circuit: _____
3. Calculate the equivalent resistance of the parallel circuit: _____
4. Label which side of the battery is positive and draw the direction of the current in each branch.



5. Identify the bugs in each LED circuit.



6. Assuming Vcc = 5V, calculate how much current would flow through each resistor. Use V = I*R



In-Lab Procedure

1. Read the color codes on the resistors and identify the nominal resistance:
   value 1: _____ value 2: _____
   If you are color blind, your lab partner will perform this step. Approximate 8% of males and 0.5% of females have varying forms of color-blindness. If by chance both lab partners are colorblind, ask the TA for the nominal value, record it here.

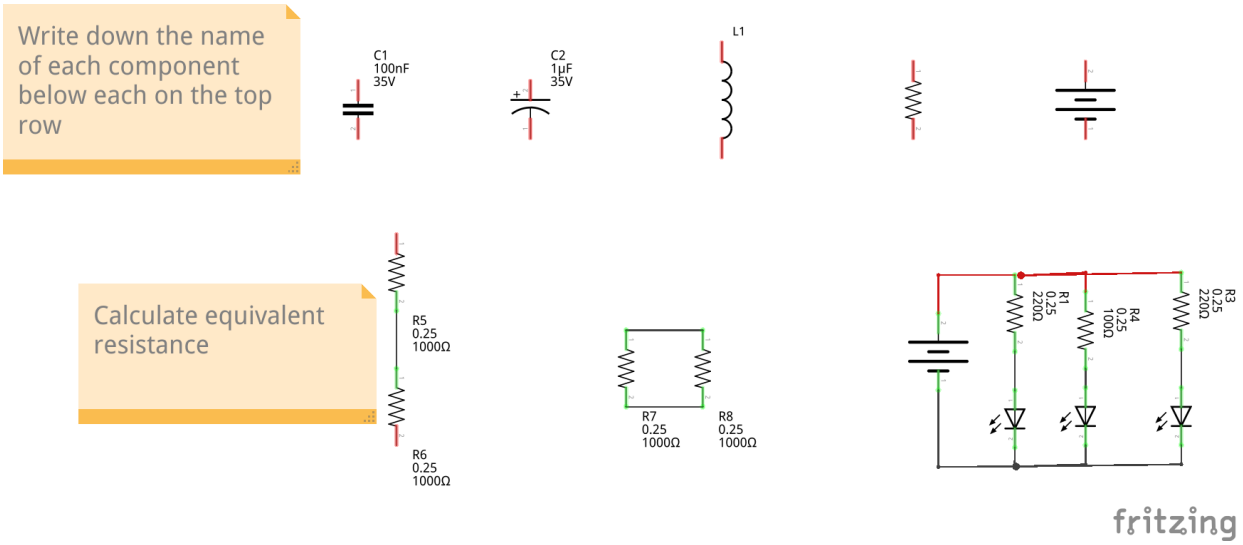
2. Measure each resistor of the same type using the Digital MultiMeter (DMM) and record the values:
   _____, _____, _____, _____
   _____, _____, _____, _____
   The resistors should be 5% tolerance. Are any resistors outside this range? _____
   Are any values exactly equal to the nominal values? _____
   Explain here:

3. Resistors in series add: $R_{eq} = R_1 + R_2$
   Resistors in parallel: $R_{eq} = \frac{1}{\frac{1}{R_1}+\frac{1}{R_2}}$

   Given the resistors you have, construct a resistor of 1333Ω
   Measure the actual resistance of your resistor network _____
   Draw the circuit schematic by hand

4. Given the resistors you have, construct a resistor of 20kΩ
   Measure the actual resistance of your resistor network _____
   Draw the circuit schematic by hand

5. Read the following schematic



6. Build a circuit with a red LED in series with a 220Ω resistor.
   Look up the LED in the spec sheet supplied. What is the maximum current at room temperature that the LED can take? _____

7. Set your power supply for 5V and apply it to your LED. If it does not light, debug.
   a. There are a number of common errors
      i. LEDs only allow current through in one direction, it might be backward
      ii. You could be mis-constructing the circuit on the breadboard
      measure the voltage across the entire circuit which should be 5V
      _____
   b. measure the voltage across the resistor. If current is flowing, then the voltage across the resistor will be V=I*R. Measured Va=_____ compute I=_____
   c. Measure the voltage across the LED Vb=_____
   d. Calculate Va + Vb = _____

8. Build the same circuit for a different color LED.
   a. Measure voltage across the LED _____
   b. Calculate current through the resistor _____

9. Power a 7404 chip according to the diagram given. Vcc = 5V (no more)
   connect input of one of the inverters to 0V. The output should be high. Connect a second gate input to 5V. The output should be 0.
   a. Measure the output voltage 1: _____
   b. Measure the output voltage 2: _____

c. Connect the output of the first gate to the positive side of an LED circuit so it lights up (but dimly).
d. Measure the voltage across the resistor. _____
e. Calculate the current by measuring the voltage across the resistor. I= _____. 74LS logic can only put out a small current so in this configuration, the LED will be dim.
f. Connect the output of the second circuit to the negative side of an LED-resistor circuit. Turn the circuit on by setting the input to 5V, driving the output to 0V