Question 1 (10 pts)

A common size jumper wire in our kit is 4 inches long and made of AWG 26 copper wire (a.k.a. “26 gauge wire”).

a. (2 pts) According to a table of wire gauge resistances http://hyperphysics.phy-astr.gsu.edu/hbase/Tables/wirega.html what is the “Ohms per 1000 ft”?
b. (4 pts) How much resistance would a single 4 inch jumper wire have?
c. (4 pts) How many jumpers connected in a row would create 1 ohm of resistance?

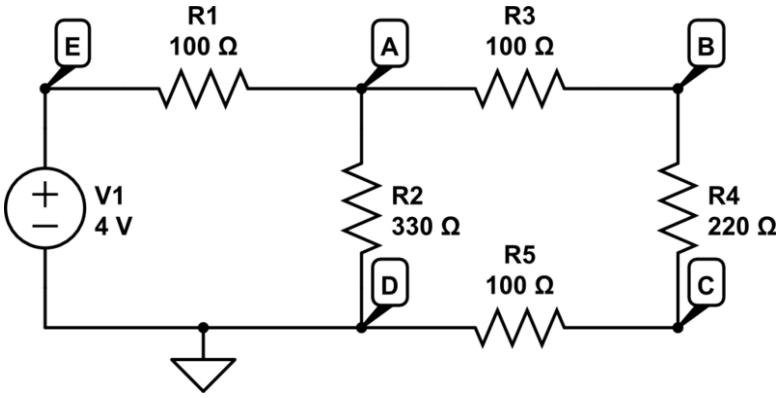
Why does this exercise matter? It shows quantitatively why we usually ignore resistance from wires in our circuits. Note that our calculation ignores the resistance of a contact (e.g., where two conductors are pressed together, such as when you plug a wire into the breadboard).

Question 2 (20 pts)

A 4V DC voltage supply is connected to a network of resistors shown below.

A. (10 pts) Calculate the currents through R1, R2, R3, R4, and R5
B. (10 pts) Calculate the voltages at the nodes A, B, C, D, and E.

Note: Don’t ignore the ground symbol, which defines where to consider a voltage of zero.



Why does this exercise matter? It gives opportunities to apply circuit modeling techniques from UP2. If you are having trouble getting started, you can use series and parallel resistances to find the overall resistance of the circuit. Then find the current through R1 and then the voltage drop across R1. With that info in hand, other quantities can be calculated.

Question 3 (20 pts)

A. (10 pts) Build the circuit from Question 2 in CircuitLab. Include a screenshot of your schematic.
B. (10 pts) “Simulate” the circuit in DC mode and measure
    a. Voltage at each node (A, B, C, D, and E)
    b. Current through the different resistors

    A screenshot of the simulation results is also fine.

Notes

- Note Questions 2 and 3 should give the same results within the numerical precision of your calculations.
- This video gives a quick example of how to draw the circuit and run the simulation. https://youtu.be/GPMVnX_IrmM

Why does it matter? It gives you practice with a circuit modeling program (CircuitLab). Also, you can use the results of Q3 to check your solution to Q2.

Question 4 (20 pts)

Recall from University Physics 2, the capacitance of parallel plate capacitors is given by $C = \epsilon_0 A / d$ where A is the area of the plate and d is the distance (gap size) between the two plates.

Suppose we made a capacitor by using two sheets of aluminum foil and separating the foil by a sheet of paper.

a. (10 pts) Estimate the capacitance of two sheets of aluminum foil the size of a standard piece of 8.5x11 printer paper, and separated by the thickness of a single sheet of paper.
b. (10 pts) With this capacitor, what resistance would be needed to achieve a 1 ms RC time constant?

Why does it matter? This question is a pre-lab question for lab 2 helping you think about parameters for measuring the RC time constant of a DIY parallel plate capacitor.