EECE 251 - Lab #1

Resistive Networks, KVL, KCL, Breadboard, Multimeter.

Due: Right at the end of the session.

This part is for the TA to fill out:

	1	On time
	2	Breadboard prototype from home
	3	Answer to pre-laboratory video question
	4	Clean work area and reset instruments after the experiment.
	5	Experiment Complete

(1) Within the first 10 minutes of the session.
(2) Only the first of the circuit configuration, and according to the quality shown in the video.
(3) One question that explores a random aspect of the video tutorials up to this experiment.
(4) All of the following points need to be met: (a) Turn off all equipment; (b) Turn knobs of voltmeter all the way counterclockwise; (c) clean surface of the workbench; (d) Clean floor around and below the workbench; (c) Multimeter red probe connected to the “volts” socket; (e) Chairs tucked neatly under the table of the workbench.
(5) All measurements were completed and written on this “report”.

Date of lab session: ___________________________ Laboratory section: _________________

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The main objective of this lab experiment is to acquaintance you with what are the eyes and ears of the electrical engineer; namely: the voltmeter, the ammeter, the ohmmeter; and to soldering safely in electronic circuits; and the fundamental tool of prototyping, the breadboard. As a secondary objective, a quick visit to Kirchoff’s circuit laws.

WARNING: Always power off the power supply (the batteries, in our case in this experiment) before changing (connecting or disconnecting) anything (with the exception of the voltmeter) to your circuit.

A) <u>Pick up the following components from your kit</u>:

1. Goggles (For safety reasons, you need to wear them at all times in the lab, as well as toe covered shoes, no sandals, nor bare feet allowed in the lab either, nor very high heel shoes).
2. Two alligator connectors (one red, one black)
3. One 1 kΩ resistor.
4. One 2 kΩ resistor.
5. One 3 kΩ resistor.
6. One 3.9 kΩ resistor.
7. One 5 kΩ resistor.
8. One 500 Ω resistor.
9. Two AA batteries, and their corresponding cradles.

B) <u>Make your own extension alligator cables for the multimeter</u>

Following the instructions given on wire stripping and soldering, in the video prelab on making your multimeter extensions, make your own team's alligator extension cables for the multimeter and take them with you, at the end of the session, to use in every future lab experiment. Always wear your safety goggles (and make sure that everybody at your workbench is wearing them too while YOU are soldering, as hot molten solder can fly off in odd patters when the solder-person shakes his/her hands while soldering). Make sure the soldering is of high quality to ensure successful future experiments in all these courses. You'll make one black cable and one red cable (Of course, match the color of the cable to the clip). Use the temperature setting as per the TA's instructions for the soldering iron. Strip the wires, clip off a pair of strands and insert the rest in the clip. Make sure to wind the wire clockwise around the screw, then tighten the screw and finally apply the hot iron to the "hole" and touch the iron with the solder to create a little blob of molten solder, retire the solder reel and keep applying the iron to the blob, until the blob liquefies and flows inside the hole and around the wire. (If it becomes a blob, or if it "glazes", it is not hot enough, just keep on heating it). Do not apply excess of solder.

C) <u>Using the ohmmeter. Color code values and actual values for resistors.</u>

Following the instructions in the prelab video on the use of the multimeter as a voltmeter and using the same probe connections as for the voltmeter, but push the select button for ohms instead (the button with the Ω on it). Then, to measure the resistance of a given resistor, connect the resistor under test between the red and the black probe. DO NOT do it in your hands, as the reading would depend on how much pressure you apply, how dry and clean your hands are; use the breadboard instead, plug the black and red probes to two multiclips about five slots apart, then plug in the resistor between those two multiclips (do not clip the terminals of the resistors for these ohms measurements). For each one of the five in the schematics below (labelled R_1 up to R_6 in increasing value of resistance), measure the actual resistance, write the theoretical (colour coded) resistance, and compute the percent error with respect to the theoretical value. (The HP-50g also has this function[1]). Is ΔR within the tolerance?

	Measured kΩ	Color code value kΩ	% Δ*
R_1			
R_2			
R_3			
R_4			
R_5			
R_6			

[1] To access it, press red-shift CAT, that activates the "catalogue" of all the pre=programmed functions in the HP-50g, scroll up to %CH. TO use it, color value in stack level 2, and measured value in stack level 1.

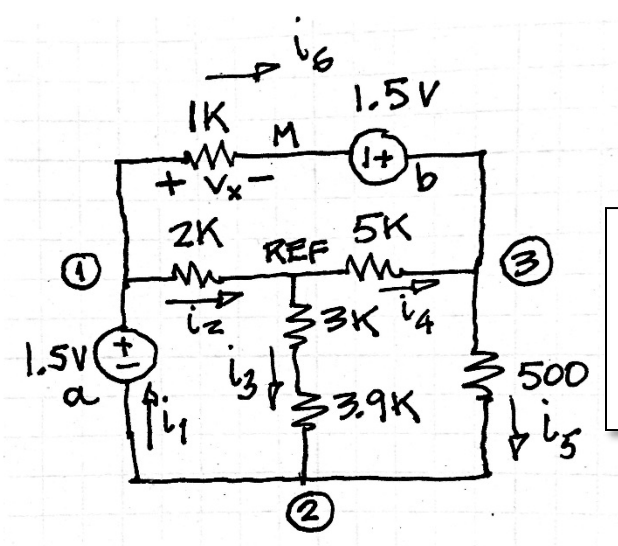
D) <u>Using a breadboard and the ohmmeter.</u>
At home, before you come to the lab, for the circuit whose function schematics is shown in the figure below, prepare a wiring schematics, and then wire it on your breadboard. Bring this circuit already mounted on the breadboard to the lab the day of your session. It will be graded by the TAs and it will become part of your lab grade (20% of that day's lab grade). As soon as the TA approves your wiring, disassemble it completely, and do it again … in the lab.

Important: In every branch where you'll need to measure the current later, insert a jumper in series with the elements in the branch. You will replace that jumper with the ammeter, as per the video on "making the extensions to the multimeter probes".

Replace the battery (voltage source) 'b', on the top branch of the circuit, by a jumper, and connect the Ohmmeter in lieu of the voltage source 'a' (that will read what we call "the equivalent resistance seen by the voltage source 'a'"). Compute that resistance using series and parallel simplifications. Compute the % difference between the measured and the theoretical value you computed.

Measured	Theoretical[2]	% Δ*

$$\Delta\% = \frac{measured - theoretical}{theoretical} \times 100\%$$



K = kilo-ohms.
500 = 500 ohms.
Observe the location of the reference, labeled REF.

[2] To compute this "theoretical" value, with the circuit as described, use parallel and series simplification until the source is connected to one equivalent resistor only. Use the resistance values given by the colour code of each resistor in these computations.

E) <u>Measuring currents and voltages</u>. Replace the wire in the previous part, the jumper, back for battery (source) 'b', as per the schematics. Connect also the source 'a'. Measure the voltages and currents indicated in that schematics. The voltages of nodes 1, 2 and 3 with respect to the indicated reference (see the figure), the voltage in source 'b', V_b, and voltage V_x. And then measure the six currents indicated in that function schematics (Remember to preinstall jumpers in every branch where you'll be measuring currents, which in this case is all of them, so you can simply replace that jumper by the ammeter and done).

	Value measured	Units
V_1		
V_2		
V_3		
V_4		
V_5		
V_b		
V_x		
i_1		
i_2		
i_3		
i_4		
i_5		
i_6		

F) In the circuit in the previous part, add all voltages around the loop on the top of the schematics (you'll have to compute first the voltages the 2k and 5k resistors, using the voltages measured in the table above) and write that sum in the KVL entry for the table below. Also, at the node labelled (2) in the circuit, add all currents arriving and subtract all currents leaving and write your result in the KCL entry of the table below.

KVL	
KCL	