Name:	Lab Session: L01	TA:
Score:	/ 10	

Online Lab 1: Resistor Networks, Voltage and Current

INTRODUCTION:

The purpose of this lab is to simulate the building of a basic resistor circuit on a breadboard, and make measurements of current and voltage. You will need to apply the concepts from unit A.1 including the basic circuit laws and voltage divider rule to work out the problems in this lab.

Learning outcomes

- ☐ Apply the basic circuit laws to evaluate resistance, voltage difference and current
- ☐ Analyze and implement basic resistor networks on a breadboard
- ☐ Simulate the circuit using LTSpice and Tinkercad

PRE-LAB

1. Download LTSpice from https://www.analog.com/en/design-center/design-tools-and-calculators/ltspice-simulator.html#. For MAC users, please note the shortcuts: https://www.analog.com/media/en/simulation-models/spice-models/LTspiceShortcutsForMacOSX.pdf?modelType=spice-models
2. Register an account in Tinkercad (https://www.tinkercad.com/). Before the lab, you shall complete all four lessons in the following link: https://www.tinkercad.com/learn/project-gallery;collectionId=0IYJ88OJ3OPN3EA Make sure that you have watched the lab basics video about breadboard on CANVAS.

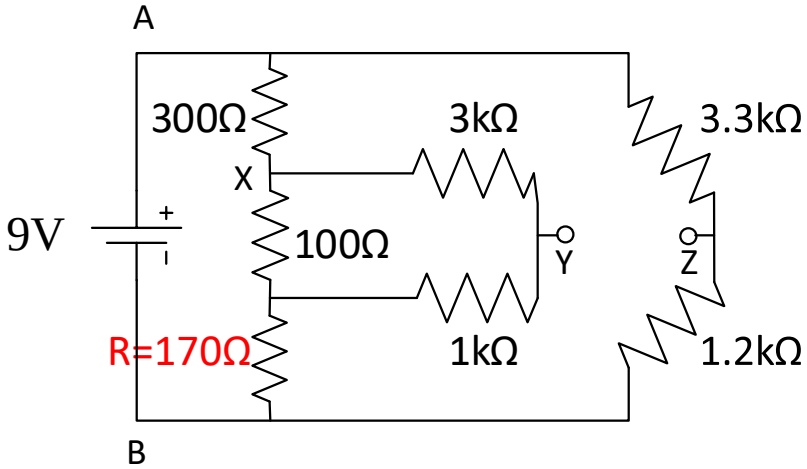

Fig 1: Circuit for lab tasks 1 to 3. R is an unknown resistor to be announced in the lab.

Mark down value of R based on the announcement by the **TA** at the beginning of the lab:

R = 170 Ω

LAB TASK 1: CIRCUIT SIMULATION WITH LTSPICE

LTSpice is a circuit schematic editor and simulator. The circuit can be simulated after the schematic is drawn. Voltage or current can be displayed by clicking on nodes or electronic components in the schematic. Build the resistor network shown in Fig 1. in LTSpice. Apply **9V** across terminals A-B of the resistor network you have built for in Fig 1. Simulate the voltage differences across the following branches:

a) Voltage across 100Ω = 1.5471V

b) Voltage across R = 2.6957V

c) Voltage across 1.2kΩ = 2.4000V

d) Voltage across terminal Y-Z = 682.51mV

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Simulate the currents through the following branches:

a) Current through 300Ω between A-X = 15.8573mA

b) Current through R = 15.8573mA

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Share your screen in ZOOM with the TA for the TA to mark this task. Save and submit the LTSpice file to CANVAS.

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Tips (for MAC users):

- Right click allows you to:
  *- Select **Draft** and to insert **Component** (e.g. you may search for resistor and voltage source from the list)*
  *- Select **Draft** for **Wires** to connect different components (left click to connect to nodes)*
  - Edit an item property by clicking on it

*- You may also use shortcuts, e.g. "**g**" to place the **ground.***

- You can choose the type of simulation under "Simulation" - "Edit Simulation Command".

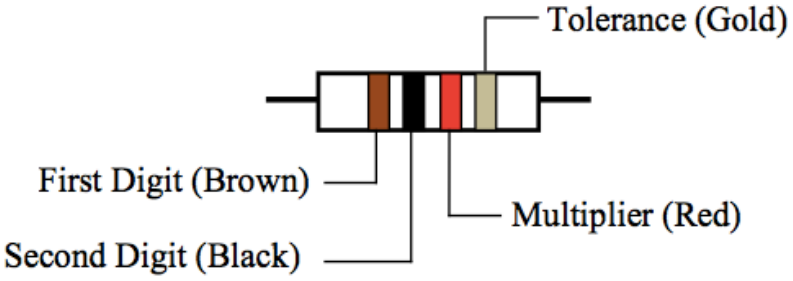
*(For OSX users, use shortcut "**s**" to add a SPICE directive then right click in text box and choose "Help me edit"). In this lab, you just need to select the tab "**DC Bias Point**" and then press OK to put the text command anywhere on the schematic.*

- Press the Run button  *to initiate the simulation.*

- After running a simulation, click on a terminal/device of interest to plot the voltage/current in the pop-up window; or click  *at the top of the pop-up window to add the voltage/current trace to be plotted.*

LAB TASK 2: RESISTOR NETWORK CONNECTION

The resistance of a resistor is printed onto the resistor in color code. A pattern of colored rings is used. Most resistors have three rings to encode the value of the resistance, and one ring to encode the tolerance in percent, as shown below.



Color	Value
Black	0
Brown	1
Red	2
Orange	3
Yellow	4
Green	5
Blue	6
Violet	7
Grey	8

For example, a resistor with the color code shown above indicates a resistance of 1kΩ.

The first band is brown which indicates 1.
The second band is black which indicates 0.
The third band is red which indicates 2.

Therefore, the resistance is 10×10^2 Ω, i.e. 1kΩ.

What is the color code of the resistor with resistance R?

Ans: Brown - Violet - Brown - Gold

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(You can self-check your answer here: http://www.dannyg.com/examples/res2/resistor.htm)

Build the resistor network shown in Fig 1. on the **breadboard** in **Tinkercad**, and simulate the equivalent resistance of the resistance across terminals A-B. Share your screen with the TA in ZOOM to get this task marked.

$R_{AB} = 504\Omega$

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LAB TASK 3: SIMULATE VOLTAGE DIFFERENCE IN TINKERCAD

Using the power supply or multiple batteries, apply 9V across terminals A-B of the resistor network you have built in Lab Task 2 just like in Fig 1. Simulate the voltage differences across the following branches:

a) Voltage across 3.3kΩ = 6.58V

b) Voltage across R = 2.69V

c) Voltage across 1kΩ = 386mV

d) Voltage across terminal Y-Z = 680mV

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LAB TASK 4: SIMULATING BRANCH CURRENTS IN TINKERCAD

Simulate the currents in Fig. 1. through the following branches:

a) Current through 300Ω between A-X = 33.4mA

b) Current through R = 22.5mA

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Share your Tinkercad drawing with the TA to get this task marked, and submit the link to CANVAS.

https://www.tinkercad.com/things/c70jvWYhOtB-neat-waasa/editel?tenant=circuits?sharecode=mvXIEIFFv3prBQlNJje2lvkxzKeR57MKnYUTSBY8WcY **_____ / 1**