

Name \_\_\_\_\_

- 1. \_\_\_\_\_ (10 pts)
- 2. \_\_\_\_\_ (6 pts)
- 3. \_\_\_\_\_ (12 pts)
- 4. \_\_\_\_\_ (14 pts)
- 5. \_\_\_\_\_ (8 pts)

Total \_\_\_\_\_

For partial credit on some questions, you may want to re-draw/label circuit diagrams to clarify your answers.

Show all of your work. Use the backs of pages if there is not enough room on the front.

Many problems can be solved using more than one method. Check your answers by using a second method.

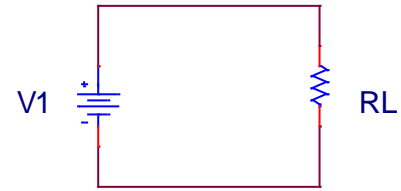
At least skim through the entire quiz before you begin and then start with the problems you know best.

The proctor will only answer clarification questions where wording is unclear or where there may be errors/typos. No other questions will be responded to.

**Problem 1 (10 Points) – Ohm’s Law**

A simple voltage source-resistor circuit is shown to the right.

- a. Determine the current through **RL** (in mAmps) when  $V_1=10V$  and  $RL=2k\Omega$ . (4 pts)



- b. For the same circuit, if the voltage increases while the resistance stays constant, the current will (circle one) (1 pt)

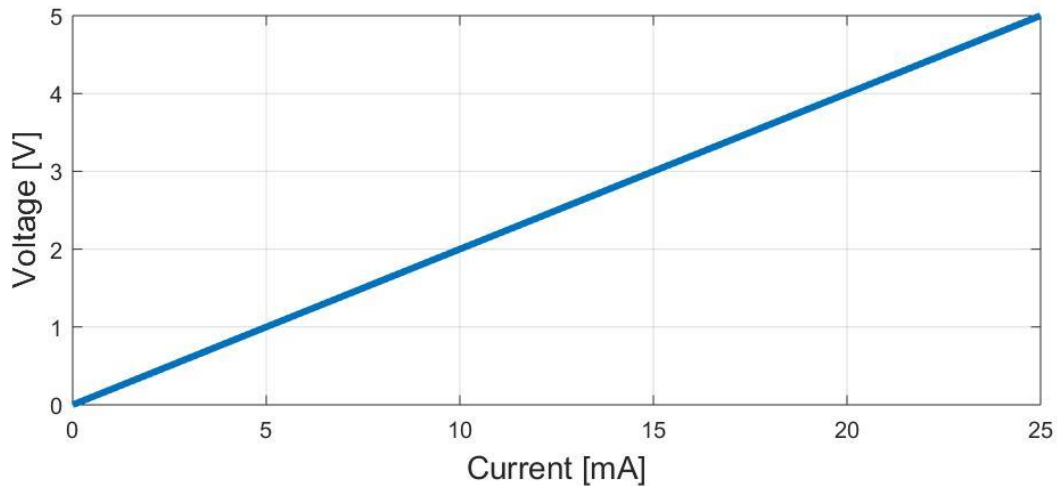
Increase

Decrease

- c. For the same circuit, if the resistance increases while the voltage source stays constant, the current will (circle one) (1 pt)

Increase

Decrease

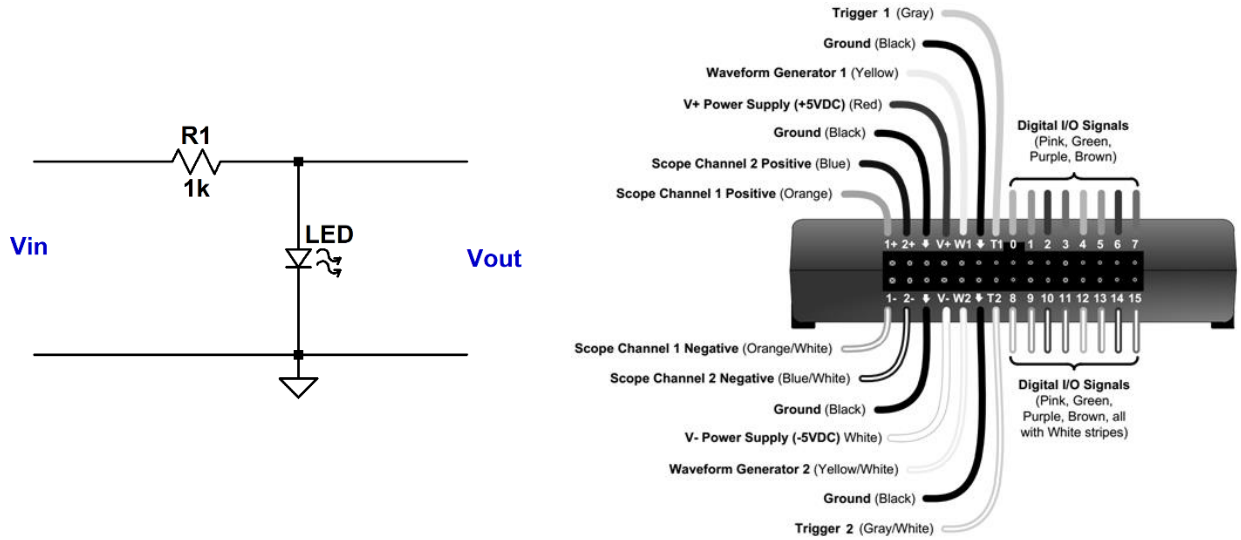


The above linear plot relates voltage and current in a resistor (similar to the circuit at the top of the page).

- d. Based on the plot, determine the value of the resistance. Note, the current is given in mA ( $10^{-3}$  A) (4 pts)

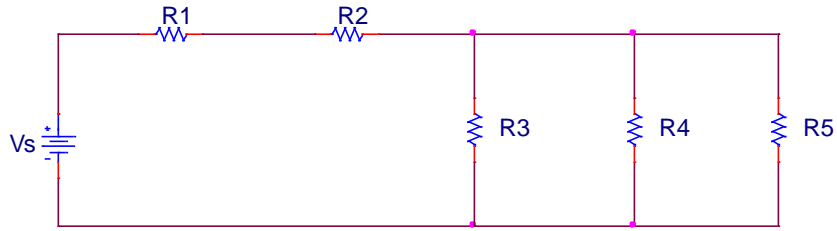
**Problem 2 (6 Points) – The Discovery Board**

- a) In the figure below, draw lines from the Discovery Board to the circuit that represent the wires you need to connect when measuring the output voltage  $V_{out}$  with **Voltmeter Channel 1**, i.e. voltage across LED. Additionally, draw lines to provide an input voltage  $V_{in}$  of 5V DC to the circuit using the Analog Discovery (no additional instrumentation). Remember, to generate a DC voltage with Wavegen, you need to use **two connections** from the Discovery Board. (4 pts)



- b) If your measurement for  $V_{out}$  is 2.0V (when  $V_{in}$  is 5V), find the current that flows through the resistor R1. (2 pts)

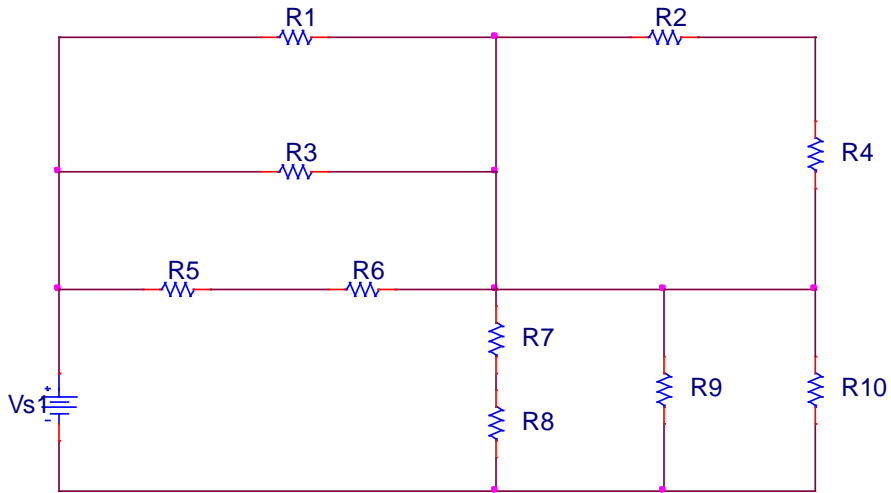
**Problem 3 (12 Points) – Resistors in parallel and series**



a) For the above circuit, indicate which resistors are in series and which resistors are in parallel. (4 pts)

Series: \_\_\_\_\_

Parallel: \_\_\_\_\_



b) For the above circuit, indicate which **pairs** of resistors are in series and which pairs of resistors are in parallel. Each line is for a specific pair. There may be more lines than needed. (8 pts)

Series: \_\_\_\_\_

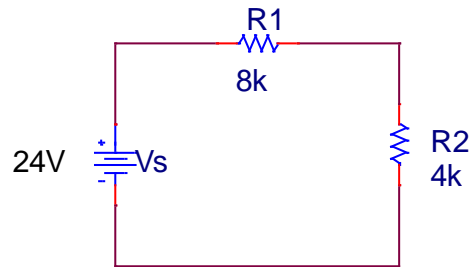
Series: \_\_\_\_\_

Series: \_\_\_\_\_

Parallel: \_\_\_\_\_

Parallel: \_\_\_\_\_

Parallel: \_\_\_\_\_

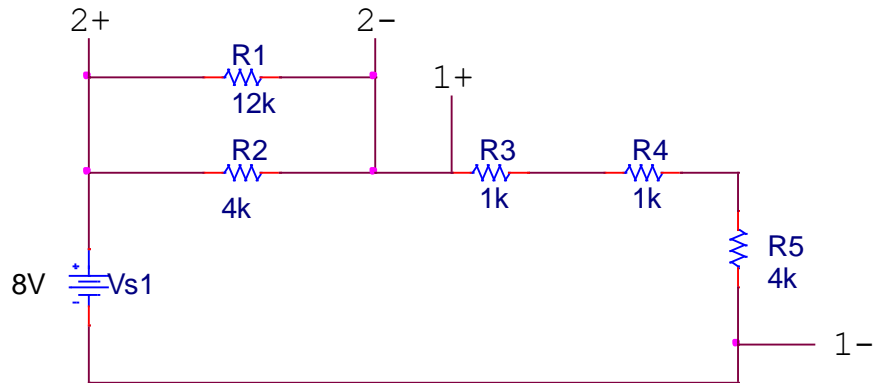
**Problem 4 (14 Points) – Voltage Dividers – Part 1**

- a) For the above circuit, determine the voltages across  $R_1$  and  $R_2$ . (4 pts)

$R_1$ :

$R_2$ :

- b) If  $R_2$  becomes very large (goes to infinity) and  $R_1$  stays the same, what is the maximum voltage across  $R_2$ ? (1 pt)
- c) If  $R_1$  becomes very large (goes to infinity) and  $R_2$  stays the same, what is the minimum voltage across  $R_2$ ? (1 pt)

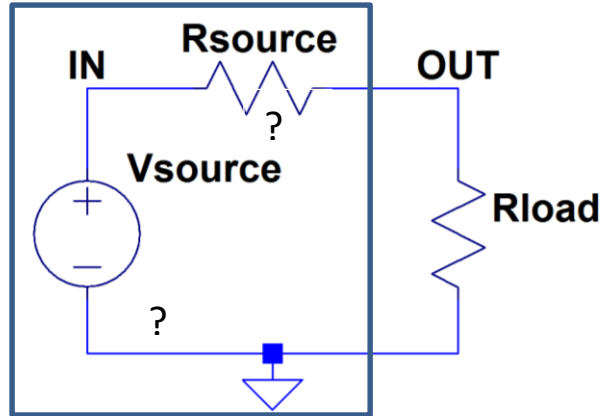


- d) Apply series and parallel relationships to obtain a simplified two resistor ( $R_{\text{series}}$  and  $R_{\text{parallel}}$ ) circuit. Sketch the new circuit. (4 pts)

- e) Use your simplified circuit to determine the voltages across the equivalent resistors,  $R_{\text{series}}$  and  $R_{\text{parallel}}$ , as indicated by the Channel 1 and 2 connections in the original circuit. (4 pts)

**Problem 5 (8 Points) – Source Characterization Using a Voltage Divider**

Batteries and other voltage sources can generally be modeled by combining an ideal voltage source and a resistor. The circuit at the right is set up to study some kind of a black box DC voltage source. Different load resistors are connected and the voltage  $V(\text{OUT})$  is measured. The results of the trials are listed in the table below. *Note that there is more information than you need to find the source voltage and resistance.*



Trial	Rload	V(OUT)
1	1Ω	0.692V
2	2Ω	1.245V
3	10Ω	4.276V
4	20Ω	6.316V
5	100Ω	10.15V
6	200Ω	11.01V
7	1kΩ	11.787V
8	2kΩ	11.892V
9	10kΩ	11.978V
10	20kΩ	11.989V

- a. (4 pts) Determine the source voltage  $V_{\text{source}}$  (in Volts)
  
- b. (4 pts) Determine the source resistance  $R_{\text{source}}$  (in Ohms)