Physics 12 **Name:** _____

Block: _____

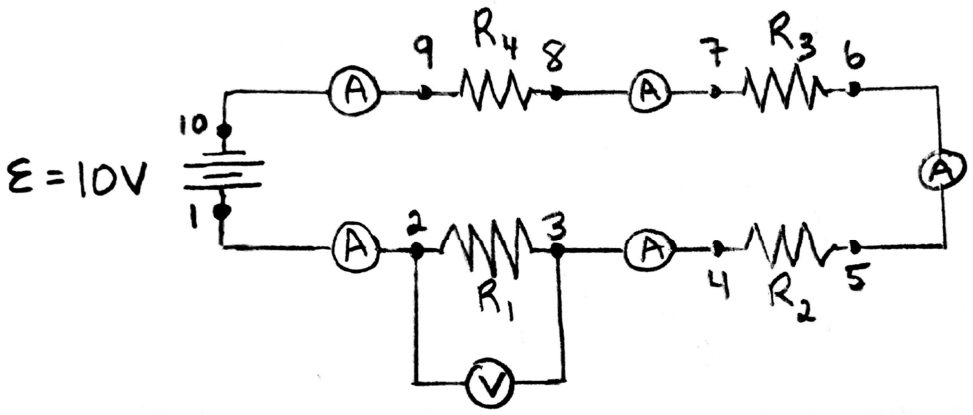
Lab 7: Kirchhoff's Laws for Circuits

Purpose: To examine several circuits from the point of view of Kirchhoff's laws.

Materials:

- Website: https://phet.colorado.edu/en/simulation/circuit-construction-kit-dc (Use the "Lab" part.)

Part A: A Series Circuit



Procedure:

1. To check Kirchhoff's current law, create a series circuit like the one above (with $R_1 = 10\Omega$, $R_2 = 30\Omega$, $R_3 = 60\Omega$, $R_4 = 120\Omega$) and insert an ammeter, in turn, at each indicated location. Record the measured currents on your diagram.

   How would you describe the current at various locations in your series circuit? Does it support Kirchhoff's current law?

2. To check Kirchhoff's voltage law, measure the terminal voltage of the battery or power supply, $V_{1\text{-}10}$. Then measure the voltages between the ends of each resistor. Remember that the voltmeter is not in the same conducting path as the circuit. An example is shown across R_1. Record all the voltages onto your diagram beside the battery and resistors. (Ignore negatives.)

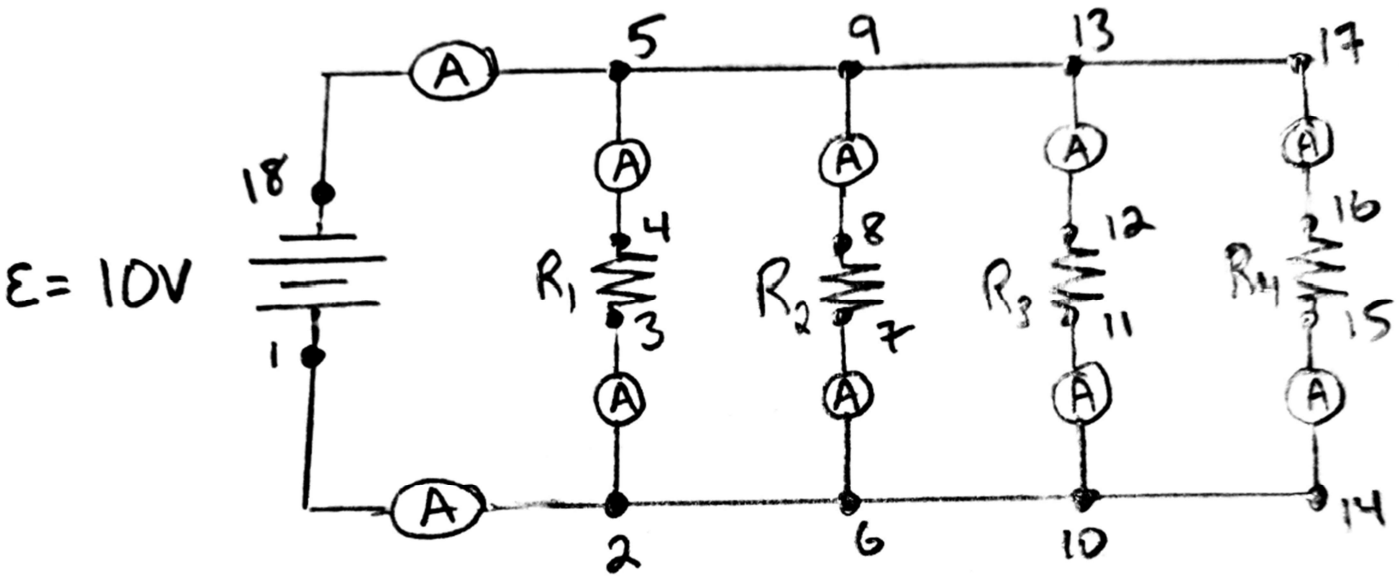
   Compare the potential gain in the battery (terminal voltage) with the potential drop in the resistors in the circuit. Do your results suggest that $\sum V = 0$?

3. Equivalent/Total Resistance:
   a. Calculate the equivalent/total resistance of the entire series circuit using the terminal voltage and the current through the battery. (Ohm's Law)

   b. Calculate the total resistance of the series circuit by adding the 4 resistances together.

   c. Calculate the percent difference of the two total resistances.

Part B: A Parallel Circuit



Procedure:

4. To check Kirchhoff's current law, create a parallel circuit like the one above (with R_1 = 10Ω, R_2 = 30Ω, R_3 = 60Ω, R_4 = 120Ω) and insert an ammeter, in turn, at each indicated location. Record the measured currents on your diagram.

   How would you describe the current at various junctions in your series circuit? Does it support Kirchhoff's current law?

5. Measure the terminal voltage of the battery or power supply, $V_{1\text{-}18}$. Then measure the voltages between the ends of each resistor. Record all the voltages onto your diagram beside the battery and resistors.

   Compare the potential gain in the battery (terminal voltage) with the potential drop in the resistors in the circuit. Do your results seem to confirm Kirchhoff's voltage law?

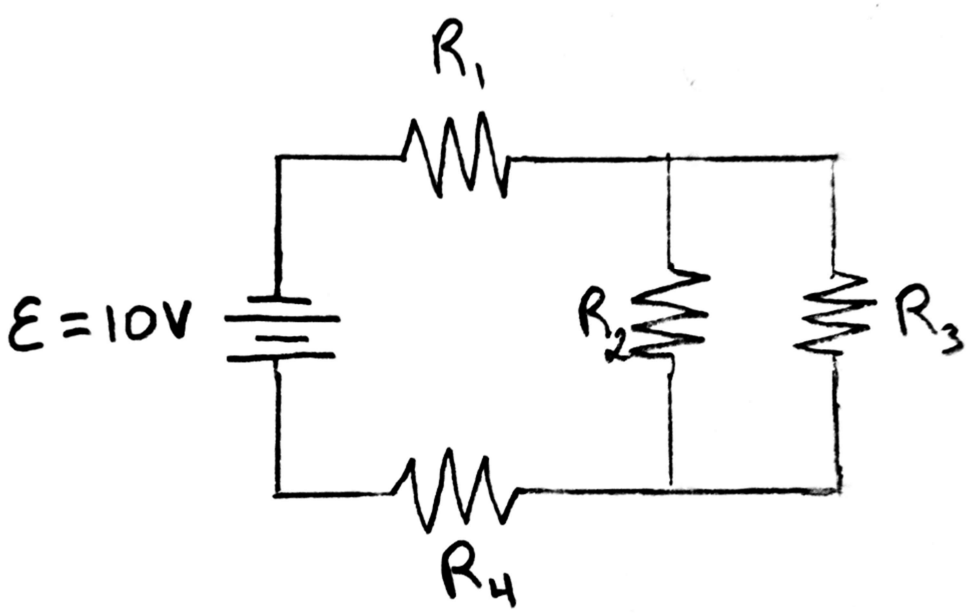
6. Equivalent/Total Resistance:
   a. Calculate the total resistance by using Ohm's law across the battery.

   b. Calculate the total resistance in the parallel circuit, R_p, using:
   $$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4}$$

   c. Calculate the percent difference of the two total resistances.

   d. If this were a real circuit, what kinds of errors might be present?

Part C: In Summary … Combined (Series-Parallel) Circuits



7. Similar to parts A and B,
    - set up the above circuit (using 10Ω for all resistors might make this part easier) and measure and record the voltages and currents.
    - Explain how your results confirm Kirchhoff's laws.
    - Use your results to calculate the equivalent resistance of the circuit.