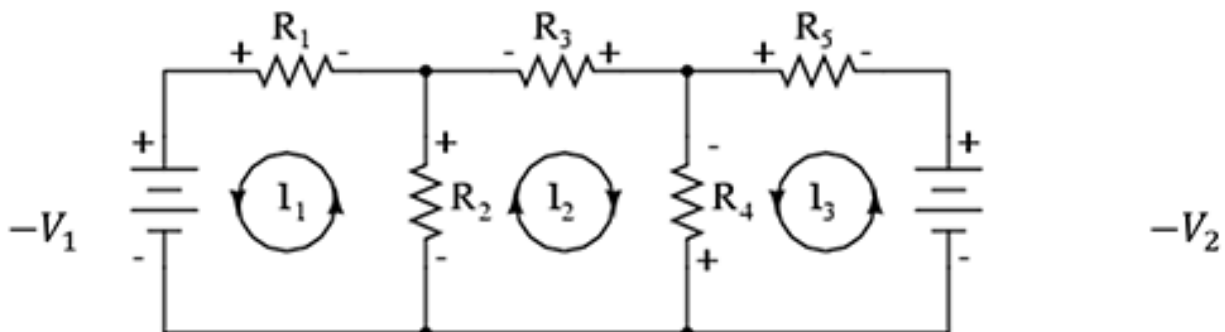Name: _____ Date: _____ Class: _____

Electronic Circuit Worksheet Answer Key

Using systems of equations and Ohm's law to solve a circuit problem.

Part 1: Using a TiNspire calculator, solve the following three equations with three unknown variables. The three unknowns are the currents represented by I_1, I_2, and I_3, as illustrated above.

The equations needed for the analysis of the above circuit are:

(1) $-V_1 + R_2(I_1 + I_2) + I_1 R_1 = 0$

(2) $-R_2(I_2 + I_1) - R_4(I_2 + I_3) - I_2 R_3 = 0$

(3) $R_4(I_3 + I_2) + V_2 + I_3 R_5 = 0$

Values of the known quantities based on the experimental circuit:

$V_1 = 3.3$ volts
$V_2 = 5.1$ volts
$R_1 = 52.3 \ k \ ohms$
$R_2 = 28 \ k \ ohms$
$R_3 = 10.5 \ k \ ohms$
$R_4 = 12.1 \ k \ ohms$
$R_5 = 14.7 \ k \ ohms$

Below, write the equations with the correct unknowns, replacing the variables with the measured quantities.

(1) $-3.3 + 28000(I_1 + I_2) + 52300 I_1 = 0$
(2) $-28000(I_2 + I_1) - 12100(I_2 + I_3) - 10500 I_2 = 0$
(3) $12100(I_3 + I_2) + 5.1 + 14700 I_3 = 0$

Solve the equations using any method you choose; write your answers below. The final units are amperes.
$I_1 = 2.9741 \times 10^{-5} \ amps$
$I_2 = 3.2565 \times 10^{-5} \ amps$
$I_3 = \text{-}2.05 \times 10^{-4} \ amps$

Part 2: Now that you know the current values, let's check them by doing an experiment.

black probe

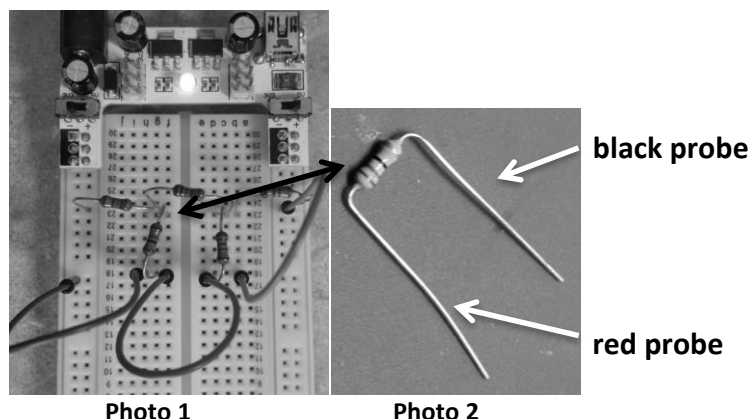**red probe**

Photo 1   **Photo 2**

Photo 1 shows an experimental circuit that is the real electrical circuit for the previous schematic diagram. The resistors are lined up in the same way. If you are not sure, please ask for help.

Measure the voltage across each resistor and use it to calculate the current. It is important to use the voltage meter the same way every time. So, orient the resistor so that it faces you, as in *Photo 2*.

With the power on, place the red probe on the left side and the black probe on the right—and then take the reading. Do this the same way for R_1, R_2, and R_3. Note that values may vary. Record your values below:

$V_{R_1} = 1.555\ V$
$V_{R_2} = 1.745\ V$
$V_{R_3} = 0.342\ V$
$V_{R_4} = $ -2.087 V
$V_{R_5} = $ -3.014 V

Now use Ohm's equation $V = R \cdot I$ to calculate the current. You need to know the values for R_1, R_2, and R_3. Solve for $i_1, i_2, and\ i_3$.

$$I_1 = \frac{V_{R_1}}{R_1} = \frac{1.555}{52300} = 2.97 \times 10^{-5}\ amps$$
$$I_2 = \frac{V_{R_2}}{R_3} = \frac{0.342}{10500} = 3.2565 \times 10^{-5}\ amps$$
$$I_3 = \frac{V_{R_5}}{R_5} = \frac{-3.014}{10500} = -2.05 \times 10^{-4}\ amps$$

Part 3: How close were your current values using both methods?
Use percentage difference in your explanation.

Example answer: The results that were measured and then calculated were close to those that were determined by solving the systems.