Name Answer Key Date _____

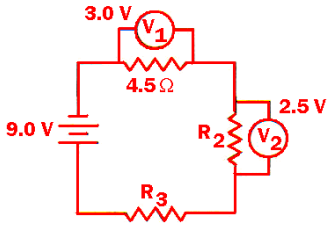
Honors Physics Electric Circuits WS #10H

Period _____ Mrs. Nadworny

Circuits Review

Directions: Solve the following problems using the GUESS method and proper significant figures. Be sure to show ALL work.

1. A circuit contains three resistors (R_1 is 4.5 ohms, R_2 and R_3 are unknown) in series with a 9.0 volt battery. A voltmeter attached to R_1 reads 3.0 volts. A voltmeter attached to R_2 reads 2.5 volts.
   a. Draw a circuit schematic of the circuit detailed above. Remember to use proper schematic symbols and label it.



   b. Calculate the potential drop across resistor R_3.

$$V = V_1 + V_2 + V_3$$

$$V_3 = V - (V_1 + V_2)$$

$$= 9.0V - (3.0V + 2.5\ V)$$

$$= 3.5\ V$$

   c. Calculate the current that passes through R_1.

$$I = \frac{V_1}{R_1} = \frac{3.0V}{4.5\Omega} = 0.67A$$

   d. Determine the current that passes through R_2 and R_3.

$$I_T = I_1 = I_2 = I_3 = 0.67A$$

   e. Calculate the resistances of R_2 and R_3.

$$R_2 = \frac{V_2}{I_2} = \frac{2.5\ V}{0.67\ A} = 3.7\ \Omega \qquad R_3 = \frac{V_3}{I_3} = \frac{3.5\ V}{0.67\ A} = 5.2\ \Omega$$

   f. Calculate the equivalent resistance of the circuit.

$$R_{eq} = R_1 + R_2 + R_3 = 4.5\Omega + 3.7\Omega + 5.2\Omega = 13.4\Omega$$

2. How many charges flow through a circuit if a 24 A current is allowed to flow for 2.7 minutes?

$$q = It = 24\ A\ (162\ s) = 3900\ C \left(\frac{1\ e}{1.60 \times 10^{-19} C} \right) = 2.4 \times 10^{22}\ e$$

3. When a 43 Ω resistor is connected to a battery, the current in the circuit is 0.54 A. What is the voltage of the battery?

$$V = IR = 0.54A(43\Omega) = 23V$$

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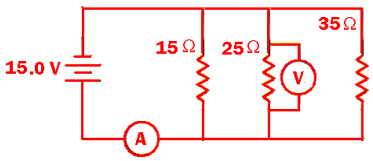
4. A circuit contains three resistors (R_1 is 15 ohms, R_2 is 25 ohms, and R_3 is 35 ohms) in parallel with a 15.0 volt battery.
   a. Draw a circuit schematic of the circuit detailed above. Remember to use proper schematic symbols and label it. Also include an ammeter capable of reading the total current in the circuit and a voltmeter capable of reading the potential difference across the 25 ohm resistor.



   b. Determine the potential difference across each resistor.

$$V = V_1 = V_2 = V_3 = 15.0V$$

   c. Calculate the current flowing through each resistor.

$$I_1 = \frac{V_1}{R_1} = \frac{15.0\ V}{15\ \Omega} = 1.0A$$
$$I_2 = \frac{V_2}{R_2} = \frac{15.0\ V}{25\ \Omega} = 0.60A$$
$$I_3 = \frac{V_3}{R_3} = \frac{15.0\ V}{35\ \Omega} = 0.43A$$

   d. Calculate the total current flowing through the circuit.

$$I = I_1 + I_2 + I_3 = 1.0A + 0.60A + 0.43A = 2.0A$$

   e. Calculate the equivalent resistance of the circuit.

$$R_T = \frac{V_T}{I_T} = \frac{15.0V}{2.0A} = 7.5\Omega$$

or

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} = \frac{1}{15\Omega} + \frac{1}{25\Omega} + \frac{1}{35\Omega} = \frac{35}{525\Omega} + \frac{21}{525\Omega} + \frac{15}{525\Omega} +$$
$$\frac{1}{R} = \frac{71}{525\Omega}$$
$$R = 7.4\Omega$$

5. A tungsten wire that is 4.0 meters long with a *diameter* of 2.6 mm at 20° C. It is part of a circuit connected to a 7.5 volt battery.
   a. Calculate the resistance of the wire.

$$R = \frac{\rho L}{A} = \frac{\rho L}{\pi r^2} = \frac{(5.60\times10^{-8}\ \Omega\cdot m)(4.0m)}{\pi(.0013m)^2} = .042\Omega$$

   b. Calculate the current in the wire.

$$I = \frac{V}{R} = \frac{7.5\ V}{.042\ \Omega} = 180A$$

Any of the three will work!

   c. Calculate the power used by the circuit.

$$P = IV = (180A)(7.5V) = 1400W \quad P = I^2R = (180A)^2(0.042\Omega) = 1400W \quad P = \frac{V^2}{R} = \frac{(7.5V)^2}{0.042\Omega} = 1300W$$

   d. Calculate the energy required to power the circuit if it runs for 4.5 minutes.

$$W = Pt = (1400\ W)(270\ s) = 3.8 \times 10^5\ J$$
$$W = Pt = (1300\ W)(270\ s) = 3.5 \times 10^5\ J$$

Answers in size order: 0.042, .43, .60, .67, .67, 1.0, 2.0, 3.5, 3.7, 5.2, 7.4 or 7.5, 13.4, 15.0, 23, 180, 1300 or 1400, 2.4×10^{22}, 3.5×10^5 or 3.8×10^5