

Problem Set #15 - Ohms Law Practice, Series and Parallel

Due on your class date the week of May 11th (B- May 11th, A- May 13th, D- May 14th, C- May 15th)

Name: Key

I worked with:

Equations:

Coulomb's Force

$$F_c = \frac{kq_1q_2}{r^2}$$

Coulomb's Constant

$$k = 9 * 10^9 Nm^2$$

Electric Field Strength

$$E = \frac{F_c}{q_2}$$

Work

$$W = F * d$$

Voltage Difference

$$\Delta V = \frac{W}{q_2}$$

Ohms Law

$$\Delta V = IR$$

Series Resistance

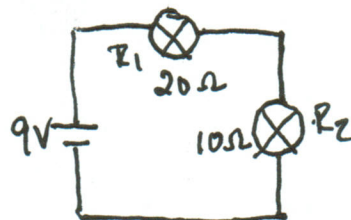
$$R_{Tot} = R_1 + R_2 + R_3 + \dots$$

Parallel Resistance

$$\frac{1}{R_{Tot}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \dots$$

1. Create a 2 light bulb series circuit in the [Phet Circuit Construction Kit](#). Set the battery voltage to 9 Volts, the resistance of the first light bulb at 20 Ohms and the second light bulb at 10 Ohms.
 - a. Draw a picture of the circuit
 - b. Use Ohm's law to fill out the table below, show your work. You can use the Circuit Construction Kit to check your answers.

$$R_{Tot} = R_1 + R_2 = 20 + 10 = 30 \Omega$$



$$V_{Tot} = I_{Tot} \cdot R_{Tot}$$

$$9 = I_{Tot} \cdot 30 \rightarrow I_{Tot} = \frac{9}{30} = 0.3 A$$

$$V_1 = I_{Tot} \cdot R_1 = 0.3 \cdot 20 = 6 V$$

$$V_2 = 0.3 \cdot 10 = 3 V$$

	Voltage	Current	Resistance
R ₁	6 V	0.3 A	20 Ω
R ₂	3 V	0.3 A	10 Ω
R _{Tot}	9 V	0.3 A	30 Ω

2. Create a 2 light bulb parallel circuit in the Phet Circuit Construction Kit. Set the battery voltage to 9 Volts, the resistance of the first light bulb at 20 Ohms and the second light bulb at 10 Ohms.

- Draw a picture of the circuit
- Use Ohm's law to fill out the table below, show your work. You can use the Circuit Construction Kit to check your answers.

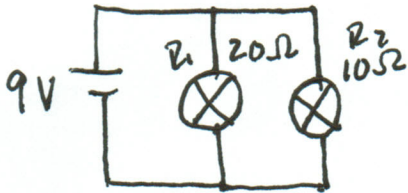
$$\frac{1}{R_{\text{Tot}}} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{20} + \frac{1}{10} = \frac{1}{20} + \frac{2}{20} = \frac{3}{20}$$

$$R_{\text{Tot}} = \frac{20}{3}$$

$$9 = I_{\text{Tot}} \cdot \frac{20}{3} \Rightarrow I_{\text{Tot}} = \frac{27}{20} = 1.35$$

$$9 = I_1 \cdot 20 \Rightarrow I_1 = \frac{9}{20} = 0.45$$

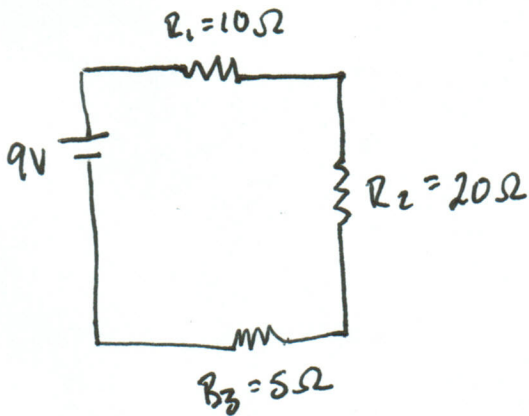
$$9 = I_2 \cdot 10 \Rightarrow I_2 = \frac{9}{10} = 0.9$$



	Voltage	Current	Resistance
R ₁	9V	0.45	20
R ₂	9V	0.9	10
R _{Tot}	9V	1.35	20/3

3. Create a 3 resistor series circuit set the resistances of the each resistor as follows: $R_1 = 10 \Omega$, $R_2 = 20 \Omega$, $R_3 = 5 \Omega$

- Draw a picture of the circuit
- Use Ohm's law to fill out the table below, show your work. You can use the Circuit Construction Kit to check your answers.



$$\frac{1}{R_{tot}} = \frac{1}{10} + \frac{1}{20} + \frac{1}{5} = \frac{2}{20} + \frac{1}{20} + \frac{4}{20} = \frac{7}{20}$$

$$R_{tot} = 20 \frac{20}{7}$$

$$R_{Tot} = 10 + 20 + 5 = 35 \Omega$$

$$I_{tot} = \frac{V_{tot}}{R_{tot}} = \frac{9}{35} = 0.26 A$$

$$V_1 = 0.26 \times 10 = 2.6 V$$

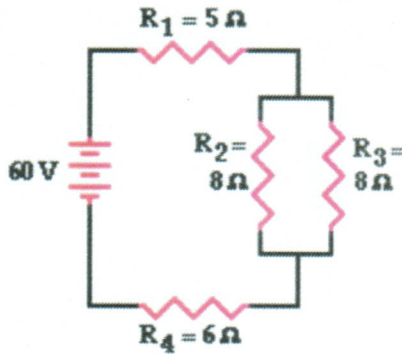
$$V_2 = 20 \times 0.26 = 5.2 V$$

$$V_3 = 0.26 \times 5 =$$

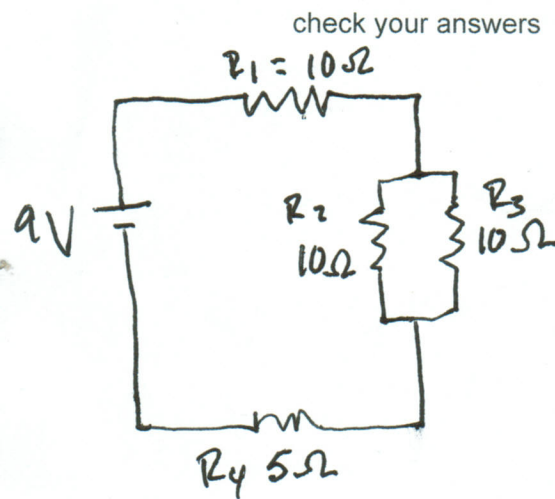
	Voltage	Current	Resistance
R_1	2.6 V	0.26 A	10 Ω
R_2	5.2 V	0.26 A	20 Ω
R_3	1.3	0.26 A	5 Ω
R_{Tot}	9V	0.26A	20 35 Ω

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Kerch this
 $V_1 + V_2 + V_3 = 9.1 \text{ not } 9 \dots$

4. Starting with the circuit you created in Problem 3 and replace Resistor 2 with two parallel $10\ \Omega$ resistors to create a combination circuit. See the example below (Note the resistors and battery in this example are different than the ones you will use in your circuit).



Use Ohm's Law to fill in the table below. You can use the Circuit Construction Kit to check your answers



$$I_{tot} = \frac{20}{9} \approx \frac{9}{20}$$

$$V_1 = 0.45 \times 10 = 4.5$$

$$V_2 = 0.45 \times 5 = 2.25$$

$$V_p = 0.45 \times 5 =$$

	V	I	R
R_1	2.25	0.45	10
R_2	2.25	0.225	10
R_p	2.25	0.45	5

	Voltage	Current	Resistance
R_1	4.5V	0.45	10 Ω
R_2	2.25	0.45 0.225	10 Ω
R_3	2.25	0.45 0.225	10 Ω
R_4	2.25V	0.45	5 Ω
R_{Tot}	9V	0.45	20 Ω

} 5