Notes - 21.1 Resistors in Series and Parallel
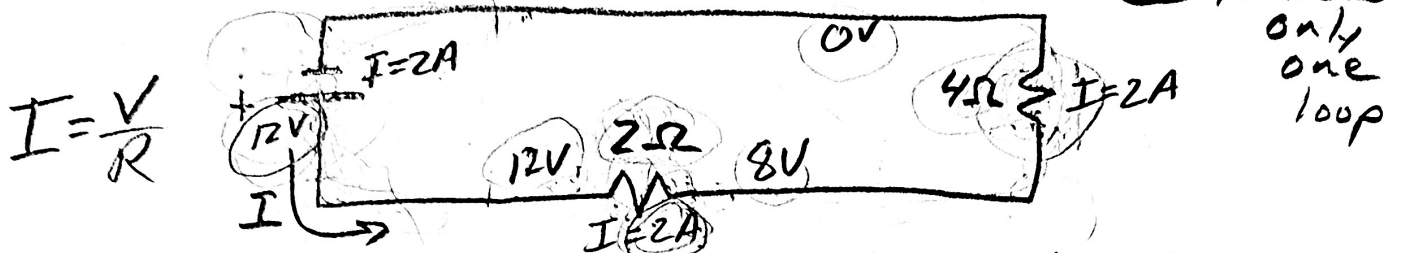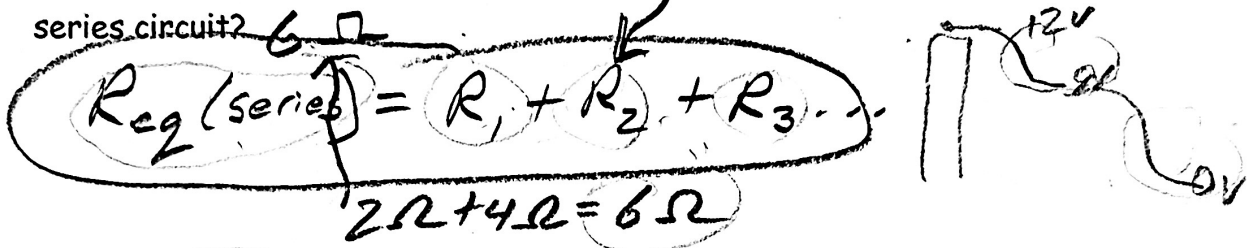
1. Suppose the voltage output of a battery is 12.0 V, and the resistances for 2 resistors connected in **series** with the battery are $R_1 = 2.00\ \Omega$ and $R_2 = 4\ \Omega$.

   A. Draw a diagram of the circuit. What makes It a **series** circuit?

   $$I = \frac{V}{R}$$

   There is only one loop

   B. What is the total resistance? What's the rule for equivalent resistance in a series circuit? 6

   $$R_{eq}(series) = R_1 + R_2 + R_3 \ldots$$

   $$2\Omega + 4\Omega = 6\Omega$$

   C. Find the current. What's the rule for individual and overall currents in a series circuit?

   $$I_{tot} = \frac{12V}{6\Omega} = 2A$$

   $$I_{Tot} = I_1 = I_2 = I_3 \ldots$$

   D. Calculate the voltage drop in each resistor. What's the rule for individual and overall currents in a series circuit?

   $$V = IR$$

   $$V_{2\Omega} = 2A(2\Omega) = 4V$$

   $$V_{4\Omega} = 2A(4\Omega) = 8V$$

   $$V_{Total} = 12V$$

   $$V_{Tot} = V_1 + V_2 + V_3 \ldots$$

   E. Calculate the power dissipated by each resistor. What's the rule for power consumed by individual resistors, and overall, in a series circuit?
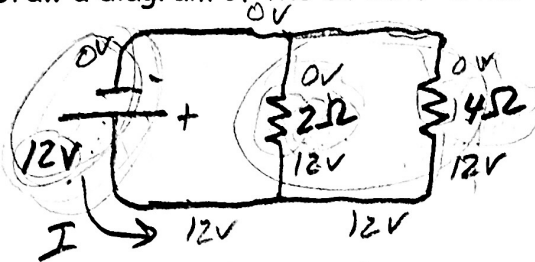
   $$P = IV$$

   $$P_{2\Omega} = 2A(4V) = 8W$$

   $$P_{4\Omega} = 2A(8V) = 16W$$

   $$P_{Tot} = P_1 + P_2 + P_3 \ldots$$

   $$P_{Tot} = 2A(12V) = 24$$

16. Suppose the voltage output of a battery is 12.0 V, and the resistances for 2 resistors connected in **parallel** with the battery are R_1 = 2.00 Ω and R_2 = 4 Ω.

   A. Draw a diagram of the circuit. What makes it a parallel circuit?

   multiple loops (paths) for charge to flow

   B. What is the total resistance? What's the rule for equivalent resistance in a parallel circuit?

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

   $$\frac{1}{2Ω} + \frac{1}{4Ω} = \frac{1}{R_{Tot}}$$

   $$\frac{3}{4Ω} = \frac{1}{R_{Tot}} \quad R = \frac{4}{3}Ω$$

   C. Find the current. What's the rule for individual and overall currents in a parallel circuit?

   $$I = \frac{V}{R}$$

   $$I_{2Ω} = \frac{12V}{2Ω} = 6A \qquad I_{4Ω} = \frac{12V}{4} = 3A$$

   $$I = \frac{12V}{\frac{4}{3}Ω} = 9A \qquad I_{Tot} = I_1 + I_2 + I_3 \cdots$$

   D. Calculate the voltage drop in each resistor. What's the rule for individual and overall currents in a parallel circuit?

   $$V_{Tot} = V_1 = V_2 = V_3 \cdots = 12V$$

   E. Calculate the power dissipated by each resistor. What's the rule for power consumed by individual resistors, and overall, in a parallel circuit?

   $$P = IV \qquad P_{Tot} = P_1 + P_2 + P_3$$

   $$P_{2Ω} = 6A(12V) = 72W$$

   $$P_{4Ω} = 3A(12W) = 36W$$

   $$P_{Tot} = 9A(12V) = 108W$$