My name is Mike Gentile.
(you can call me "Mike")
mgentile@physics.rutgers.edu

Welcome!

Physics 194 - Lecture 8

Have a question during class? Please ask it right away, even if it means interrupting in the middle of a thought. I want you to!

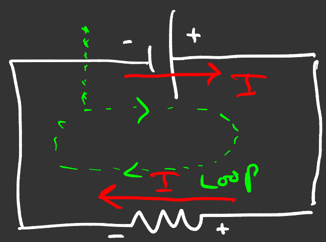
Agenda

- Multi-device circuits
- Circuit simplification + analysis
- Electrical systems in buildings

Class starts @2:15 pm

Analysis of the simplest circuit

$\mathcal{E} = 120\ V$



$R = 72\ \Omega$

$$\sum_{loop} \Delta V = 0$$

$$\Delta V_{\mathcal{E}} + \Delta V_R = 0$$

$$+\mathcal{E} - IR = 0$$

$$I = \frac{\mathcal{E}}{R} = \frac{120 V}{72 \Omega} = 1.67\ A$$

Power

$$P = I \Delta V$$ (A) (V)

$(W = J/s)$

$\Delta V_{\mathcal{E}} = \mathcal{E}$

$\Delta V_R = I_R R$

Resistors only

$$P_R = I_R \Delta V_R = (1.67 A)(120 V)$$

$$= 200 W$$

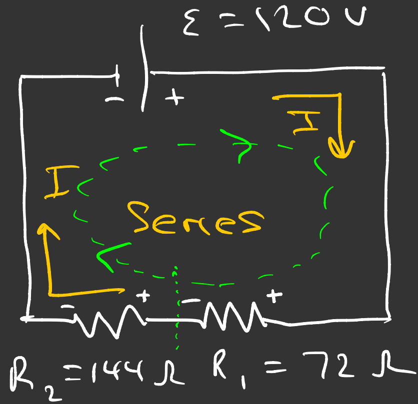
All

$$\boxed{P = I \Delta V} = \left(\frac{\Delta V}{R}\right)\Delta V = \boxed{\frac{\Delta V^2}{R}}$$

Joule's law

$$= I(IR) = \boxed{I^2 R}$$

Resistors only



$$\sum_{loop} \Delta V = 0$$

$$\Delta V_{R_2} + \Delta V_{\varepsilon} + \Delta V_{R_1} = 0$$

$$-IR_2 + \varepsilon - IR_1 = 0$$

$$\rightarrow I = \frac{\varepsilon}{R_1 + R_2} = \frac{120\,V}{72\,\Omega + 144\,\Omega} = 0.56\,A$$

$$P_{R_1} = I_{R_1}^2 R_1 = (0.56\,A)^2 (72\,\Omega) = 23\,W$$

$$P_{R_2} = I_{R_2}^2 R_2 = (0.56\,A)^2 (144\,\Omega) = 45\,W$$

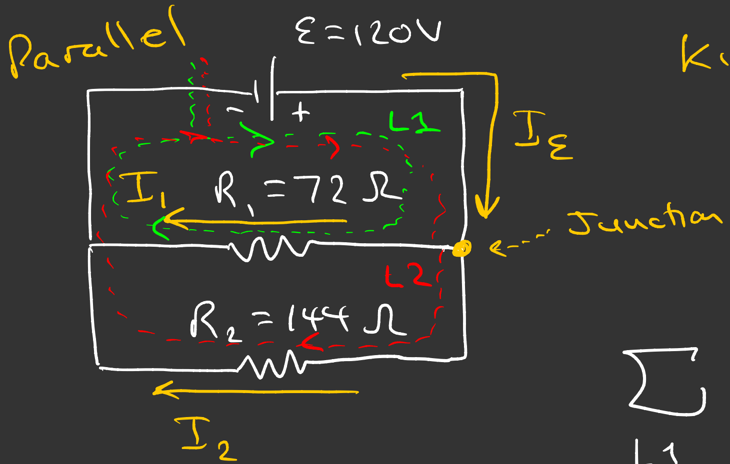
NOT 120 V

$$P_{R_2} = \frac{(\Delta V_{R_2})^2}{R_2} = \frac{(80\,V)^2}{144\,\Omega} = 45\,W$$

$$\Delta V_{R_2} = I_{R_2} R_2 = (0.56\,A)(144\,\Omega) = 80\,V$$

$$\Delta V_{R_1} = I_{R_1} R_1 = (0.56\,A)(72\,\Omega) = 40\,V$$

$$= 120\,V$$



Kirchhoff's junction rule:

$$\sum I_{in} = \sum I_{out}$$

$$I_\varepsilon = I_1 + I_2$$

$$\sum_{L1} \Delta V = 0 \longrightarrow \Delta V_\varepsilon + \Delta V_{R_1} = 0$$

$$+\varepsilon - I_1 R_1 = 0 \longrightarrow I_1 = \frac{\varepsilon}{R_1} = \frac{120V}{72\Omega} = 1.67A$$

$$P_{R_1} = I_1^2 R_1 = (1.67A)^2 (72\Omega)$$

$$= 200W$$

$$\sum_{L2} \Delta V = 0$$

$$\Delta V_\varepsilon + \Delta V_{R_2} = 0$$

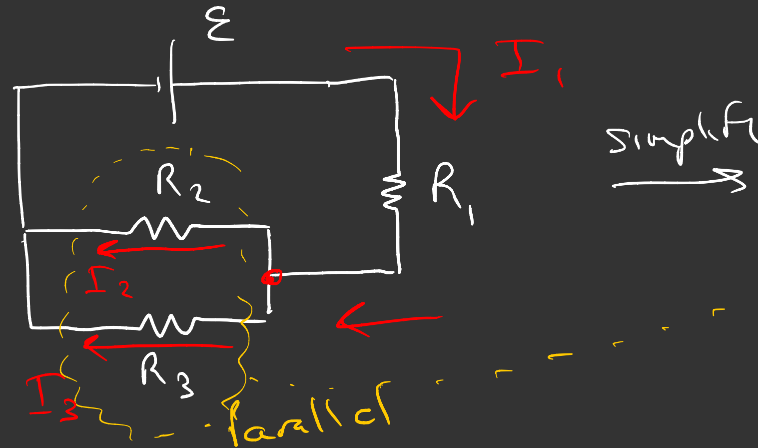
$$+\varepsilon - I_2 R_2 = 0$$

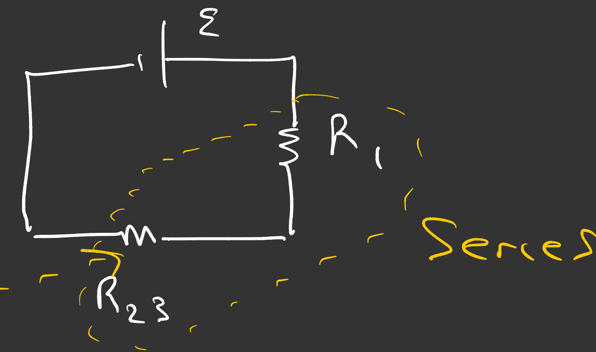
$$I_2 = \frac{\varepsilon}{R_2} = \frac{120V}{144\Omega} = 0.83A$$

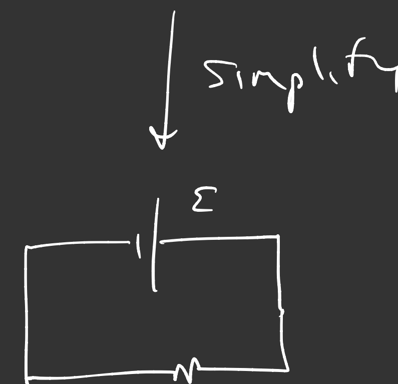
$$I_\varepsilon = I_1 + I_2$$

$$= 2.5A$$

$$P_{R_2} = I_2^2 R_2 = (0.83A)^2 (144\Omega) = 100W$$







$$R_{123} = R_1 + R_{23}$$

Simplify in parallel...

$$R_{23} = \left(\frac{1}{R_2} + \frac{1}{R_3} + \dots\right)^{-1}$$

$< R_2$ and R_3

Parallel

$$R_{eq} = \left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \dots\right)^{-1}$$

Series

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