Using Excel and MathCAD in DC Circuit Analysis

EAS 199A Notes

The Goal

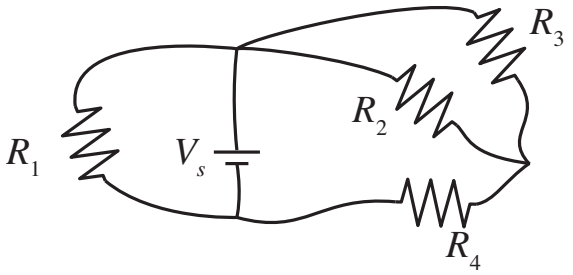
These slides provide a very brief analysis of a DC circuit.

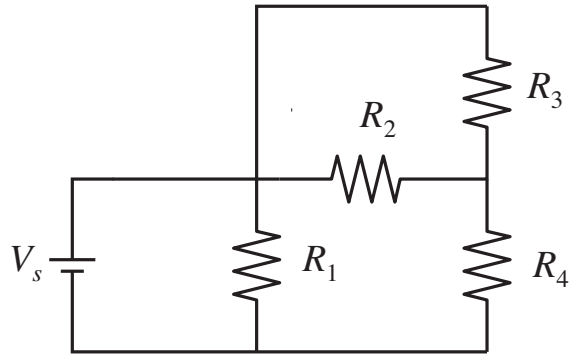
The goal is to set up an analysis that is performed in Excel and MathCAD.

There are no Excel or MathCAD computations in these slides.

The Problem

What is the total power consumed by the circuit, and the power consumed by resistor R_4 for the following two circuits?

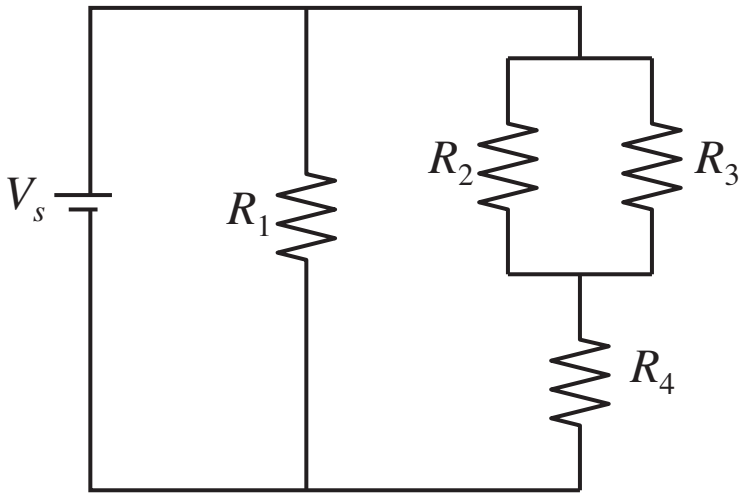




Use $R_1 = R_2 = 330\,\Omega$, $R_3 = 500\,\Omega$, $V_s = 12\,\mathrm{V}$ and let R_4 vary from $50\,\Omega$ to $500\,\Omega$.

The Problem in Standard Form

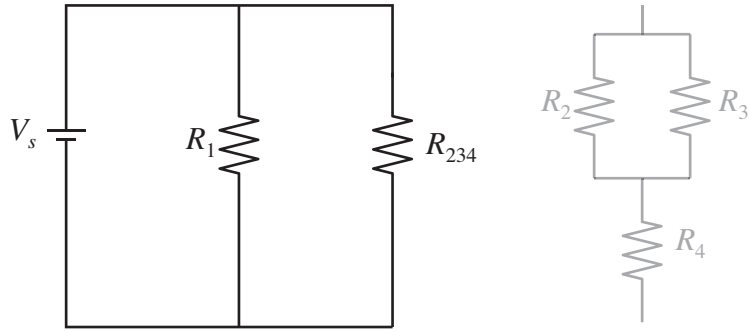
Examination of the two circuits shows that they are both equivalent to the following.



Circuit Simplification

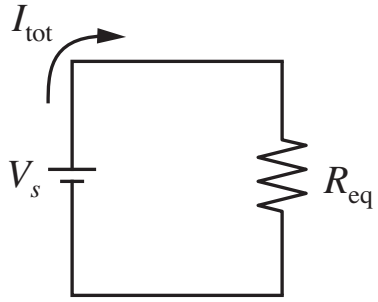
Resistors R_2, R_3, and R_4 can be combined to yield the equivalent resistance R_{234}.

$$R_{234} = \frac{1}{\frac{1}{R_2} + \frac{1}{R_3}} + R_4$$



R_1 and R_{234} can be further combined to give the equivalent resistance for the circuit

$$R_{\text{eq}} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_{234}}}$$

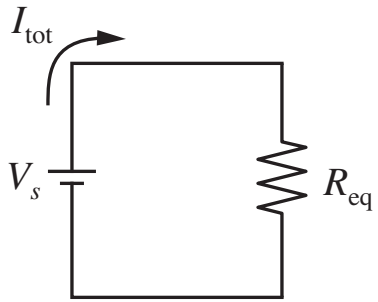


Total Current and Power

With R_{eq} known, the total current and total power from the voltage supply can be computed

$$V_s = I_{\text{tot}} R_{\text{eq}} \Longrightarrow I_{\text{tot}} = \frac{V_s}{R_{\text{eq}}}$$

$$P_{\text{tot}} = I_{\text{tot}}^2 R_{\text{eq}}$$



Current and Power through R_4

R_1 and R_{234} are in parallel with V_s, therefore

$$V_s = I_{234} R_{234} \implies I_{234} = \frac{V_2}{R_{234}}$$

Finally, with I_{234} known, the power dissipated by R_4 is

$$P_4 = I_{234}^2 R_4$$