In-Class Exercise: Circuit Analysis.

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The DC circuit shown in Figure 1 has both series and parallel resistors, your job is to find the currents i, i_1, i_2 using Ohm's Law, Kirchoff's Voltage Law (KVL), Kirchoff's Current Law (KCL).

Ohm's Law: The voltage DROP (hence the Δ) ΔU across a resistor is equal to the current i flowing through it in Ampere, times the resistor value R in Ohm.

$$\Delta U = iR \tag{1}$$

KCL: In a node, the algebraic sum of the currents is equal to zero, in other words, what comes in must come out. In our circuit node that means:

$$i = i_1 + i_2 \tag{2}$$

KVL: In a loop, the algebraic sum of the voltage is equal to zero. The first thing to do is put + and - signs on the resistors, the current always flows from a higher voltage to a lower voltage, in our case all currents run towards ground level (bottom) [1]. In our circuit you can recognize three loops, put arrows in the circuit to indicate them.

Resistors in series: When two resistors R_1, R_2 are placed in series, you can replace them with a single resistor with the value being the sum of R_1, R_2:

$$R_{series} = R_1 + R_2 \tag{3}$$

Resistors in parallel: When two resistors R_1, R_2 are placed in parallel, you can replace them with a single resistor with the "product over sum" value of R_1, R_2:

$$R_{parallel} = \frac{R_1 R_2}{R_1 + R_2} \tag{4}$$

Solution

[1] Technically since current is a stream of electrons, they run in exactly the opposite direction, but for the analysis it makes no difference as long as you are consistent.

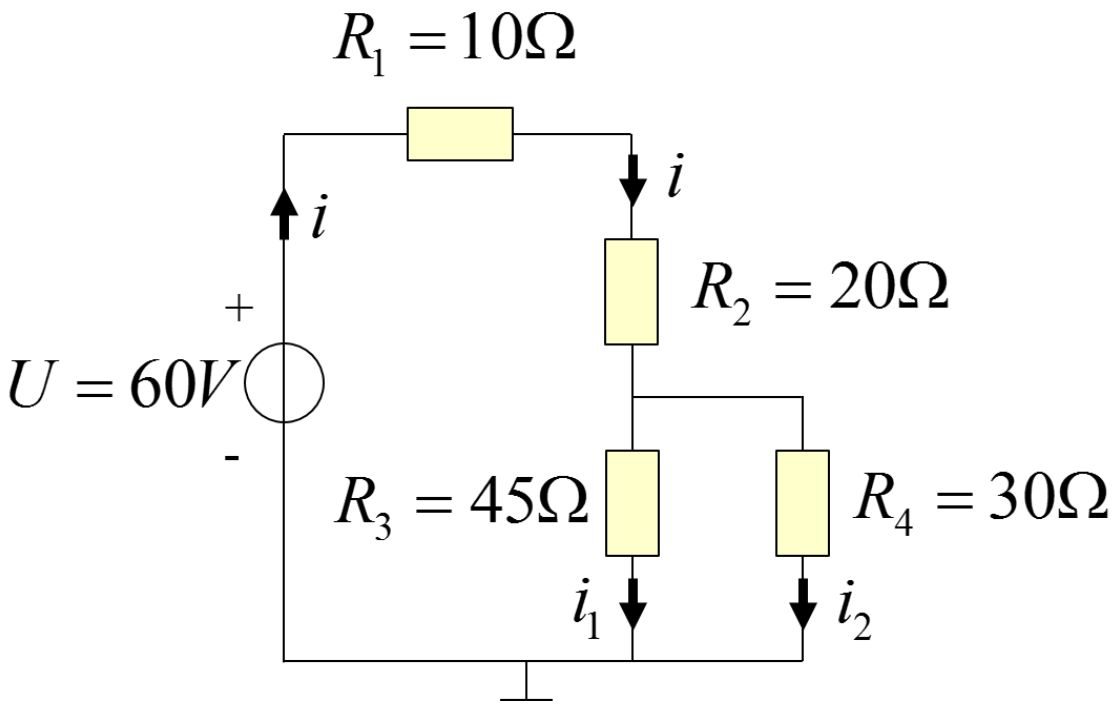

Figure 1: Here a simple circuit with a DC input voltage is shown followed by four resistors in series and parallel.