Voltage and Current Dividers

Voltage Divider

It is interesting and useful to consider how voltage is divided among resistors in series. Consider the circuit to the right. There is only one current flowing around the loop, $i_{s.}$ We know that:

$$v_2 = R_2 i_s$$

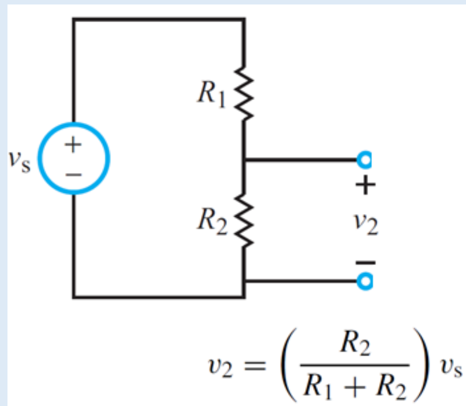
we also know (see Series and Parallel Resistors page) that

$$i_s = \frac{v_s}{R_{eq}}$$

$$R_{eq} = R_1 + R_2$$

Putting this together:

$$v_2 = \left(\frac{R_2}{R_1 + R_2}\right) v_s$$



This is the basic voltage divider result. Namely, **the voltage across a resistor in series with other resistors is the ratio of that resistor to the total resistance of all resistors, multiplied by the total voltage across all the resistors.**

Current Divider

It is equally useful to consider how current divides across parallel resistors.

We know from the Series and Parallel Resistors page that we can calculate R_{eq} for a set of parallel resistors. For the circuit at right,

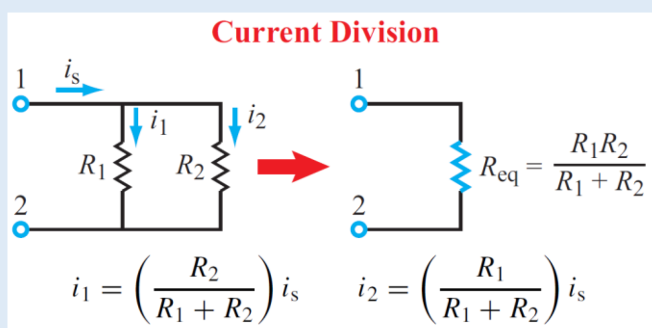
$$R_{eq} = \frac{R_1 R_2}{R_1 + R_2}$$

$$v_{12} = i_s . R_{eq}$$

Applying Ohm's Law to each resistor:

$$i_1 = \frac{v_{12}}{R_1} = \left(\frac{R_{eq}}{R_1}\right) i_s = \left(\frac{R_2}{R_1 + R_2}\right) i_s$$

$$i_2 = \frac{v_{12}}{R_2} = \left(\frac{R_{eq}}{R_2}\right) i_s = \left(\frac{R_1}{R_1 + R_2}\right) i_s$$



Thus, current entering a set of parallel resistors splits such that more current passes through the less resistive path. Note that if one of these resistors is a short (R = 0), all of the current will pass through that resistor.