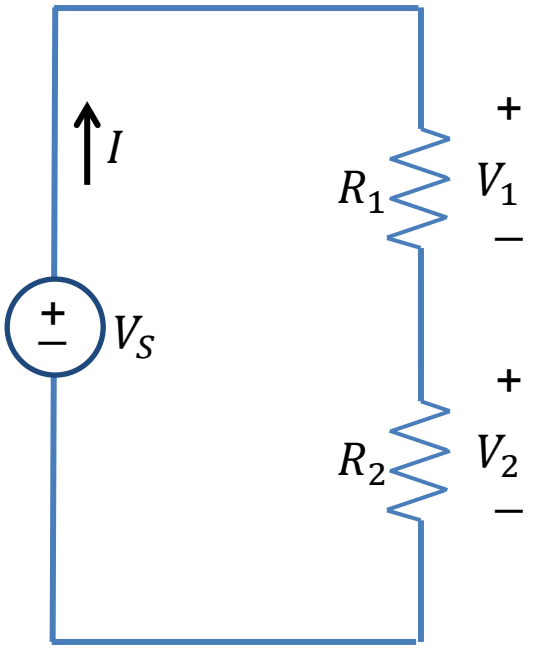
Voltage Dividers

If a voltage is applied across a series resistance combination, the voltage is divided (unequally) across the resistors.

$$V_s = V_1 + V_2 = IR_1 + IR_2 \Rightarrow I = \frac{V_s}{R_1 + R_2}$$

$$V_1 = IR_1 = V_s \frac{R_1}{R_1 + R_2} \qquad V_2 = IR_2 = V_s \frac{R_2}{R_1 + R_2}$$

These ratios are known as voltage dividers



The voltage is split proportionally according to the resistance values. Higher voltage goes to the larger resistor.

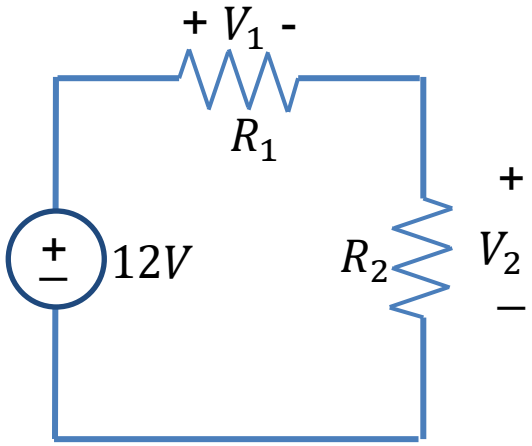
Note: This kind of configuration occurs so frequently that it is worthwhile committing this result to memory.

Example

For the voltage divider circuit shown:

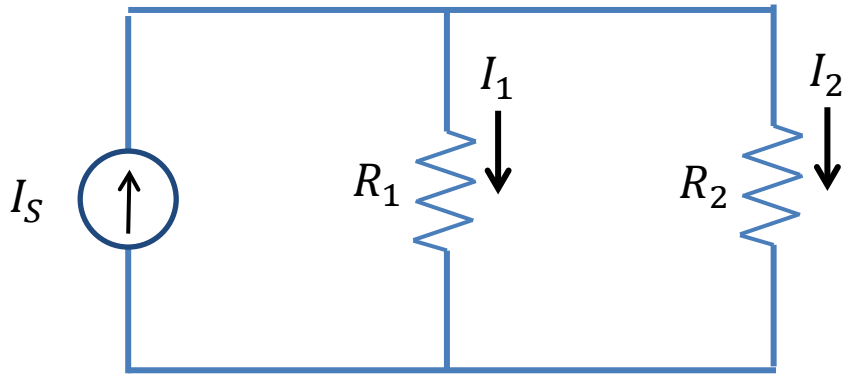
(a) If $R_1 = 1k\Omega$ and $R_2 = 2k\Omega$, determine the voltages V_1 and V_2. Also determine the power generated by the source.

(b) Suppose we want $V_2 = 9V$ and that the source is capable of producing no more than 250mW of power. What are the smallest resistors that can be used to achieve these specifications?



Current Dividers

If a current is applied to a parallel resistance combination, the current is divided (unequally) through the resistors.



$$I_1 R_1 = I_2 R_2 = I_s R_{eq} = I_s \frac{R_1 R_2}{R_1 + R_2}$$

These ratios are known as current dividers

$$I_1 = I_s \frac{R_2}{R_1 + R_2}$$

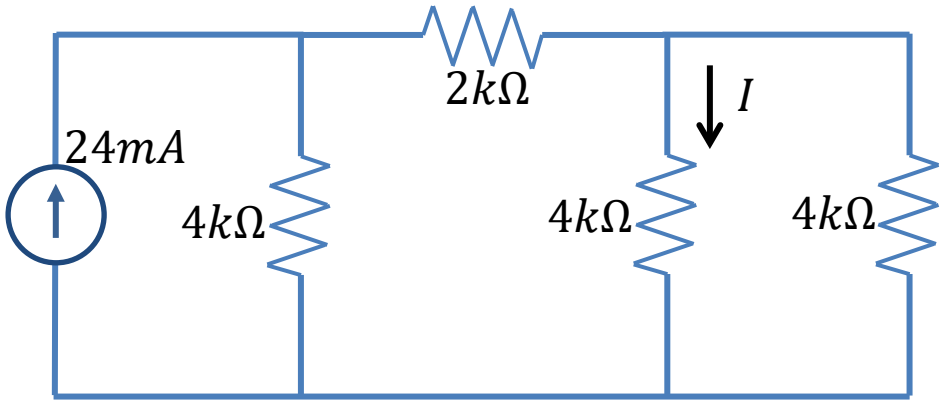
$$I_2 = I_s \frac{R_1}{R_1 + R_2}$$

The current is split proportionally according to the resistance values. Higher current goes to the **smaller** resistor. Again, commit this result to memory.

Beware: The current dividers are the opposite of the voltage dividers. This will be a source of great confusion to some.

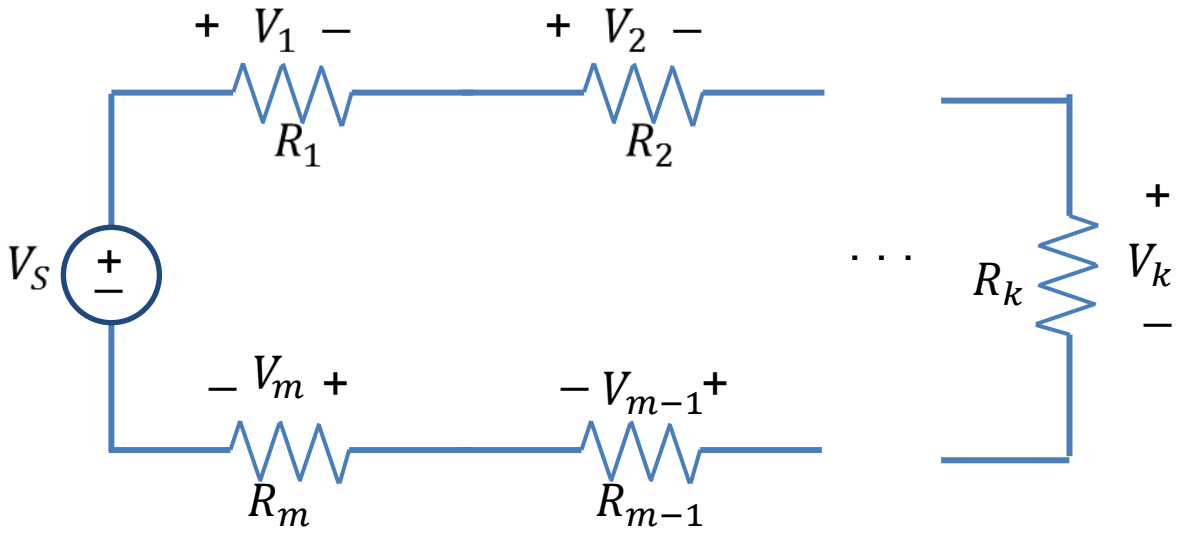
Example

Find the current I in the circuit shown.

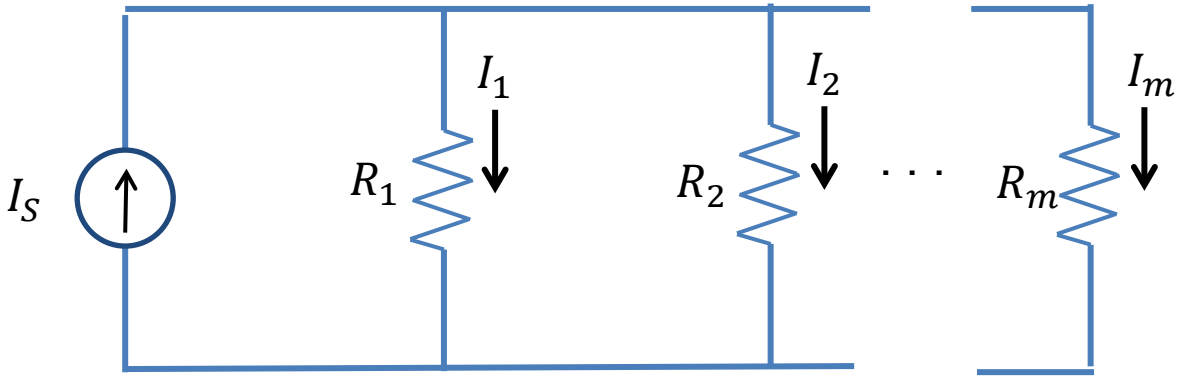


Voltage/Current Dividers

The concepts of voltage and current division can be applied to more than two resistors.



$$V_k = V_s \frac{R_k}{R_1 + R_2 + \cdots + R_m}$$



$$I_k = I_s \frac{R_{eq}}{R_k}$$

$$= I_s \frac{\frac{1}{R_k}}{\frac{1}{R_1} + \frac{1}{R_2} + \cdots + \frac{1}{R_m}}$$