Mississippi State University
Department of Physics and Astronomy
PH 2223 Lab

Simple Circuits

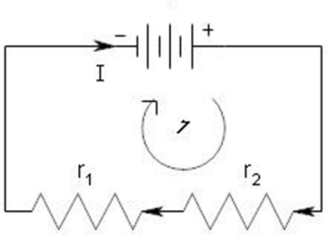
Why are certain arrangements of resistors called series or parallel networks? Draw small diagrams to illustrate these. If I want to increase my effective resistance which arrangement will I use? What about reducing the effective resistance?

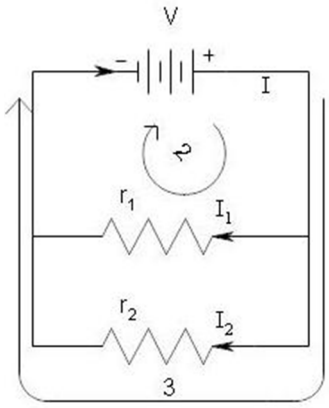
Understand how *Equations 26.1* and *26.2* (P.882; Sears and Zemansky's University Physics, Ed.12) were derived. Read up Section 26.2 (P.886; Sears and Zemansky's University Physics, Ed.12) on Kirchhoff's Rules. Particularly pay attention to *Equations 26.5* and *26.6.*

Let us derive these using Kirchhoff's Laws!!!
All we will need to do is, find out the value of **V/I** in both the arrangements in terms of $\mathbf{r_1}$ and $\mathbf{r_2}$. **V/I** is nothing but effective resistance **R**.

Fig.2: Resistances in Parallel

Fig.1: Resistances in Series





Resistances in Series

1. Write the expression for loop rule for loop 1 in Fig. 1. This might seem trivial, but just rearrange the equation to find **R**. ($R = r_1 + r_2$)

Resistances in Parallel

1. Write the junction rule for current in Fig. 2, expressing the relation between **I**, $\mathbf{I_1}$ and $\mathbf{I_2}$.
2. Now use the loop rule to write the expression for loop 2 and 3 in terms **V**, $\mathbf{r_1}$, $\mathbf{r_2}$, $\mathbf{I_1}$ and $\mathbf{I_2}$.
3. Find **V/I** in terms of $\mathbf{r_1}$ and $\mathbf{r_2}$ only. This should be possible with the 3 expressions written in steps 1 and 2. **V/I** is **R** so if everything is right, the answers must match with the ones in the text. ($\frac{1}{R} = \frac{1}{r_1} + \frac{1}{r_2}$)

That was for 2 resistances. By simply looking at the answers can you gauge what would the relations look like for **n** resistances in series/ parallel?

Challenge

Repeat the above process by replacing $\mathbf{r_1}$ and $\mathbf{r_2}$ with $\mathbf{c_1}$ and $\mathbf{c_2}$ which are capacitors of capacitance $\mathbf{c_1}$ and $\mathbf{c_2}$ respectively. What is the expression for effective capacitance **C** when $\mathbf{c_1}$ and $\mathbf{c_2}$ are in series and when they are in parallel?