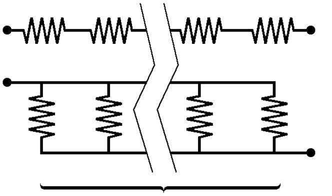
**57.** A voltage $\Delta V$ is applied to a series configuration of $n$ resistors, each of value $R$. The circuit components are reconnected in a parallel configuration, and voltage $\Delta V$ is again applied. Show that the power consumed by the series configuration is $1/n^2$ times the power consumed by the parallel configuration.




**Solution**

When connected in series, the equivalent resistance is

$$R_{eq} = R_1 + R_2 + \ \ldots \ + R_n = nR$$

Thus, the power consumed by the series configuration is

$$\mathcal{P}_s = (\Delta V)I = (\Delta V)\left(\frac{\Delta V}{R_{eq}}\right) = \frac{(\Delta V)^2}{R_{eq}} = \frac{(\Delta V)^2}{nR}$$

For the parallel connection, the power consumed by each individual resistor is

$$\mathcal{P}_1 = \frac{(\Delta V)^2}{R}$$

and the total power consumption by the parallel configuration is

$$\mathcal{P}_p = n\mathcal{P}_1 = \frac{n(\Delta V)^2}{R}$$

Therefore, $$\frac{\mathcal{P}_s}{\mathcal{P}_p} = \left(\frac{(\Delta V)^2}{nR}\right)\left(\frac{R}{n(\Delta V)^2}\right) = \frac{1}{n^2}$$

or $$\mathcal{P}_s = \frac{1}{n^2}\mathcal{P}_p$$ ◊