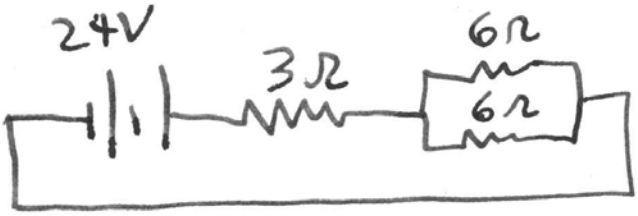
CLASS EXERCISE #10 - 30 June 2005

An electric circuit consists of a series combination of the following circuit elements: A 24-V battery, a 3-ohm resistor, and a parallel combination of two branches each with a 6-ohm resistor.



(a) Determine the equivalent resistance of the whole circuit and find the current drawn from the battery.

The parallel combination has an equivalent resistance R_{eq} given by $1/R\text{eq} = 1/6\ \Omega + 1/6\ \Omega = 2/6\ \Omega = 1/3\ \Omega$ so $R_{eq} = 3\ \Omega$. Since this is in series with the 3-Ω resistor, the equivalent resistance of the whole circuit is $3\ \Omega + 3\ \Omega = 6\ \Omega$. The current drawn from the battery is then $I_{total} = \Delta V_{bat}/R_{eq} = (24\text{ V})/(6\ \Omega) = 4\text{ A}$.

(b) Fill out the $R - I - \Delta V - P$ table for this circuit, including rows for each resistor and the battery. Check - and show - that the power supplied by the battery equals the power dissipated by the three resistors.

R	I	ΔV	P
3 Ω	4 A	12 V	48 W
6 Ω	2 A	12 V	24 W
6 Ω	2 A	12 V	24 W
$R_{eq} = 6\ \Omega$	4 A	24 V	96 W

In filling out this table, first put the battery voltage and current in the last row, then the same current for the 3-Ω resistor. Next, determine the ΔV of the 3-Ω resistor; since this is 12 V, there must be 24 V $-$ 12 V $=$ 12 V across the parallel branch, so enter 12 V for each of the 6-Ω resistors. Now determine the currents through the resistors in parallel (and verify that they correctly add up to 4 A). Finally, determine the power dissipated in each resistor and the power supplied by the battery, and verify that $48\text{ W} + 24\text{ W} + 24\text{ W} = 96\text{ W}$. Everything checks out.