# P214 Midterm Practice Problems
(note that these are a little bit harder than the problems on the actual midterm will be, but are very good practice for them)

1. Show that, if you have a 15 volt battery, it is *not* possible to exceed the power rating of a ¼ watt resistor of resistance greater than 1 kΩ (no matter how you connect it).

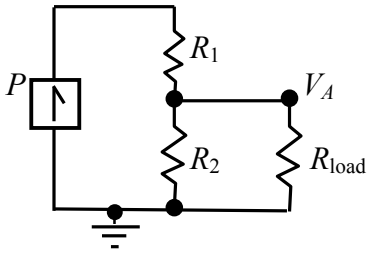
2. (A quite hard [especially parts b) – d)] but good problem!) Let's say that, instead of a voltage source (like a battery) or a constant-current source, we have a constant-*power* source. A constant-power source will do whatever it can to make sure that the voltage across its terminals, *multiplied by* the current it provides, is kept at a constant value (say, for example, 10 watts, or alternatively 100 milliwatts, etc). We know that the symbols for a voltage source and for a current source are as follows:

Voltage source:  Current source: 

Let us let the symbol for a constant-power source be:

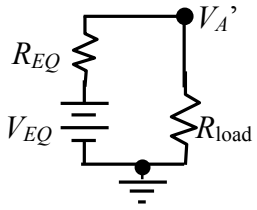
Power source: 

And let's say we have the following circuit:



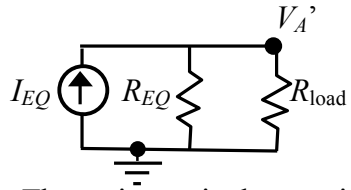

a) Find the voltage $V_A$, as a function of $P$, $R_1$, $R_2$, and $R_{load}$.

b) If we decide to "formally" define the Thevenin equivalent voltage $V_{EQ}$, and Thevenin equivalent resistance $R_{EQ}$, as: 1) $\boldsymbol{V_{EQ}} \equiv V_A' = V_A$ in both of the circuits below and above respectively when taking the limit that $R_{load} \rightarrow \infty$, and 2) $\boldsymbol{R_{EQ}} \equiv R_{load}((V_{EQ}/V_A) - 1) = R_{load}((V_{EQ}/V_A') - 1)$ in both of the circuits above and below respectively when taking the limit that $R_{load} << R_{EQ}$, then find the Thevenin equivalents $V_{EQ}$ and $R_{EQ}$ as functions of $P$, $R_1$, and $R_2$.



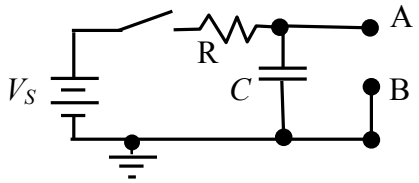

c) If we decide to "formally" define the Norton equivalent current $I_{EQ}$, and Norton equivalent resistance $R_{EQ}$, as: 1) $\boldsymbol{I_{EQ}} \equiv V_A'/R_{load} = V_A/R_{load}$ in both of the circuits below and above respectively when taking the limit that $R_{load} << R_{EQ}$, and 2) $\boldsymbol{R_{EQ}} \equiv V_A/I_{EQ} =$

$V_A'/I_{EQ}$ in both of the circuits above and below respectively when taking the limit that $R_{load} \rightarrow \infty$, then find the Norton equivalents $I_{EQ}$ and $R_{EQ}$ as functions of $P$, $R_1$, and $R_2$.




d) Does the Thevenin equivalent resistance $R_{EQ}$ equal the Norton equivalent resistance $R_{EQ}$ in your calculations above? Does $V_{EQ} = I_{EQ}R_{EQ}$, where $R_{EQ}$ is the Thevenin equivalent resistance above?

3. At time $t = 0$, someone closes the switch of the circuit below. If we define the rise time of the circuit to be the time the circuit takes to go from 10% to 90% of its final value, show that the rise time of this circuit equals $2.2RC$.




4. Bugg problems 1.10.3, 1.10.6, 1.10.7, 1.10.9, 2.10.7, 2.10.8, 2.10.12, 2.10.13, 3.12.6, 3.12.13.