[lex35] Resistor circuit
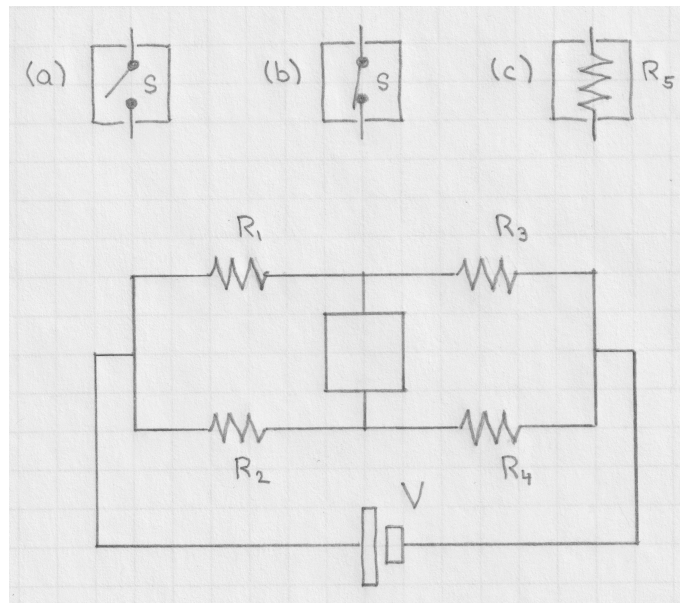
The specifications of the resistor circuit shown in three versions are $V = 12\text{V}$, $R_m = m\,\Omega$, $m = 1,\ldots,5$. Find the currents I_m on each resistor when the circuit is in a steady state. Find also the equivalent resistance of a single resistor that mimics the function of the multi-resistor configuration in each version.

(i) For versions (a) and (b), reduce the configuration in two steps to a single resistor to find the equivalent resistance. Then reverse the reduction to find the currents through each resistor.

(ii) For version (c), derive five linear equations using the junction rule and the loop rule for the five unknown I_m and solve them. Infer the equivalent resistance from the current that flows through the battery and the voltage across it.

(iii) Use the same equations in the limit $R_5 \to \infty$ to recover the results of version (a) and in the limit $R_5 \to 0$ to recover the results of version (b).

Solution: