Equivalent Resistance

1 Introduction

The current in all parts of a circuit with resistors and batteries can always be found by writing equations for KCL and KVL and solving for the unknown currents. This was the approach taken in the Kirchhoff's law activity.

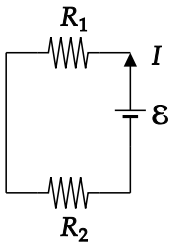
There is an alternative approach that is often faster:

1. replace resistors in series or parallel with equivalent resistances to create a new circuit. If no resistors in the new circuit are in series or parallel, skip to step 3.
2. repeat step 1.
3. Use KCL and KVL to find currents in the remaining equivalent circuit.

In many problems, we are only interested in the currents through the batteries, so no further analysis is needed beyond step 3. If the currents in the resistors of the original circuit are needed, rebuild it step–by–step, finding all currents at each step using KCL and KVL.

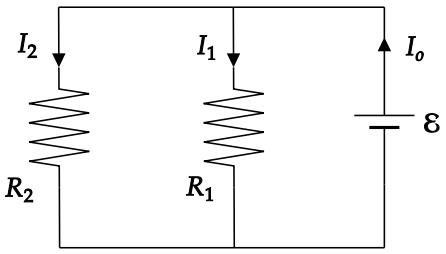
2 Single Loop

Reduce the following circuit as much as possible using equivalent resistances. Then, find I.



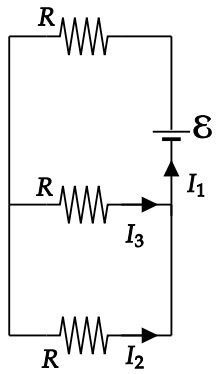
3 Multiple Loops I

Reduce the following circuit as much as possible using equivalent resistances. Then find I_o.



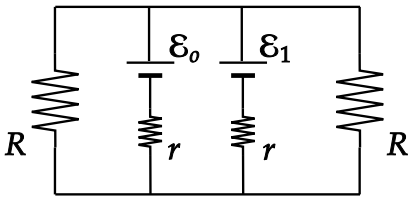
4 Multiple Loops II

Reduce the following circuit as much as possible using equivalent resistances. Then find I_1.



5 Multiple Loops III

Reduce the following circuit as much as possible using equivalent resistances. Then find the equations for KCL and KVL that are needed to find the currents through $\mathcal{E}_o$ and $\mathcal{E}_1$.



6 Rebuilding I

Find all of the currents in the circuit in Multiple Loops I.

7 Rebuilding II

Find all of the currents in the circuit in Multiple Loops II.

8 Rebuilding III

Find all of the currents in the circuit in Multiple Loops III.