

Solving DC Circuit Problems

Some Guidelines

Suggested Strategy

Apply Kirchhoff's Rules

To

The Chart Method (see the 152 Web Page)

Kirchhoff's Rules

There are ways in which resistors can be connected so that the circuits formed cannot be reduced to a single equivalent resistor.

Two rules, called *Kirchhoff's Rules* can be used instead.

Statement of Kirchhoff's Rules

Junction Rule

The sum of the currents entering any junction must equal the sum of the currents leaving that junction.

(A statement of Conservation of Charge)

Loop Rule

The sum of the potential differences across all the elements around any closed circuit loop must be zero.

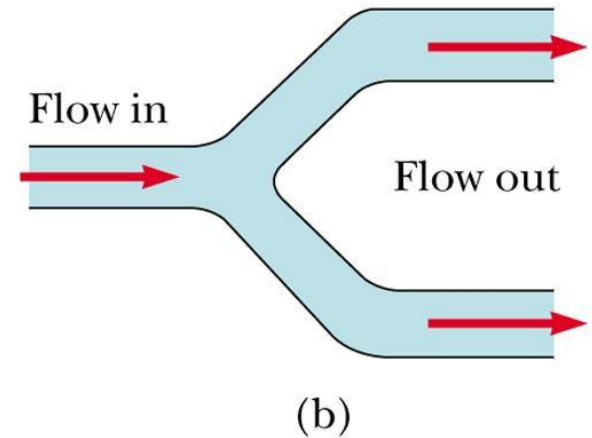
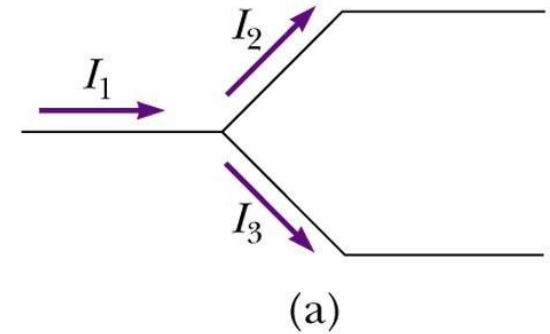
(A statement of Conservation of Energy)

More About the Junction Rule

$$I_1 = I_2 + I_3$$

From Conservation of Charge

Diagram b shows a mechanical analog.



Setting Up Kirchhoff's Rules

Solving for Currents

Assign symbols and directions to the currents in all branches of the circuit.

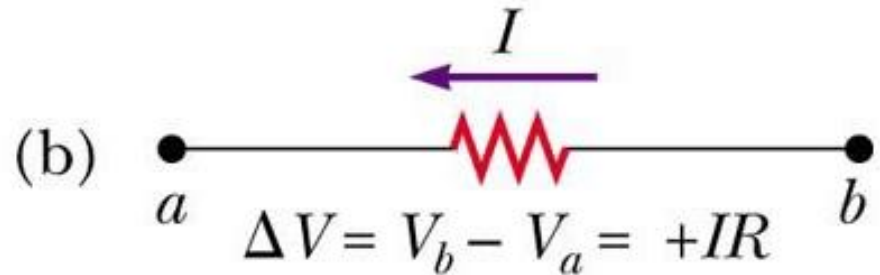
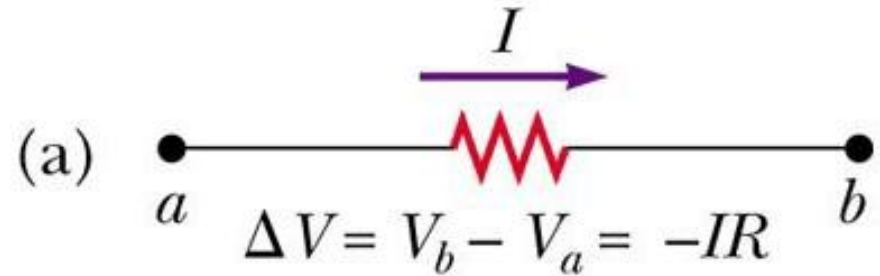
(If a direction is chosen incorrectly, the resulting answer will be negative, but the magnitude will be correct.)

When applying the loop rule, choose a direction for traversing the loop.

Record voltage drops and rises as they occur.

More About the Loop Rule

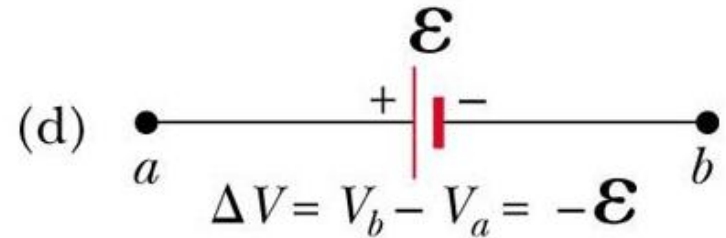
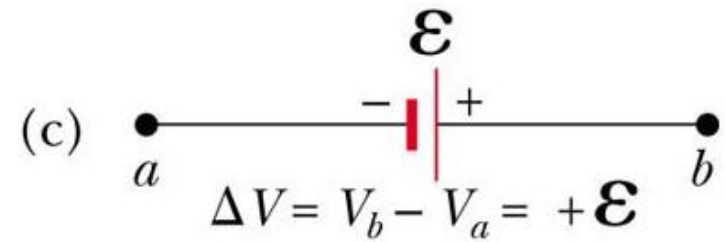
Traveling around the loop from a to b:
In (a), the resistor is traversed in the direction of the current. The potential across the resistor is $-IR$.



In (b), the resistor is traversed in the direction opposite of the current, the potential across the resistor is $+IR$.

Still More on the Loop Rule

In (c), the source of emf is traversed in the direction of the emf (from $-$ to $+$). The change in the electric potential is $+\mathcal{E}$.



In (d), the source of emf is traversed in the direction opposite of the emf (from $+$ to $-$). The change in the electric potential is $-\mathcal{E}$.

Junction Equations from Kirchhoff's Rules

Use the junction rule as often as needed, so long as, each time you write an equation, you include in it a current that has not been used in a previous junction rule equation.

In general, the number of times the junction rule can be used is one fewer than the number of junction points in the circuit.

The loop rule can be used as often as needed so long as a new circuit element (resistor or battery) or a new current appears in each new equation.

You need as many independent equations as you have unknowns.

**To Solve Circuit Problems
for Unknown Currents
Using the Chart Method
You Will**

- 1. Find equivalent resistances for series and parallel combinations**
- 2. Apply Ohm's law**
- 3. Use Kirchhoff's Rules**