Electronics
Kirchhoff's Laws

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There are two Kirchhoff's laws:

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- Kirchhoff's *Current* Law

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- Kirchhoff's *Current* Law
- Kirchhoff's *Voltage* Law

Kirchhoff's Current Law

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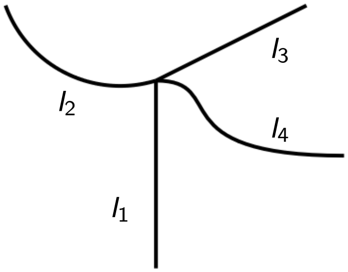
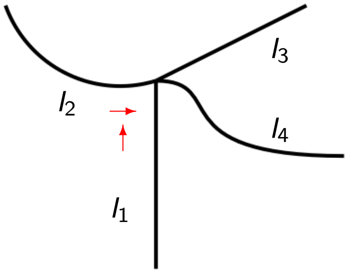


Kirchhoff's Current Law



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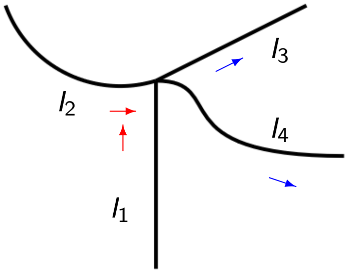

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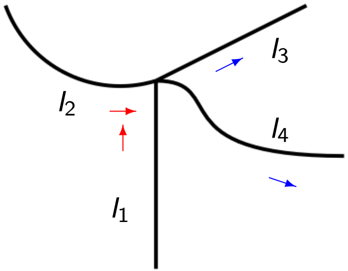
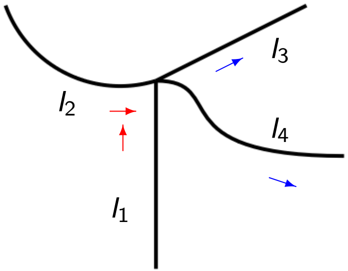


Sum of the currents at a node is zero

Kirchhoff's Current Law



Sum of the currents at a node is zero

$\rightarrow$ Sum of the currents *into* a node equals the sum of the currents *out of* the node.

Kirchhoff's Voltage Law

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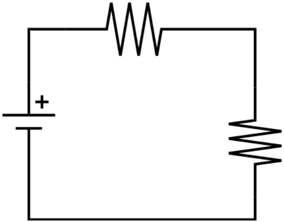
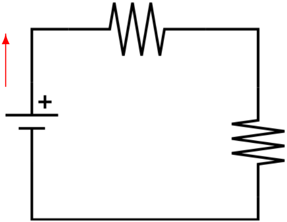


Kirchhoff's Voltage Law



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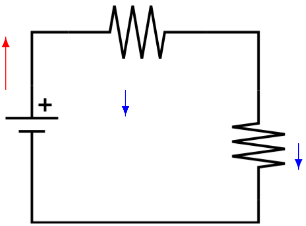
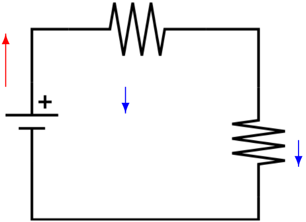
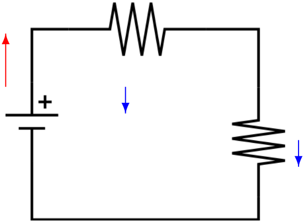


Kirchhoff's Voltage Law



Sum of the voltage drops around a loop is zero

Kirchhoff's Voltage Law



Sum of the voltage drops around a loop is zero

→ Sum of the voltage *increases* in a loop equals the sum of the voltage *drops* in the loop

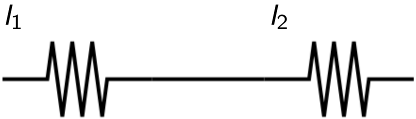
Applications of Kirchhoff's Current Law

Applications of Kirchhoff's Current Law

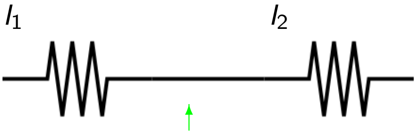
Series Circuits

Series Circuits

Series Circuits

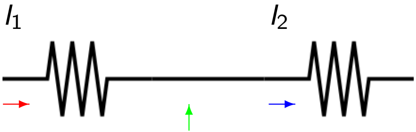


Series Circuits



A "virtual" node can be created between the two resistors

Series Circuits



Since there is nowhere else for current to go, $I_1 \equiv I_2$

Applications of Kirchhoff's Current Law

Applications of Kirchhoff's Current Law

Parallel Circuits

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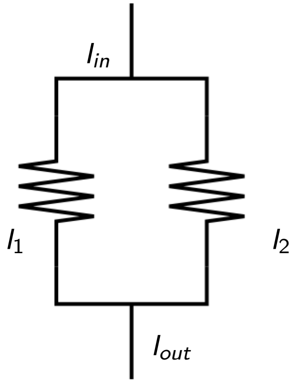
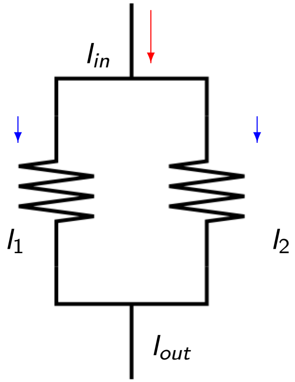


Parallel Circuits



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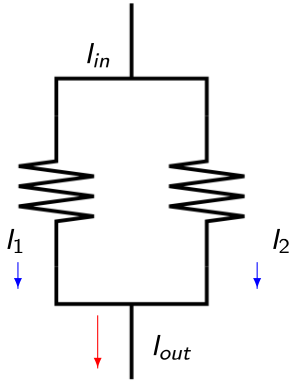

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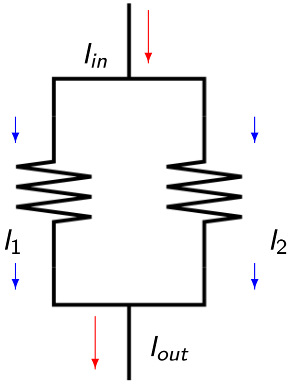
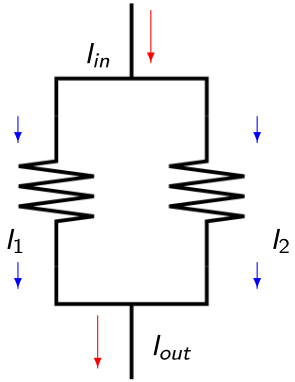


The current exiting at the bottom has to equal the current entering at the top

Parallel Circuits



$$I_{in} = I_1 + I_2 = I_{out}$$

Applications of Kirchhoff's Voltage Law

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Series Circuits

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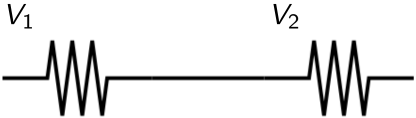

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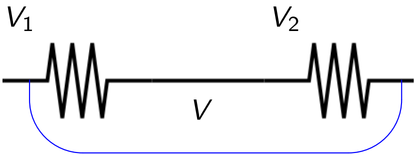
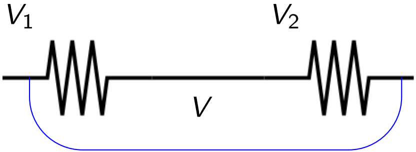


A "virtual" loop can be created by connecting both ends of the circuit.

Series Circuits



The voltages around the loop must add to zero, so

$$V = V_1 + V_2$$

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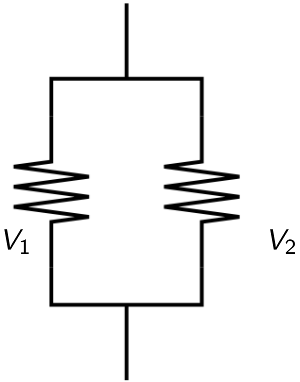

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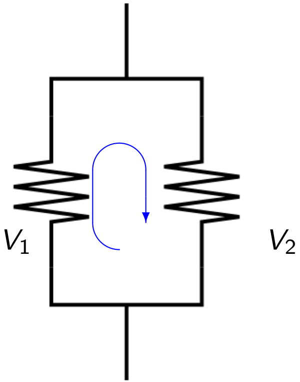
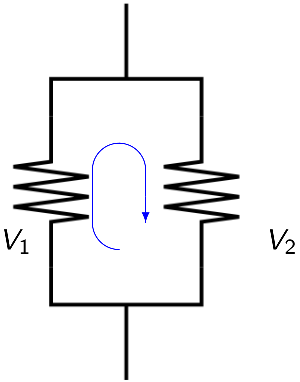


A loop consists of just the two components as shown.

Parallel Circuits



Since the sum of voltages around the loop is zero, $V_1 = V_2$

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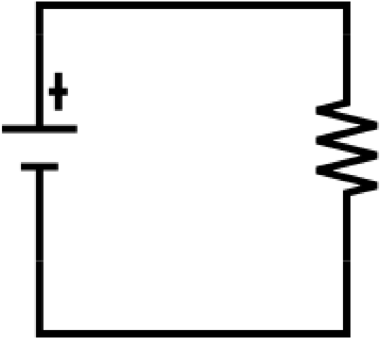

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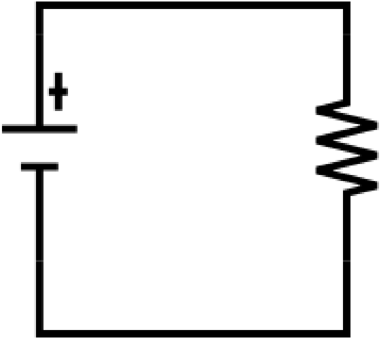

Q: Are the elements in series or parallel?

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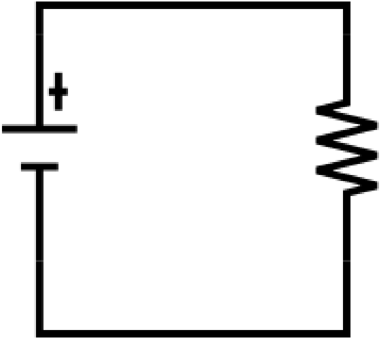

Q: Are the elements in series or parallel?

A: Both! So both voltage *and* current are the same.