

Junctions and Loops

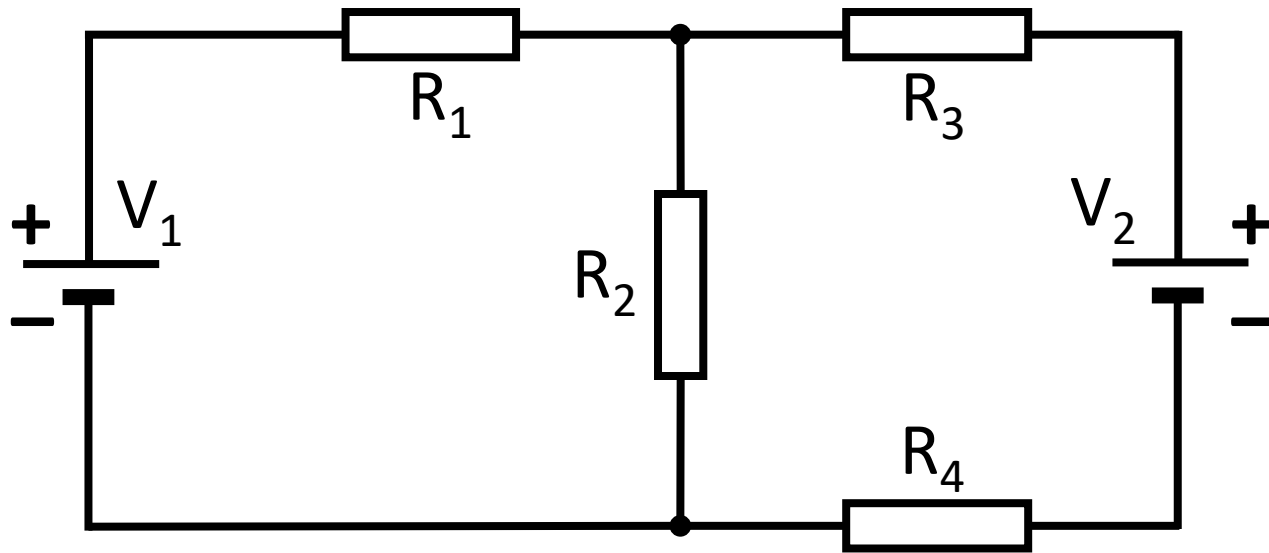
Electrical Engineering

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Kirchhoff's Circuit Laws (1)

- Complex Circuits

- Have multiple voltage sources and resistances
- What about voltage and current?



Kirchhoff's Circuit Laws (2)

- Kirchhoff's current law

- What about current?
- Law of conservation of mass
 - In any closed system the mass cannot change
- Electrons do not get lost



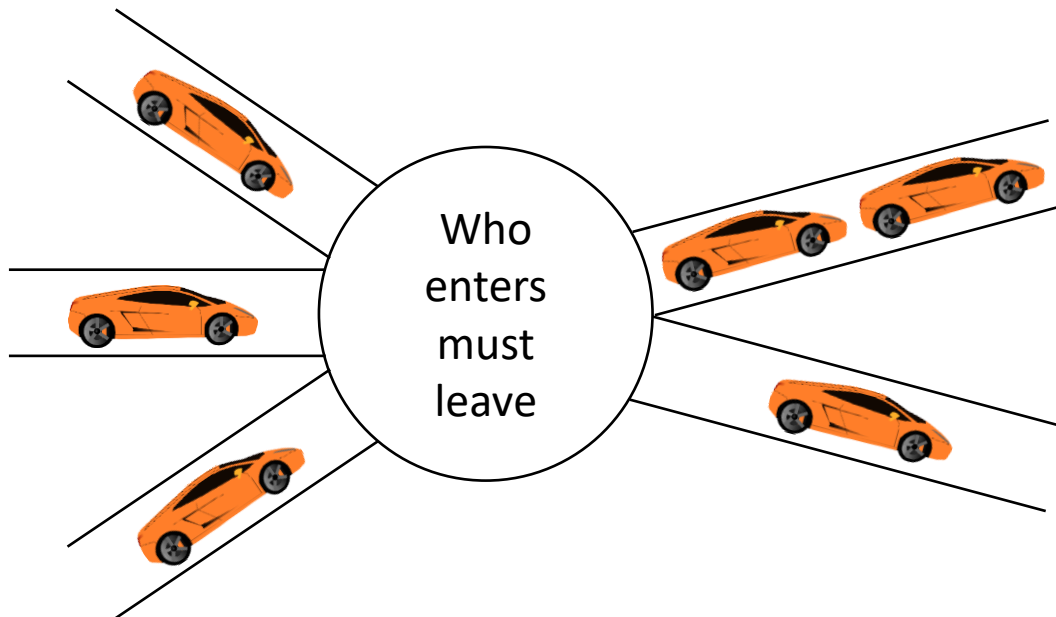
- Kirchhoff's voltage law

- What about voltage?
- Law of conservation of energy
 - In any closed system the amount of energy cannot change
- What gets produced must be consumed



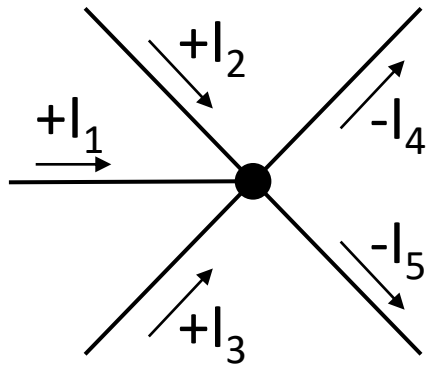
Kirchhoff's Current Laws (1)

- Electrons do not get lost
- There is no accumulation in the crossway



Kirchhoff's Current Laws (2)

- The sum of currents at any point is zero
 - $\sum_{k=1}^n I_k = I_1 + I_2 + \dots + I_n = 0$
- Inflowing current is positive
- Outflowing current is negative



$$I_1 + I_2 + I_3 - I_4 - I_5 = 0$$

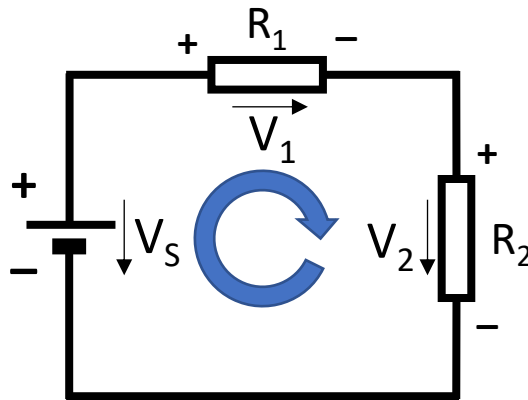
Kirchhoff's Voltage Laws (1)

- What gets produced must be consumed
- There is no accumulation of energy



Kirchhoff's Voltage Laws (2)

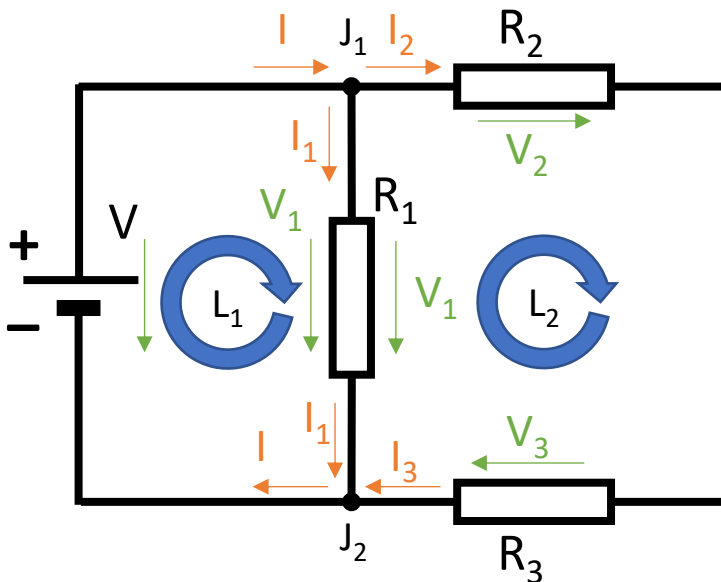
- The sum of voltages in a closed loop is zero
 - $\sum_{k=1}^n V_k = V_1 + V_2 + \dots + V_n = 0$
- Positive voltages point from plus to minus



$$V_1 + V_2 - V_S = 0$$

Kirchhoff's Circuit Laws (3)

- Complex Circuits have junctions and loops
 - The loops tell us something about the voltages
 - The junctions tell us something about the currents



Loops:

- $L_1: V_1 - V = 0$
- $L_2: V_2 + V_3 - V_1 = 0$
- $L_3: V_2 + V_3 - V = 0$

Junctions:

- $J_1: I - I_1 - I_2 = 0$
- $J_2: I_1 + I_3 - I = 0$