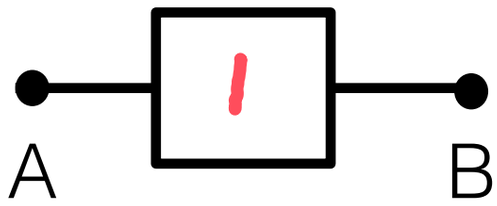
Last Class…

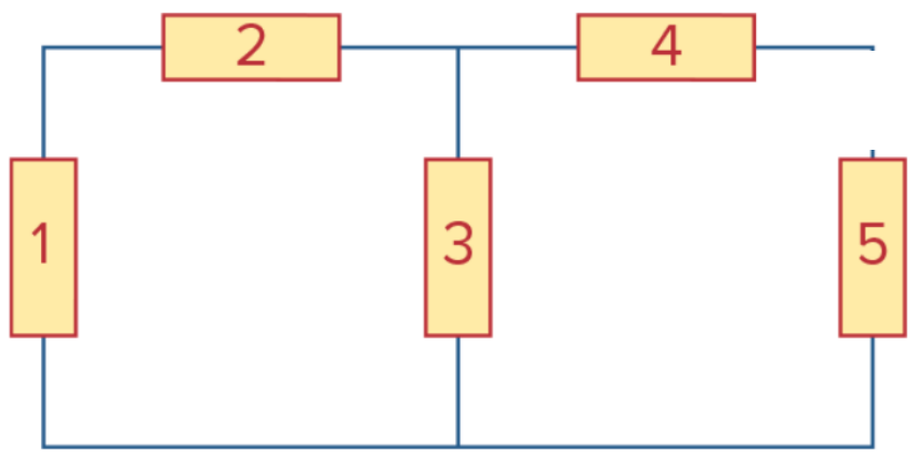
1. What is the relationship between the voltage across a component and the voltage on its nodes?

$V_1 = V_A - V_B$



2. Will current flow across all of the element on the circuit below?

No



THE OHIO STATE UNIVERSITY

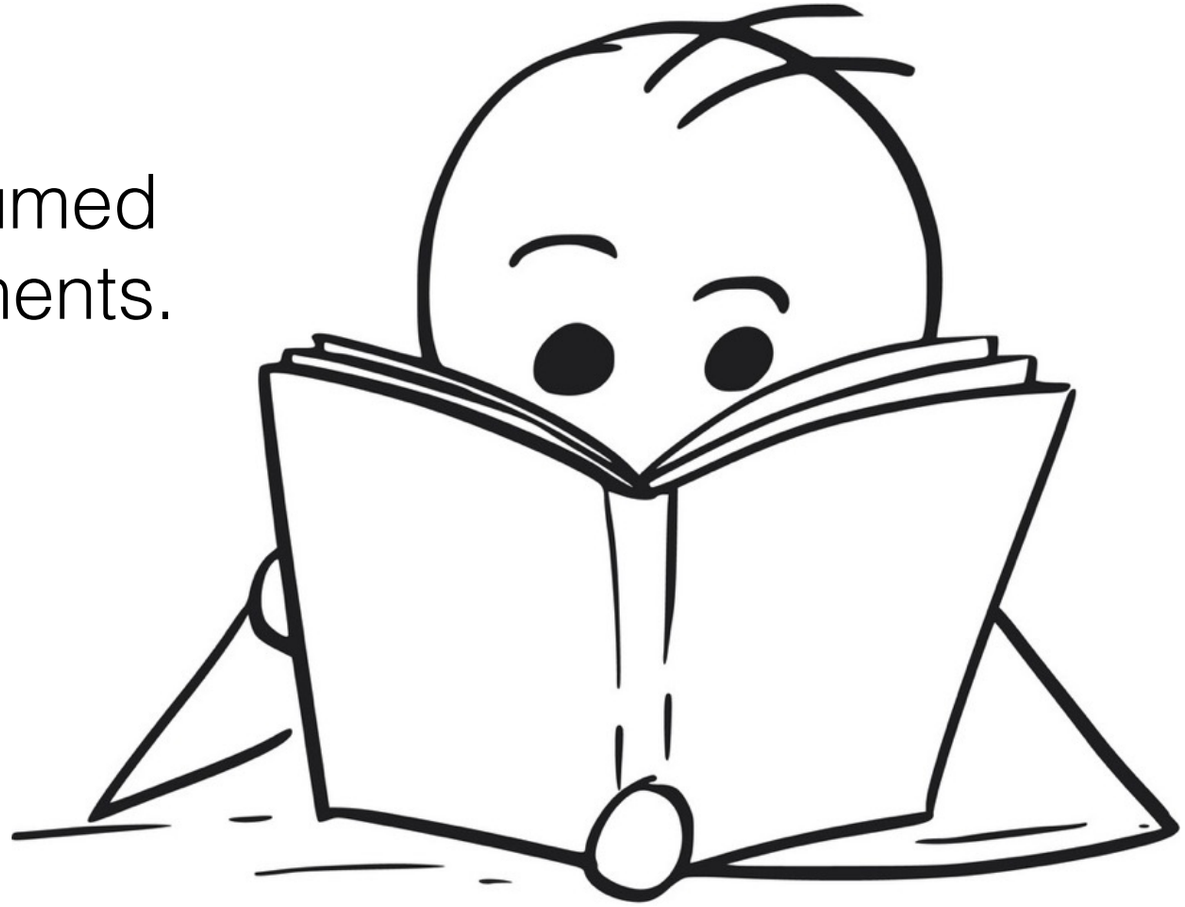
COLLEGE OF ENGINEERING

Power

Kanye West

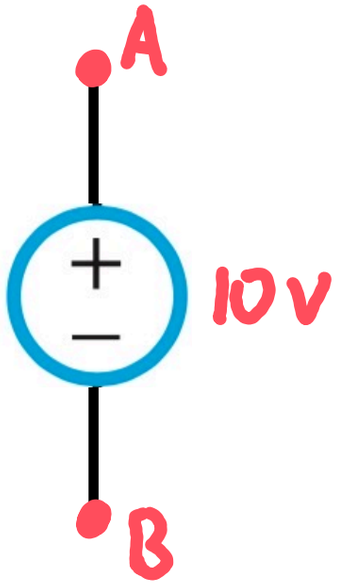
Today…

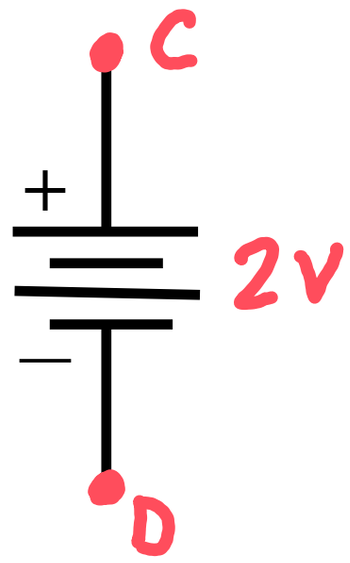
- Learning Objectives:
  - Identify voltage and current sources, ground, resistors, inductors, and capacitors in a circuit.
  - Understand what passive sign convention is.
  - Compute the power consumed or supplied by circuit elements.

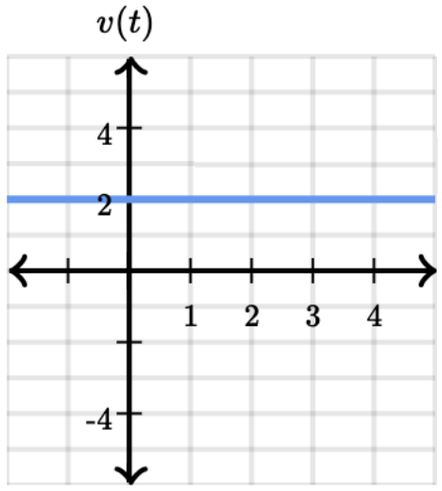


Independent Voltage Sources

- Constant Sources - DC



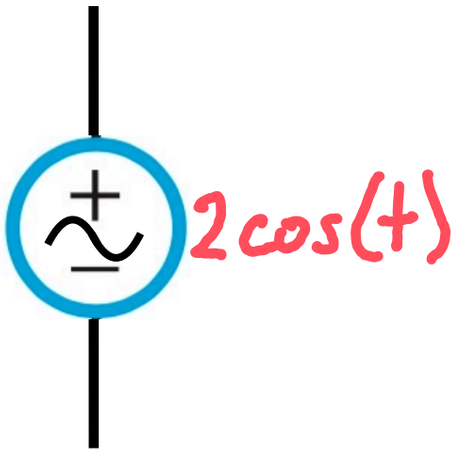


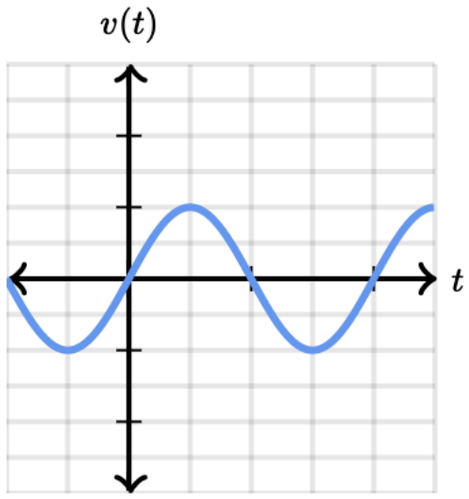


$V_A - V_B = 10V$

$V_C - V_D = 2V$

- Variable Sources - AC

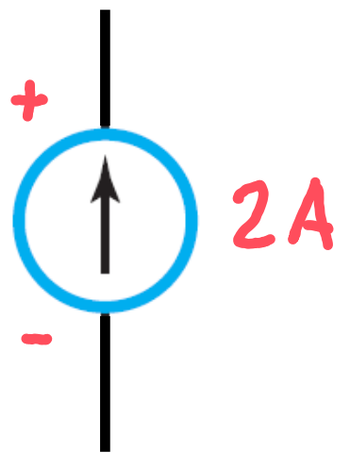


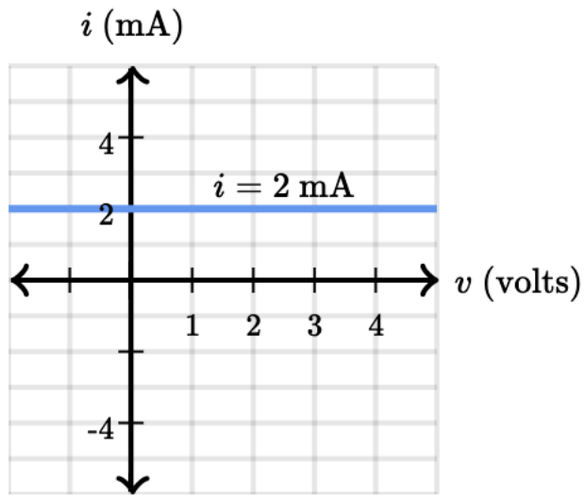


- independent of i
- i is determined by circuit

More Sources

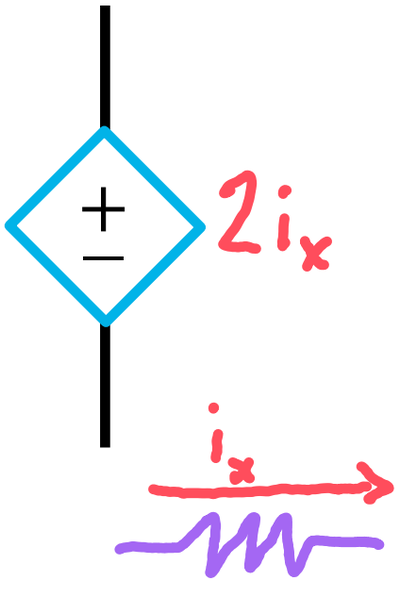
- Current Source

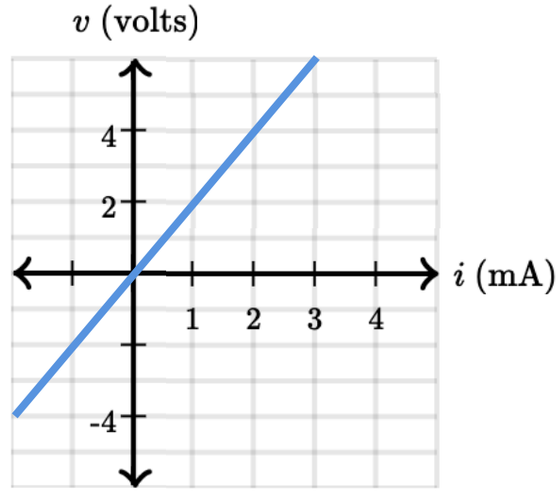




- independent of v
- v is determined by circuit

- Dependent Sources

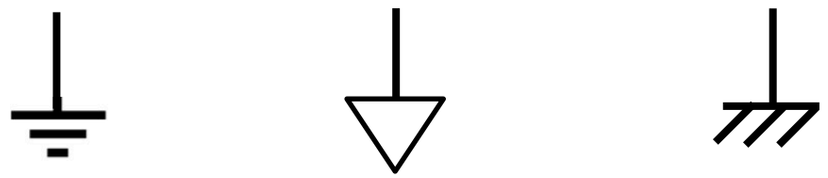




- dependent of some voltage of current
- used as a modeling tool.

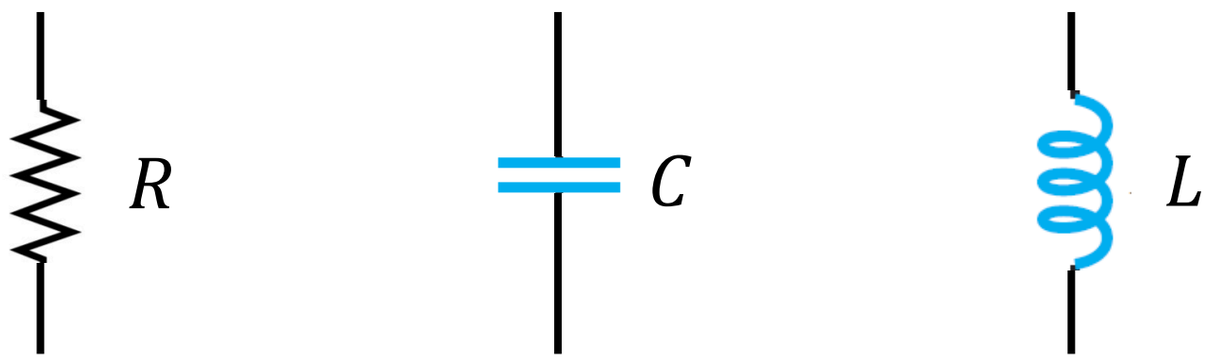
More Circuit Elements

- Ground $V_G = 0V$



Earth Common Chassis

- Passive Elements



Resistor Capacitor Inductor

Why do we need a Convention?

- Passive elements is an electrical component that does not generate power, but instead dissipates, stores, and/or releases it. E.g., resistors (R), inductors (L), capacitors (C).

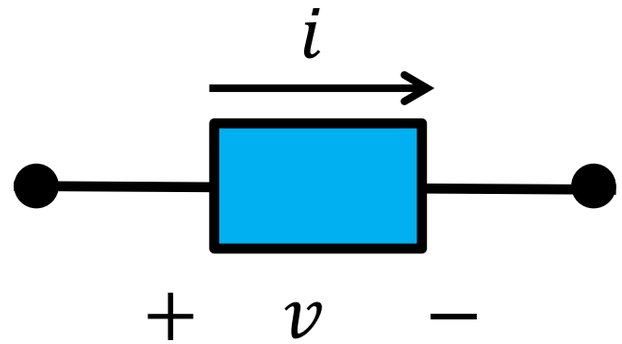
- Passive components have a defining equations that establish the relationship between voltage and current for each of them (e.g., Ohm's Law for resistor).

- Voltage polarity and current direction must be consistent with such laws for us to be able to apply them in circuit analysis.

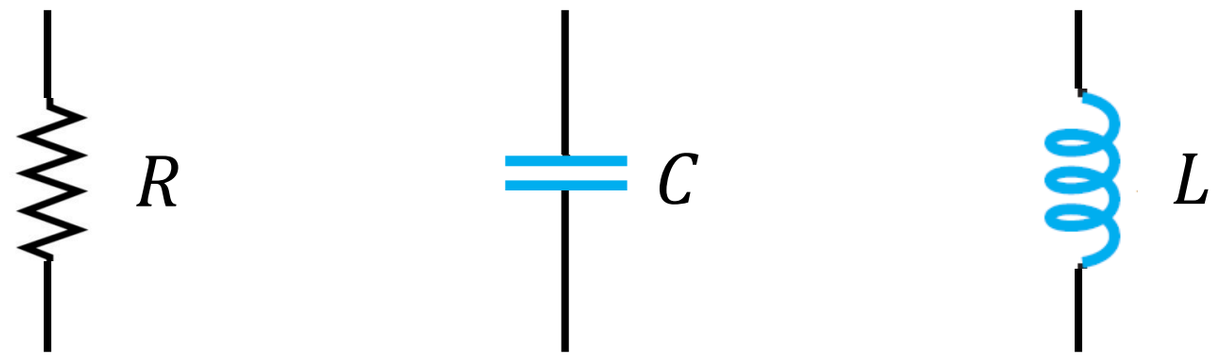
- Active elements generate power so other elements can operate

Passive Sign Convention

- Passive Sign Convention states that current must flow from positive to negative potential (higher to lower).

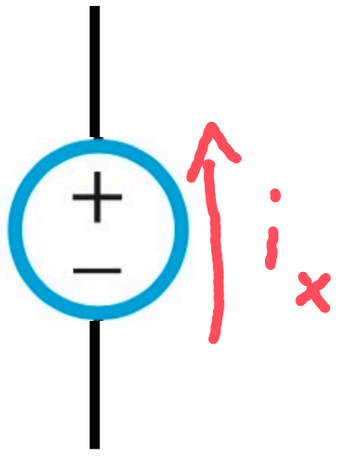


- How to apply Passive Sign Convention?
  1. Assign a current with arbitrary direction.
  2. Assign a voltage such that assigned current flows from high to low potential.

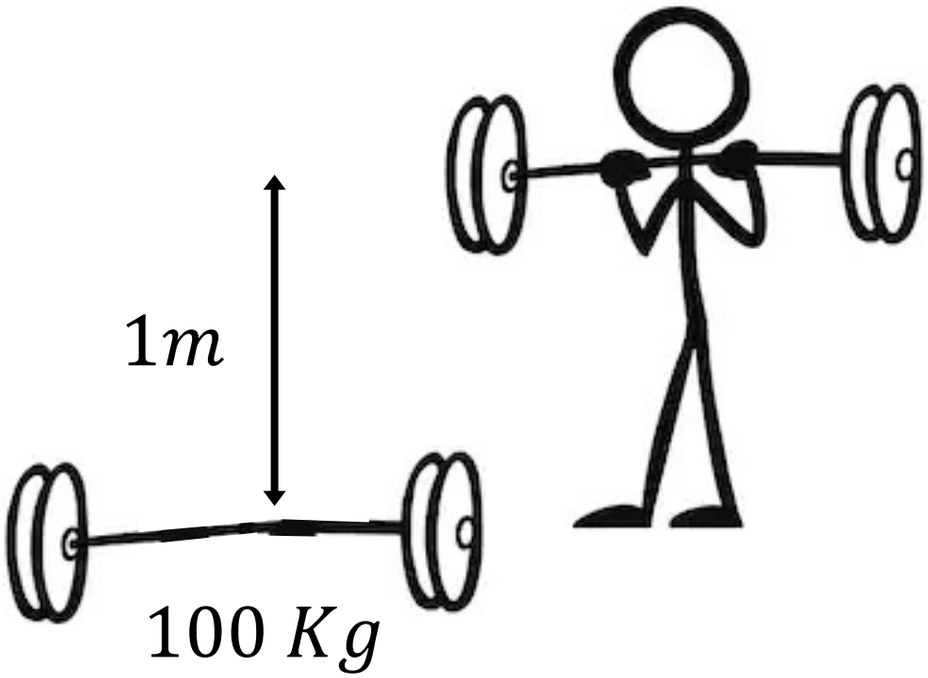


Active Elements

- Voltage and current sources do not follow passive sign convention, they supply power to the circuit.



Power



$3s$ - requires energy.

$1s$ - same energy, more power.

Power:

- Rate at which the energy is used.
- Work done per unit time.

$$P = \frac{dW}{dt} = [Watts] = [W]$$

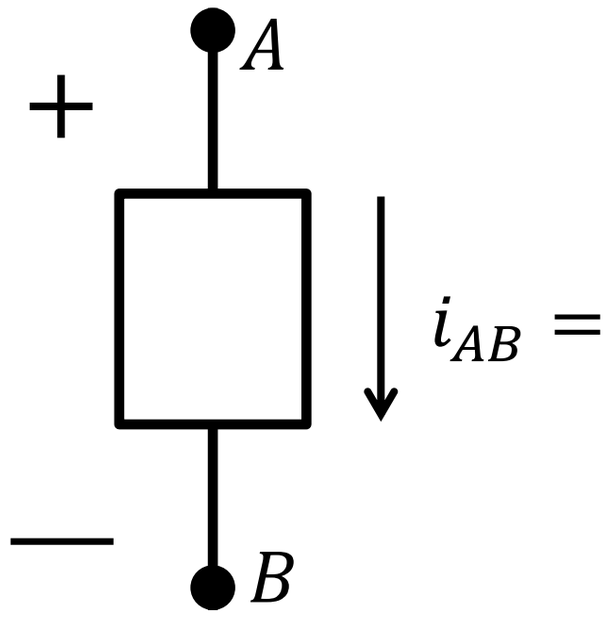
$$power = \frac{work}{time}$$

$$= \frac{work}{charge} \times \frac{charge}{time}$$

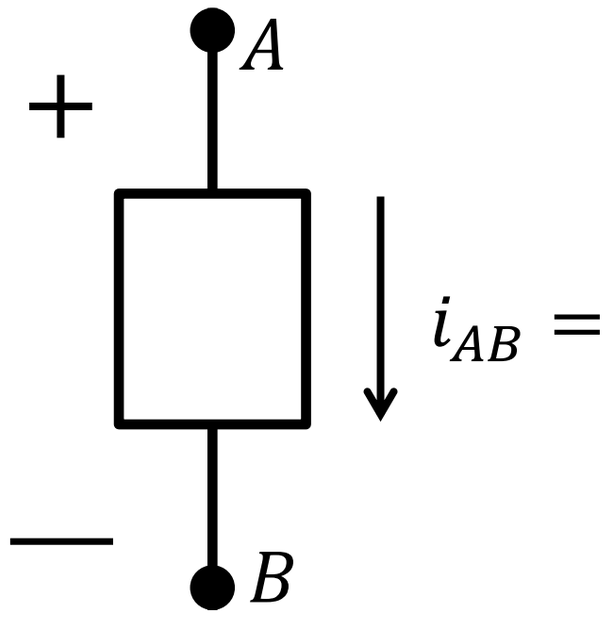
$$p = v \times i$$

Note: Assume passive sign convention.

- $P > 0$: dissipated or consumed.
- $P < 0$: generated or supplied.



P_{AB} =



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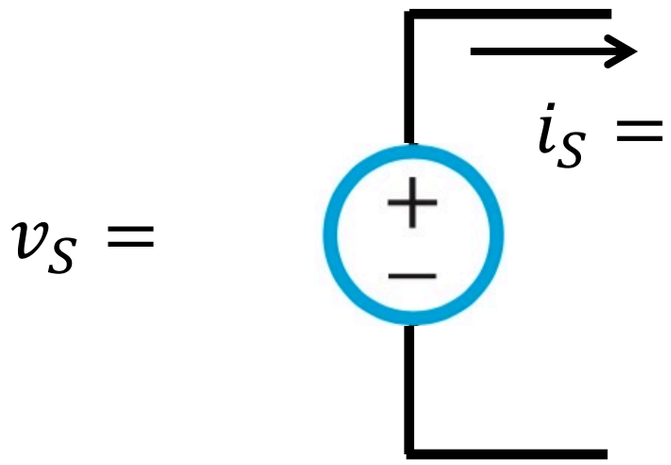
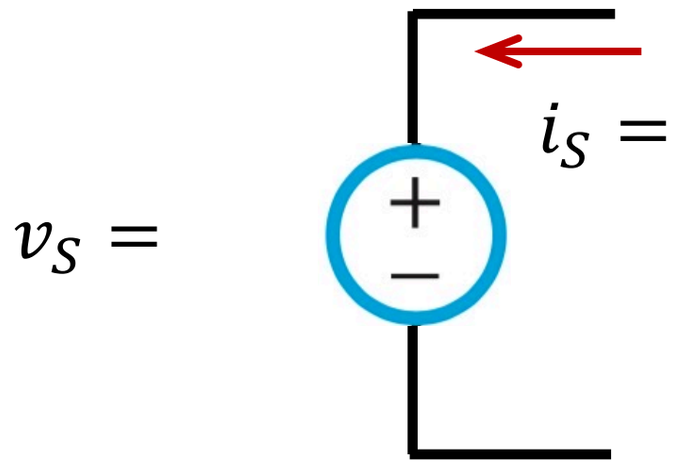
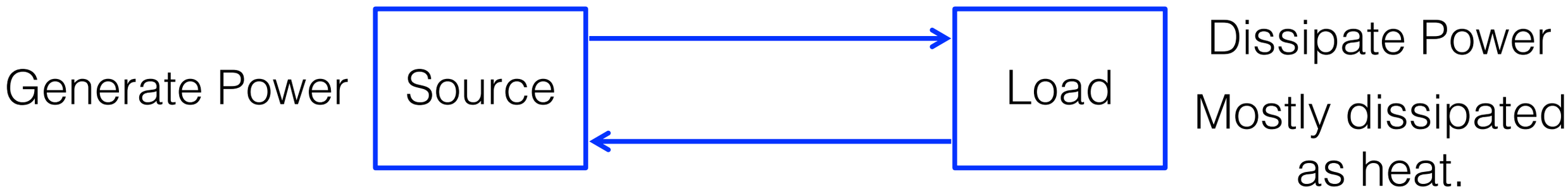
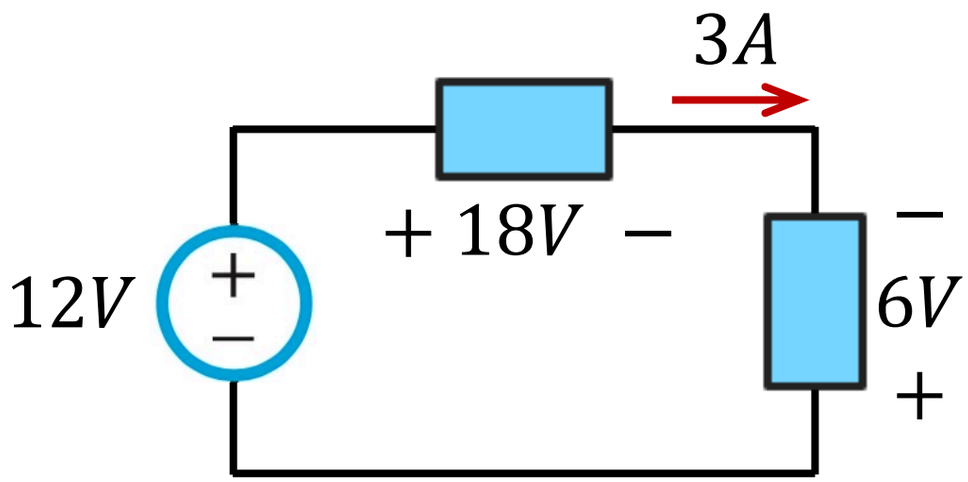




Law of Conservation of Power

$$\sum P_{system} = 0$$





Example

For each circuit below, find the power consumed or dissipated by each of the components. Show that conservation of power is satisfied.