

# Lecture 2

The direction of current ( $I$ ) is defined to be the same as the direction of flow that positive charges would follow, which is opposite to the direction of flow of electrons.

Electric Current is defined as the time rate of transfer of electric charge across a specified cross section.

$i = \frac{dq}{dt}$

$\text{Circuit} \quad 5 \text{ A} = \text{Circuit} \quad -5 \text{ A}$

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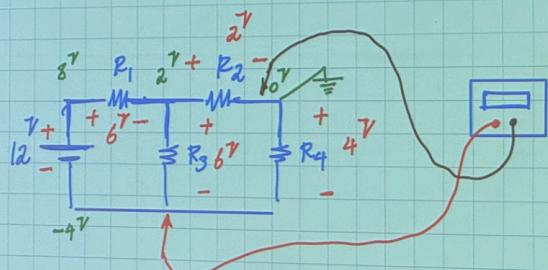
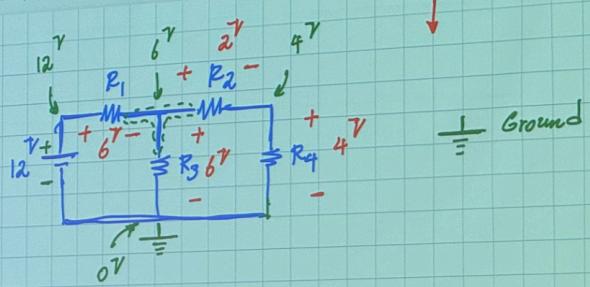
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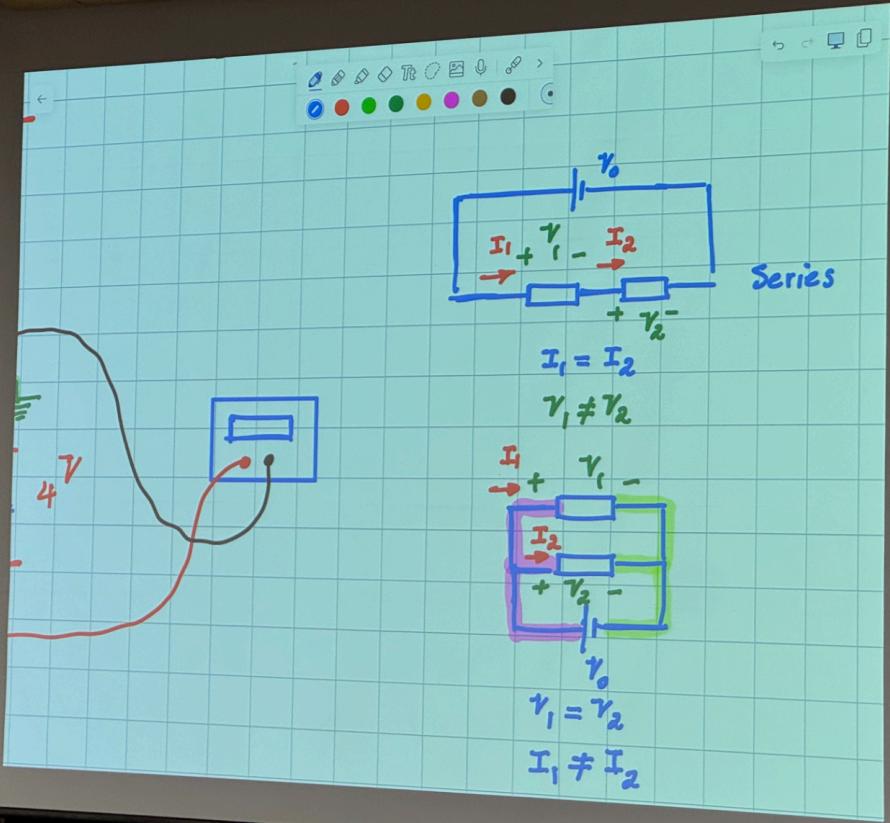
**Diagram illustrating current flow:** A cylindrical wire is shown with a cross-section highlighted. Arrows indicate electron flow from left to right, labeled "Direction of electron flow". The current direction is indicated by a red arrow pointing to the right, labeled "Current direction".

**Equation:**  $i = \frac{dq}{dt}$

**Circuit Diagram:** A circuit diagram showing a battery (labeled + and -), a resistor (indicated by a zigzag line), and a capacitor (indicated by two parallel lines). A current arrow flows through the circuit, labeled "5 A" on the left and "-5 A" on the right, indicating the direction of charge flow.

Note Jul 28, 2024



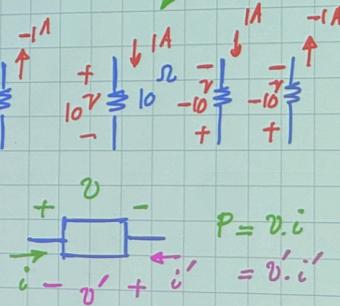
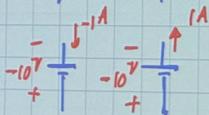
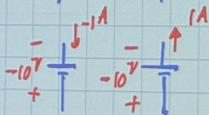
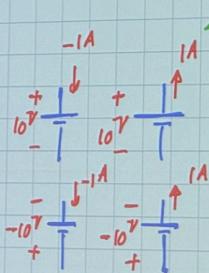
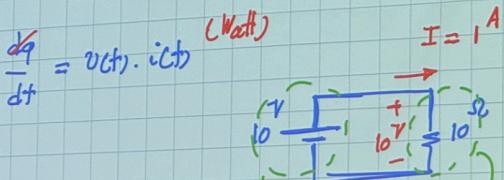


$\leftarrow$  i.e. Power:

$$= \frac{dW}{dt} = \frac{dW}{dq} \cdot \frac{dq}{dt} = v(t) \cdot i(t) \quad (\text{Watt})$$

$$v = \frac{dq}{dt}$$

$$i = \frac{dW}{dq}$$



$$P = v \cdot i = v' \cdot i'$$

Passive Sign Convention

$P = 10V \times 1A = 10W$   
 Passivo Sign Convention  
 $P = 0.0 = v \cdot i$

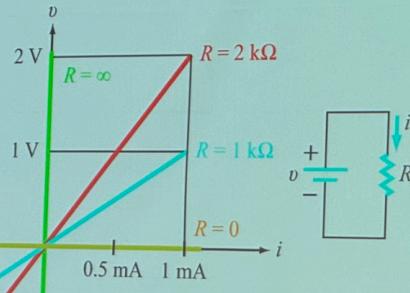
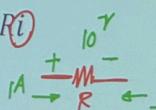
**Example:**
 $\sum_{k=1}^n P_k = 0$   
 Law of conservation  
 of power

$$\begin{aligned}
 P_{\text{batt}} &= 12V \times 3A = -36W \\
 P_1 &= 18V \times 3A = 54W \\
 P_2 &= -6V \times 3A = -18W
 \end{aligned}$$

## $i-v$ Characteristics of Ideal Resistor

- Ohm's law: the voltage across a resistor ( $v$ ) is directly proportional to the current ( $i$ ) flowing through it:

$$v = Ri$$



- The power rating of a resistor defines the maximum continuous power level that the resistor can dissipate without getting damaged. Excessive heat can cause melting, smoke, and even fire.

$$p = vi = Ri^2 = \frac{v^2}{R}$$

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## Kirchhoff's Current Law (KCL)

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