# Topic1 Recap

- Current is the rate of flow of electrons in a conductor.
  - $i = \frac{dq}{dt}$ (A)
  - $q = \int_{t_0}^{t_1} i\, dt + q(t_0), \;\; t_0 \le t \le t_1$ (C)
- Voltage is the potential difference between two points of the circuit (difference in charge between two locations):
  - $v_{ab} = v_a - v_b = \frac{dw}{dq}$ (V)
- They are described by their values and direction/polarity.
- DC and AC voltage/current.
  - DC (direct current): Not changing direction/polarity.
  - AC (alternating current): Changing direction/polarity.
- Power and energy
  - $p = \frac{dw}{dt} = vi$ (W)
  - $w = \int_{t_0}^{t} p\, dt = \int_{t_0}^{t} vi\, dt, \;\; t_0 \le t \le t_1$ (J)

# Topic1 Recap

- Passive sign convention
  - Power is **positive** if the current enters the **positive terminal**, $p = +vi$.
    Power is **negative** if the current enters the **negative terminal**, $p = -vi$.
  - Positive power is **absorbed/dissipated** by an element.
    Negative power is **supplied/generated** by an element.
- Conservation of energy
  - $\sum p = 0$
- Sources
  - Voltage sources generate or dissipate power at a specified voltage with whatever current is required.
  - Current sources generate or dissipate power at a specified current with whatever voltage is required.
  - Sources can be ideal/real, dependent/independent.

# Topic 1 recap

## Resistors

- Resistance $R$ is a physical property of a circuit element that impedes the flow of charge. It is measured in ohms, $\Omega$.
- Ohm's Law establishes the relationship between the voltage across a resistive element (called resistor) and the current through it:

$$v = Ri$$

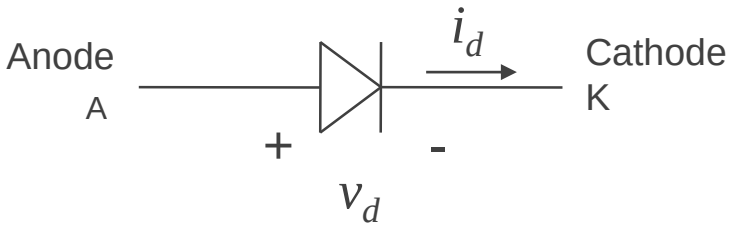
- Short circuit: $R = 0\,\Omega \rightarrow v = Ri = 0$. Open circuit: $R = \infty\,\Omega \rightarrow i = \frac{v}{R} = 0$.
- Conductance $G = \frac{1}{R}$
- Power dissipation on resistor:

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

# Topic 1 Recap

## Diodes

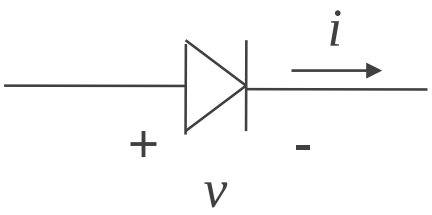
- A diode is a semiconductor electrical component that allows the flow of current in only one direction.
- Current flows in the direction of the arrow, and not against the direction of the arrow.
- Voltage is required to start current flow in the forward direction.
  - When $v_d$ > forward voltage, the diode is **forward biased**, and $i_d > 0$.
  - When $v_d$ < forward voltage, the diode is **reverse biased**, and $i_d \approx 0$.

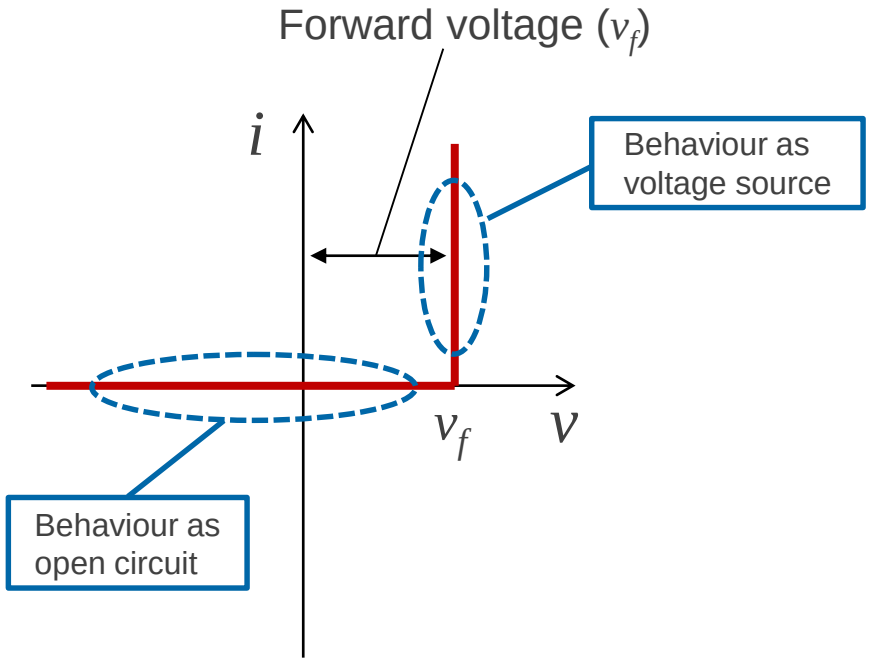


# Topic 1 Recap

## Diodes

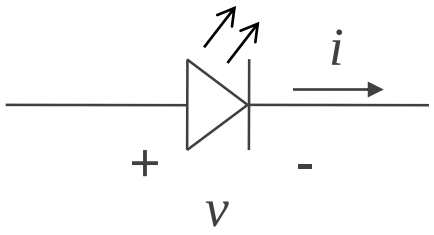
- Diodes have a *non-linear* $v$-$i$ characteristic.
  - When the diode is **forward biased**, it behaves as a **voltage source of value $v_f$** V.
  - When the diode is **reverse biased**, it behaves as an **open circuit ($i = 0$)**.



# Useful information: Light Emitting Diodes (LEDs)

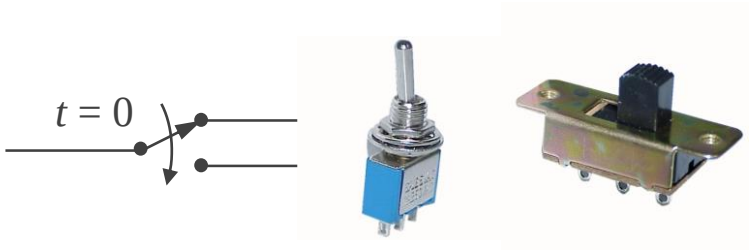
- A Light Emitting Diode (LED) is a semiconductor electrical component that emits light when a forward current is passed through it.
- Forward current refers to the flow of current from the anode (positive) to the cathode (negative) terminals.
- Direction of the current is specified because electrical polarity of the LED is important, and will only emit light in forward-bias. LEDs will not illuminate in reverse-bias.




# Useful information: Switches

- A switch is an electrical component that can break an electrical circuit, interrupting the current or diverting it from one conductor to another.
- The most familiar form of switch is a manually operated electromechanical device with one or more sets of electrical contacts.
- Each set of contacts can be in one of two states:
  - ”closed”: contacts are touching and electricity can flow between them.
  - ”open”: contacts are separated and the switch is nonconducting.
- There are different mechanisms actuating the transition between these two states (open or closed):
  - ”toggle”: flip switch for continuous ”on” or ”off”
  - ”momentary”: push-for ”on” or push-for ”off” type


Single pole, single throw switches




Single pole, double throw switches