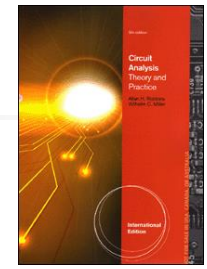


Chapter 04

Ohm's Law, Power, and Energy

Ohm's Law (published in 1827)

- **Current in a resistive circuit**
  - Directly **proportional to** its applied **voltage**
  - **Inversely proportional** to its **resistance**

$$I = E / R$$

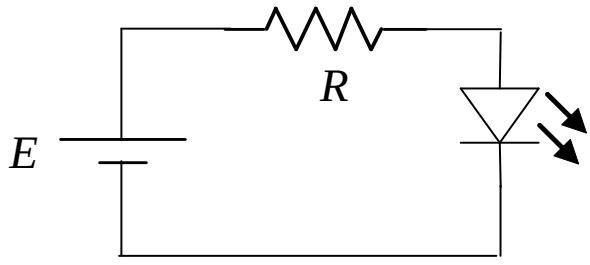
How to light LEDs

- In **forward** direction, **LED on, 10~20mA, 1.7V**
- In **reverse** direction, **LED off**.

For example:

If ***E*** = 6V, determine ***R*** for lighting the **LED**.

If ***E*** =19V, determine ***R*** for lighting the **LED**.



Power in Electrical Systems

- From $V = W/Q$ and $I = Q/t$, we get

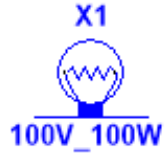
$$P = V \times I \quad (I = V/R)$$

- From Ohm's Law, we can also find that

$$P = I^2 \times R \text{ and } P = V^2/R$$

- Power is always in watts

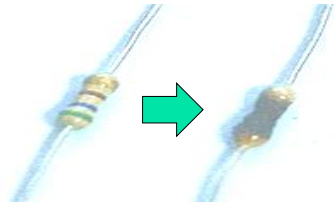
For example:



***R* = ?**

Power Rating of Resistors

- **Resistors must be able to safely dissipate their heat without damage**
- Customary safety margin: **two times the expected power**
- An **overheated** resistor



Energy in Cost

- **Cost = Power (*P*) × time (*t*) × cost per unit**

For example:

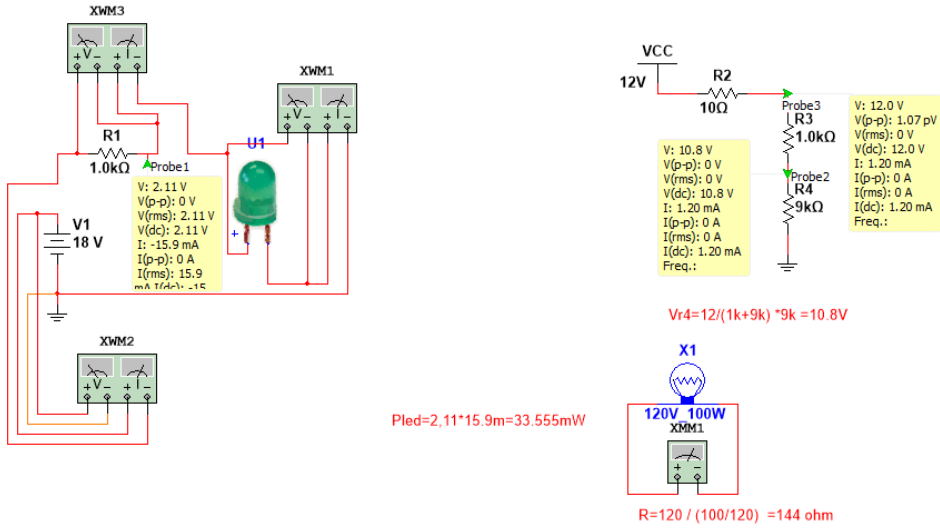
Find the cost of running a **2000-watt heater** for **12 hours** if electric energy costs **$3 per kilowatt-hour(kWh)**:

Solution:

Energy = 2000W × 12 h = 24kWh

Cost = $3/kWh × 24kWh = $ 72

Multisim



Kernel abilities

1. **What is Ohm's law? Please give an example.**
2. **How to light a LED? Please give an example.**
3. **How to calculate the dissipated power on a resistor? Please give an example.**
4. **How to estimate the power fee per month for a family? Please give an example.**