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CSE250 – Circuits and Electronics

Basics of Electricity

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Electricity

- *Electricity* is the set of physical phenomena associated with the presence and motion of matter that has a property of electric charge.
- *Static electricity*
- *Current electricity*

Charge

- *Charge* is an electrical property of the atomic particles of which matter consists, measured in coulombs (C).

- The *law of conservation of charge* states that charge can neither be created nor destroyed, only transferred. Thus, the algebraic sum of the electric charges in a system does not change.

- *Charge quantization* is the principle that the charge of any object is an integer multiple of the elementary charge

Example 1

How many electrons are there in 1C of charge?

Ans: **6250000000000000000** electrons or **6.25×10^{16}** electrons.

Electric potential and potential energy

- *Electric potential or potential difference is the energy required per unit charge to move a charge from a reference point to another point of interest.*

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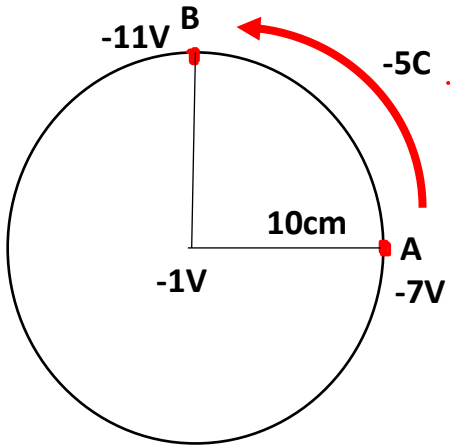
-7V

Example 2 & 3

2. At point **A**, there's a voltage of V_A=**22 V**. If a charge with q= **-2 C** moves from point A to another point B and while moving it does a work of W=**10 J**, what's the voltage of point **B**?

3. How much work must be done to transport the **-5C** charge from point **A** to point **B** around the circle depicted in the diagram?



Ans: (2) $\mathbf{V_B}$ **= 27 V**

(3) **W = + 20 J**

Current

- *Current is the rate of flow of charge.*

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Power

- *Power is the rate of flow of energy.*

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Circuit element

- Active element
  - An active element is capable of generating energy while a passive element is not.
  - Active elements have the ability to electrically control electron flow
  - Voltage/current sources, generators, transistors, operational amplifiers.
- Passive element
  - Resistors, capacitors, inductors, transformers

Circuit symbols

- [Basic Electrical and Electronic Schematic Symbols (electronics-tutorials.ws)]

Power Supply Schematic Symbols

Schematic Symbol	Symbol Identification	Description of Symbol
	Single Cell	A single DC battery cell of 0.5V
	DC Battery Supply	A collection of single cells forming a DC battery supply
	DC Voltage Source	A constant DC voltage supply of a fixed value
	DC Current Source	A constant DC current supply of a fixed value
	Controlled Voltage Source	A dependent voltage source controlled by an external voltage or current
	Controlled Current Source	A dependent current source controlled by an external voltage or current
	AC Voltage Source	A sinusoidal voltage source or generator

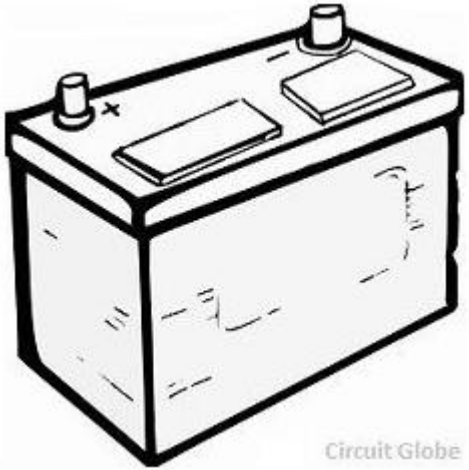
Electrical Grounding Schematic Symbols

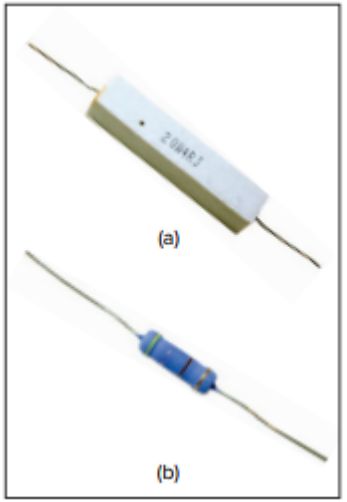
Schematic Symbol	Symbol Identification	Description of Symbol
	Earth Ground	Earth ground referencing a common zero potential point
	Digital Ground	A common digital logic circuit ground line

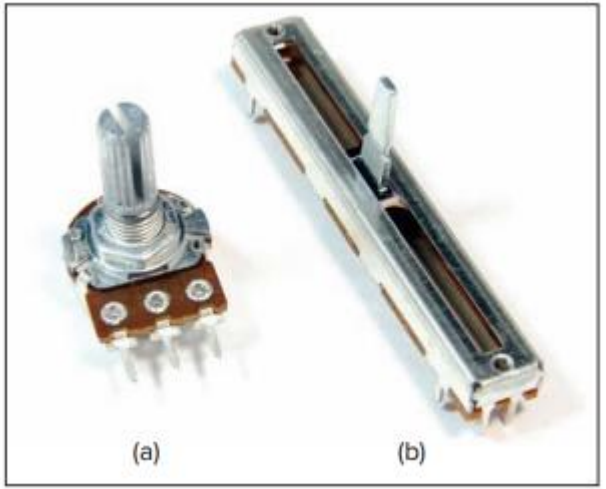
Resistor Schematic Symbols

Schematic Symbol	Symbol Identification	Description of Symbol
	Fixed Resistor (IEEE Design)	A fixed value resistor whose resistive value is indicated next to its schematic symbol
	Fixed Resistor (IEC Design)	
	Potentiometer (IEEE Design)	Three terminal variable resistance whose resistive value is adjustable from zero to its maximum value
	Potentiometer (IEC Design)	
	Rheostat (IEEE Design)	Two terminal fully adjustable rheostat whose resistive value varies from zero to a maximum value
	Rheostat (IEC Design)	


BATTERY

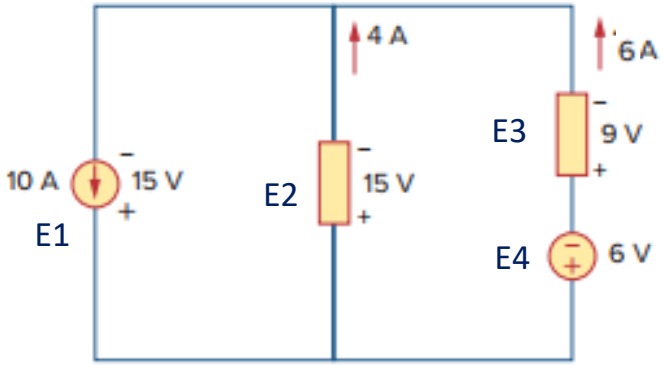

Circuit Globe


(a)
(b)


(a)
(b)

Example 4

- Find power absorbed by each element in the network.



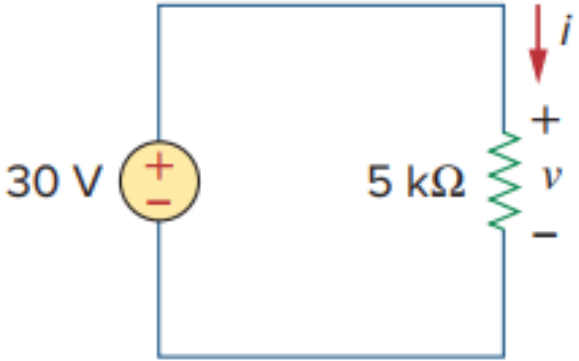
Ans: $P_{E1} = -150$ W; $P_{E2} = 60$ W; $P_{E3} = 54$ W; $P_{E4} = 36$ W.

Ohm’s Law

Ohm’s law states that the voltage across a resistor is directly proportional to the current flowing through the resistor.

Example 5

- In the circuit shown in the following figure, calculate the current *i*, the conductance *G*, and the power *p*.



Ans: **i = 6 mA; G = 200 ℧; P = 180 mW.**

Thank you for your attention