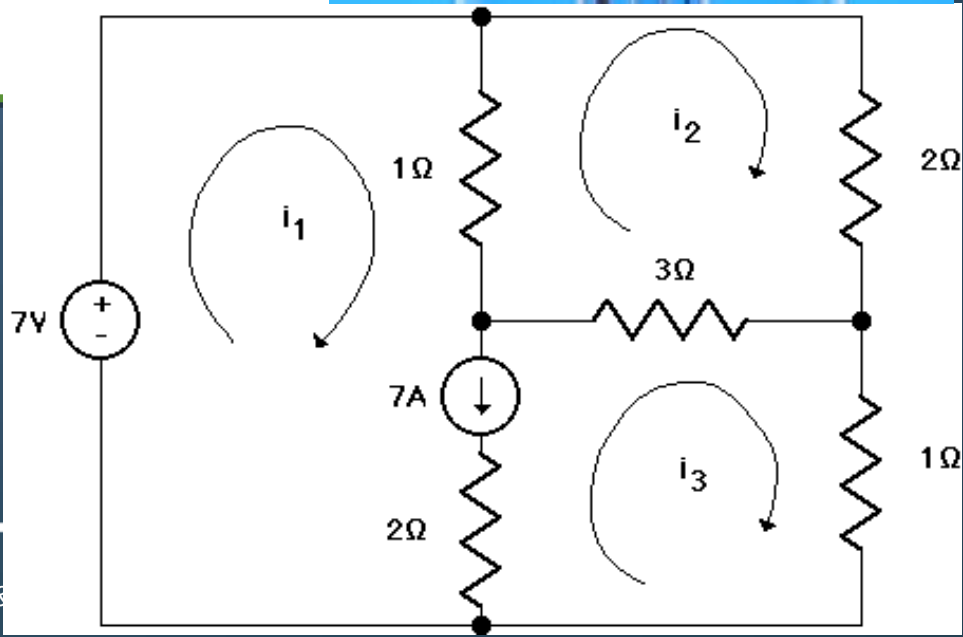
Chapter 26

Current and Resistance



26-2 Electric Current

Learning Objectives

26.01 Apply the definition of current as the rate at which charge moves through a point, including solving for the amount of charge that passes the point in a given time interval.

26.02 Identify that current is normally due to the motion of conduction electrons that are driven by electric fields (such as those set up in a wire by a battery).

26.03 Identify a junction in a circuit and apply the fact that (due to conservation of charge) the total current into a junction must equal the total current out of the junction.

26.04 Explain how current arrows are drawn in a schematic diagram of a circuit, and identify that the arrows are not vectors.

26-3 Current Density

Learning Objectives

26.05 Identify a current density and a current density vector.

26.06 For current through an area element on a cross section through a conductor (such as a wire), identify the element's area vector *dA*.

26.07 Find the current through a cross section of a conductor by integrating the dot product of the current density vector *J* and the element area vector *dA* over the full cross section.

26.08 For the case where current is uniformly spread over a cross section in a conductor, apply the relationship between the current *i*, the current density magnitude *J*, and the area *A*.

26.09 Identify streamlines.

26.10 Explain the motion of conduction electrons in terms of their drift speed.

26-3 Current Density

Learning Objectives (Continued)

26.11 Distinguish the drift speeds of conduction electrons from their random-motion speeds, including relative magnitudes.

26.12 Identify carrier charge density n.

26.13 Apply the relationship between current density J, charge carrier density n, and charge carrier drift speed v_d.

26-4 Resistance and Resistivity

Learning Objectives

26.14 Apply the relationship between the potential difference *V* applied across an object, the object's resistance *R*, and the resulting current *i* through the object, between the application points.

26.15 Identify a resistor.

26.16 Apply the relationship between the electric field magnitude *E* set up at a point in a given material, the material's resistivity ρ, and the resulting current density magnitude *J* at that point.

26.17 For a uniform electric field set up in a wire, apply the relationship between the electric field magnitude *E*, the potential difference *V* between the two ends, and the wire's length *L*.

26.18 Apply the relationship between resistivity ρ and conductivity σ.

26.19 Apply the relationship between an object's resistance R, the resistivity of its material ρ, its length *L*, and its cross-sectional area *A*.

26-4 Resistance and Resistivity

Learning Objectives (Continued)

26.20 Apply the equation that approximately gives a conductor's resistivity ρ as a function of temperature T.

26.21 Sketch a graph of resistivity ρ versus temperature T for a metal.

26-5 Ohm's Law

Learning Objectives

26.22 Distinguish between an *object* that obeys Ohm's law and one that does not.

26.23 Distinguish between a *material* that obeys Ohm's law and one that does not.

26.24 Describe the general motion of a conduction electron in a current.

26.25 For the conduction electrons in a conductor, explain the relationship between the mean free time τ, the effective speed, and the thermal (random) motion.

26.26 Apply the relationship between resistivity ρ, number density n of conduction electrons, and the mean free time τ of the electrons.

26-7,8,9 Power, Semiconductors, Superconductors

Learning Objectives

26.27 Explain how conduction electrons in a circuit lose energy in a resistive device.

26.28 Identify that power is the rate at which energy is transferred from one type to another.

26.29 For a resistive device, apply the relationships between power *P*, current *i*, voltage *V*, and resistance *R*.

26.30 For a battery, apply the relationship between power *P*, current *i*, and potential difference *V*.

26.31 Apply the conservation of energy to a circuit with a battery and a resistive device to relate the energy transfers in the circuit.

26.32 Distinguish conductors, semiconductors, and superconductors.