I can define, analyze, and solve problems involving current electricity.

Key Concepts
- 2 Kinds of charge, positive and negative
- Conservation of charge
- Conductors vs. insulators
- Charging by conduction vs. induction
- Grounding
- Coulomb's Law

Electric Field Strength
Definition: The force per unit charge experienced by a small positive test charge placed in the field.

\[ E = \frac{F}{Q} \]
Units: NC\(^{-1}\)

Gravitational Field Strength
Definition: The force per unit mass experienced by a small test mass placed in the field.

\[ \theta = \frac{F}{m} \]
Units: NKg\(^{-1}\)

The Electric Field
Electric field lines provide a picture of the electric field. They are directed away from positive charges and toward negative charges. They never cross, and their density is related to the strength of the field.

Energy and Electric Potential
Work is needed to move an object against the force of gravity and also against the electric force. In both cases, the potential energy of the object is increased.

\[ \Delta V = \frac{W}{q} = \frac{\Delta U_e}{q} \]
Electric current is the flow of charge.

Electric currents flow from high electric potential to low electric potential. And the greater the difference between the high and low potential, the more current that flows!

Electric current \( I \) can be calculated by finding the total amount of charge \( \Delta q \), in Coulombs, which passes a specific point in a given time \( \Delta t \).

\[
I = \frac{\Delta q}{\Delta t}
\]

We describe a material's ability to conduct electric charge as conductivity.

In similar fashion, we describe a material's ability to resist the movement of electric charge using resistance. Units of resistance are ohms (Ω).
A material’s ability to resist the movement of electric charge is its resistivity, symbolized with the Greek letter rho ($\rho$).

\[ R = \frac{\rho l}{A} \]

**Resistance (R)**

For any given temperature, we can calculate an object's electrical resistance, in ohms, using the following formula:

- $R$ is the resistance of the object, in ohms ($\Omega$)
- $\rho$ ($\rho$) is the resistivity of the material the object is made out of, in ohm*meters ($\Omega\cdot m$)
- $l$ is the length of the object, in meters
- $A$ is the cross-sectional area of the object, in meters squared.

### UNIT 14: IN-CLASS PROBLEMS

5. How much work is required to move a charge of $2.20 \times 10^{-6} \text{ C}$ from point A to point B, given that the change in electric potential between those points is 24.0 V?

6. The disk drive in a portable CD player is connected to a battery that supplies it with a current of 0.22 A. How many electrons pass through the disk drive in 4.5 s?

7. A 3.50-meter length of wire has a cross-sectional area of $3.14 \times 10^{-6} \text{ m}^2$. At 20° Celsius, the wire has a resistance of 0.0625 $\Omega$. Determine what material is most likely in this wire.

### Vector of Scalar

**Relationship**

\[ \mathbf{V} = \frac{\mathbf{W}}{\mathbf{q}} \]

\[ \Delta V = 24.0 \text{ V} \]

\[ W = ? \]

\[ W = 5.28 \times 10^{-5} \]
6. The disk drive in a portable CD player is connected to a battery that supplies it with a current of 0.22 A. How many electrons pass through the disk drive in 4.5 s?

\[ I = \frac{q}{t} \quad q = It = 0.99 \, \text{C} \]

\[ e = 1.60 \times 10^{-19} \, \text{C} \]

\[ \frac{0.99}{e} = 6.2 \times 10^{18} \, \text{electrons} \]

7. A 3.50-meter length of wire has a cross-sectional area of $3.14 \times 10^{-4}$ m$^2$. At 20° Celsius, the wire has a resistance of 0.0625 Ω. Determine what material is most likely in this wire.

\[ R = \frac{\rho L}{A} \]

\[ \rho = \frac{R A}{L} = 5.61 \times 10^8 \, \Omega \cdot \text{m} \]

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**Practice Makes Perfect**

**Problems (21-32)**