

UNIT V: Electricity and Magnetism

Chapters 32-37

Chapter 34: Electric Current

I. The Flow of Charge (34.1)

A. **Potential Difference-** *When there is a difference in _____ (voltage), between the ends of a conductor, charge will flow until both ends reach a common potential*

1. Much like temperature flows from _____ to _____ object until they are the same temperature

2. When there is **no potential difference** then **no longer a flow of _____** through the conductor

B. To maintain a flow of charge in a conductor, a difference in _____ must be maintained

1. Analogous to the flow of water from higher reservoir to a lower one

2. A suitable " _____ " must be supplied to maintain difference. (whether we talk about water flowing or flow of charge)

II. Electric Current (34.2)

A. **Electric current-** *the flow of _____*

1. **Solid conductors-** _____ carry the charge through the circuit (electrons are free to move throughout the atomic network)

a. called _____ **electrons**

b. **Protons** are in **fixed position** in nucleus of atom and **cannot** _____ about

3. **In fluids such as electrolytes** (car battery)- **positive and negative** _____ as well as _____ may compose the flow of electric charge

B. Electric **current** measured in _____

1. **SI unit is (A) amperes**

2. **1A = flow of 1 _____ of charge per _____**

a. _____ is standard **unit of charge**

b. **1 coulomb = _____**

IMPORTANT TERMS:

- Alternating current (AC)
- Ampere
- Diode
- Direct current (DC)
- Electric current
- Electric power
- Electric resistance
- Ohm
- Ohm's Law
- Potential difference
- Voltage source

EQUATIONS:

$$F = k \frac{q_1 q_2}{d^2}$$

$$\text{Electric potential} = \frac{\text{Electrical potential}}{\text{Charge}}$$

$$1 \text{ Volt} = \frac{\text{Joule}}{\text{Coulomb}}$$

$$\text{current} = \frac{\text{voltage}}{\text{resistance}}$$

$$I = \frac{V}{R}$$

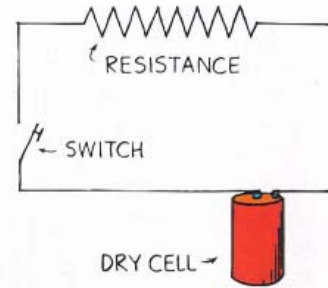
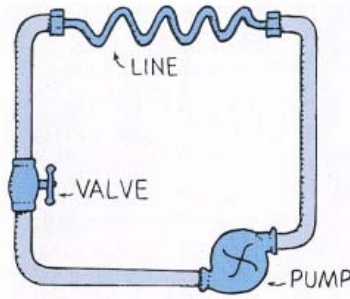
$$1 \text{ ampere} = 1 \frac{\text{volt}}{\text{ohm}}$$

$$\text{electric energy} = \text{current} \times \text{voltage}$$

III. Voltage Source (34.3)

A. _____ do not flow **without a potential difference**

1. A sustained current requires a suitable
“ _____ ” to provide **potential difference**



2. Something that provides potential difference is called a _____ **source**.

3. **Dry cells, wet cells, and generators** supply
_____ that allows charges to move

a. **Dry and wet cells**- energy released in
_____ **reactions** occurring inside that
is converted into **electrical energy**

b. **Generator**-convert _____
energy into **electrical energy**

c. This electrical potential energy is available at
the _____ of the cell or generator

B. The **potential energy per coulomb of charge** available to
electrons moving between terminals is the _____

1. Sometimes called _____ **force** (emf)

2. The **voltage** provides the “**electric** _____”
to move electrons between terminals in circuit

C. Power utilities use large **electric generators** to provide
_____ **volts** delivered to home outlets

D. **Voltage causes** _____

1. _____ does not flow- creates the “**pressure**”

2. **Charges flow through circuit** (called _____)

IV. Electric Resistance (34.4)

A. **Electrical resistance**- the current depends on the
_____ that the **conductor** offers to the **flow of charge**

1. **Resistance** or wire depends on _____

of material

2. Also on _____ and _____ of wire

a. **Thick** wires- _____ **resistance**

b. **Thin** wires- _____ **resistance**

c. **Short** wires - _____ **resistance**

d. **Long** wires - _____ **resistance**

3. Resistance also depends on temperature

a. **High temperature**- for most conductors, increased temp means _____ **resistance**

b. **resistance** of some conductors becomes ____ at very **low temperatures (superconductors)**

B. **Electrical resistance** measured in units called _____

V. Ohm's Law (34.5)

A. Ohm discovered that **current** is _____ proportional to **voltage** impressed across circuit and _____ proportional to the **resistance**



1. Called **Ohm's Law**

2. **Units** for these are:



a. For a given circuit of constant resistance, current and voltage are _____

b. The greater the resistance, the _____ the current (inversely proportional)

B. Resistance of materials

1. Typical lamp cord- much less than ____ ohm

2. An iron or toaster- resistance of ____ to ____ ohms (**low resistance permits large current**- which produces considerable _____)

3. Inside electrical devices- current regulated by circuit elements called _____ (range from a few ohms to millions of ohms)

VI. Ohm's Law and Electric Shock (34.6)

A. It is _____ not **voltage** that causes effect of electrical shock

1. **Human body varies in resistance** (100 ohms if _____, and up to 500,000 ohms if very _____)

2. If a pathway is provided for current (_____) can be dangerous



a. Home appliances are grounded with _____ plugs to prevent electrocution

b. If live wire comes into contact with metal surface of appliance, the current will be directed to the _____ rather than shocking you.

B. Effect of electric shock- **overheats** _____ in body or **disrupt normal** _____ **functions**

VII. Direct Current and Alternating Current (34.7)

A. Electric current can be _____ or _____

1. **Direct Current (DC)**- Flow of charge in _____ **direction**

a. _____ produce **DC**

b. Electrons move from repelling _____ terminal towards attracting _____ terminal

2. **Alternating Current (AC)**- Electrons move first in one direction and then in the opposite direction

a. In North America nearly all **AC circuits** alternate back and forth at a **frequency of** _____ **cycles per second. (60 _____)**

b. **Voltage** is normally _____ **volts**

c. **Europe** adopted _____ **volts** (power transmission more efficient at higher voltages)

B. Popularity of AC arises from fact that electrical energy can be transmitted great _____ with easy voltage step-ups that result in _____ heat losses in the wires

VIII. Converting AC to DC (34.8)

A. The current in you home is _____ and current in battery

operated device is _____

1. Can operate device with an AC-DC _____
2. Uses _____ to lower the voltage as well

B. _____ - tiny electronic device that acts as one-way valve to allow _____ flow in only one direction

1. Only half of each cycle will pass through the diode
2. _____ used to store energy and maintain continuous _____

IX. The Speed of Electrons in a Circuit (34.9)

A. The **signal** (turning on light bulb or telephone signal) travels nearly the **speed of** _____

1. It is **not the** _____ that move at this speed **but the** _____
2. At room temperature, electrons move inside wire at an average speed of a few million _____ per hour due to their _____ motion

B. It is the pulsating _____ that can travel

1. Conducting wire acts as a “guide” or “pipe” for **electric** _____
2. _____ **electrons** are accelerated by the **field** in a **direction** _____ **to the field lines**
 - a. Before they gain appreciable speed, they “bump into” anchored metallic ions in their paths and **transfer** some of their _____ **energy** to them
 - b. This is why current carrying wires become _____

C. In AC circuits, **conduction electrons** _____ make any net progress in any direction

1. Electrons _____ **rhythmically** to and fro about relatively _____ positions
2. The electrons already in the wires _____ to the rhythm of the traveling pattern.

X. The Source of Electrons in a Circuit (34.10)

A. The source of electrons in a circuit is the conducting circuit _____ itself

1. _____ do not flow through power lines into the wall outlets of your house. (outlets are AC)

2. When plug in AC, _____ **flows** from outlet into appliance, **not** _____

B. **Energy** is carried by _____ **field** and causes **vibratory motion** of the electrons that already exist.

1. When you are jolted by AC electric shock, electrons making up the current in your body _____ in your body

2. **Electrons do not come out of the wire** and through your body and into the ground; _____ **does**

XI. Electric Power (34.11)

A. **Electric power**- the _____ at which **electrical energy** in converted into another form such as _____ **energy**, _____, **or** _____.

1. Equation:

2. Units:

B. Important when consider _____ of electrical energy

1. Rate varies from 1 cent to 10 cents per kilowatt-hour

2. **kilowatt-hour** represents the **amount of** _____ **consumed in 1** _____ **at the rate of 1 kilowatt**

3. Example: a 100 watt light bulb (60W 120V) where electrical energy costs 5 cents per kilowatt-hour can be run for 10 hours at a cost of _____