

Enhanced Guided Notes: Set 2

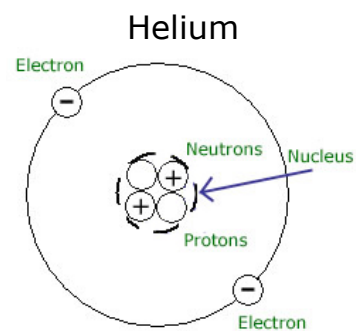
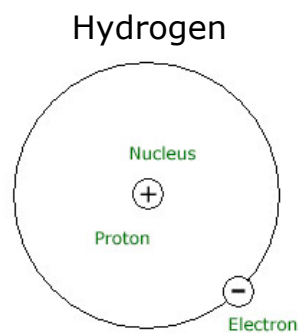
Voltage and Current

Topics:

- A. Atomic Structure
- B. Coulomb's Law
- C. Voltage
- D. Current

- E. Voltage – Sources
- F. Ampere Hour Rating
- G. Conductors

A. Atomic Structure



Electrons have _____ charge

Protons have _____ charge

Neutrons have _____ charge

Stable atoms
have

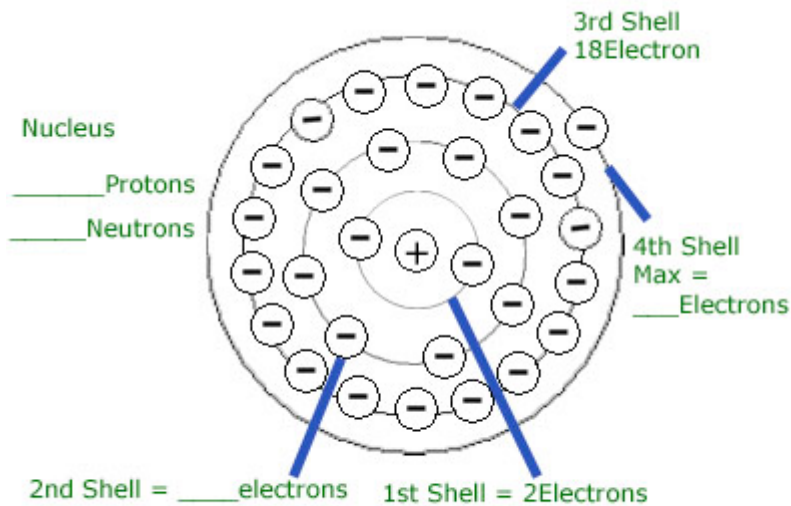
electrons orbit in concentric orbits called _____

quantity of electrons in the shells determined by:

n is the:

Cu (Copper)

Most commonly used metal in electrical/electronics industry. Why?



If Cu had 32 e⁻ in the outer shell it would be extremely _____

What is a free electron?

1 cubic inch of Cu at room temp = 1.4×10^{24} free electrons.

Write this number in conventional form

What happens at a higher temperature?

B. Coulomb's Law

$$F = k \frac{Q_1 Q_2}{r^2}$$

F = newtons (N)

k = constant = $9.0 \times 10^9 \frac{\text{N m}^2}{\text{C}^2}$

Q_1 and Q_2 = charges in
Coulombs

r = distance between charges in
m

Distances between charges is a squared term in denominator

What will happen if the distance doubles?

✳ Examples:

Two charges of $40\mu\text{C}$ are set at a given distance requiring $7.2 \times 10^4 \text{ N}$ of force. What is the distance between the charges?

Ni has 28 e^- . Draw its electron configuration.

C. Voltage

- The separation of the 29th e- in the Cu atom creates:
- The Cu atom becomes _____
- This separation of charges is the same as that occurring in _____ and establishes a source of _____

To create more voltage, what must be done?

We quantify the separation of a _____ of electrons as a Coulomb.

1 coulomb charge is produced by 6.242×10^{18} electrons

$$V = \frac{W}{Q}$$

V = volts (v)

W = joules (J) – an energy measurement

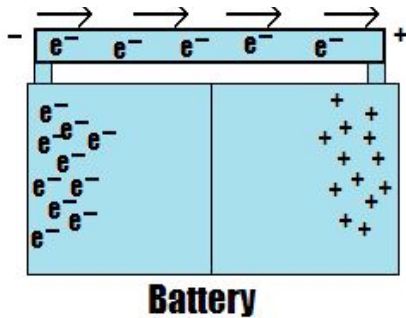
Q = coulomb (C)

1 volt occurs when we move 1 Coulomb negative charge with 1 joule of energy.

To create 12 volts of potential by moving 1 Coulomb of negative charge, what energy amount would be required?

D. Current

Applied voltage is starting mechanism, current is the reaction.



- free electron movement

? What happens when the electron supply is depleted?

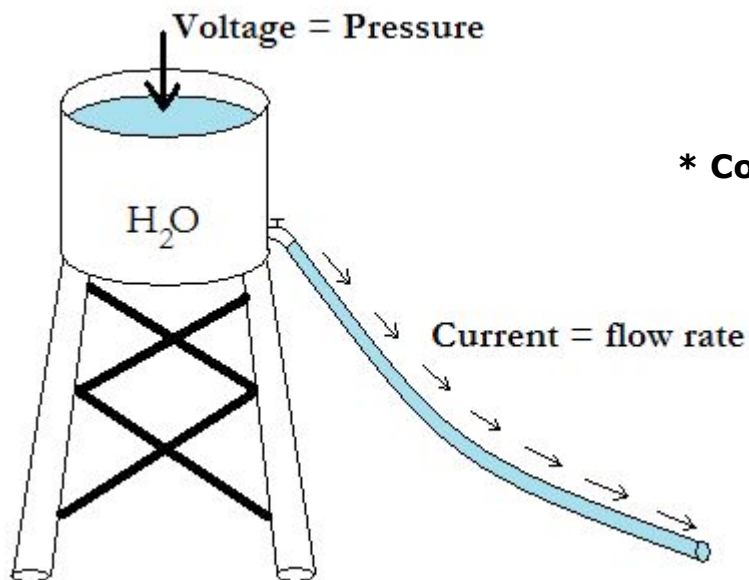
Measured in Amperes (A)

1 A is $6.242 \times 10^{18} e^-$ passing an imaginary plane in 1 second.

$$I = \frac{Q}{t}$$

Q = _____
t = time (s)
I = Amperes

Analogy



Electron Flow

✱ Examples:

What charge passes through an 18V Dewalt drill battery if 200 J are expended?

Your car has a 2A fuse in its ignition circuit. Will it blow if you pass 51 Coulombs through it in 25 seconds?

E. Voltage Sources

dc = _____

charge flows in _____ direction

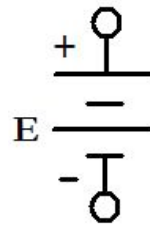
emf = _____

establishes flow of charge (_____) due to application of a difference in potential

Types of DC Sources

1) _____

- most common dc source
- consists of 2 or more similar cells
- uses chemical energy to establish potential difference



Primary

-

- examples

Secondary

-

- examples

F. Ampere Hour Rating

- indicates
- battery size is typically dictated by this if batteries are of the same type

$$\text{Life (hours)} = \frac{\text{ampere-hour rating (Ah)}}{\text{amperes drawn}}$$

2. Generators

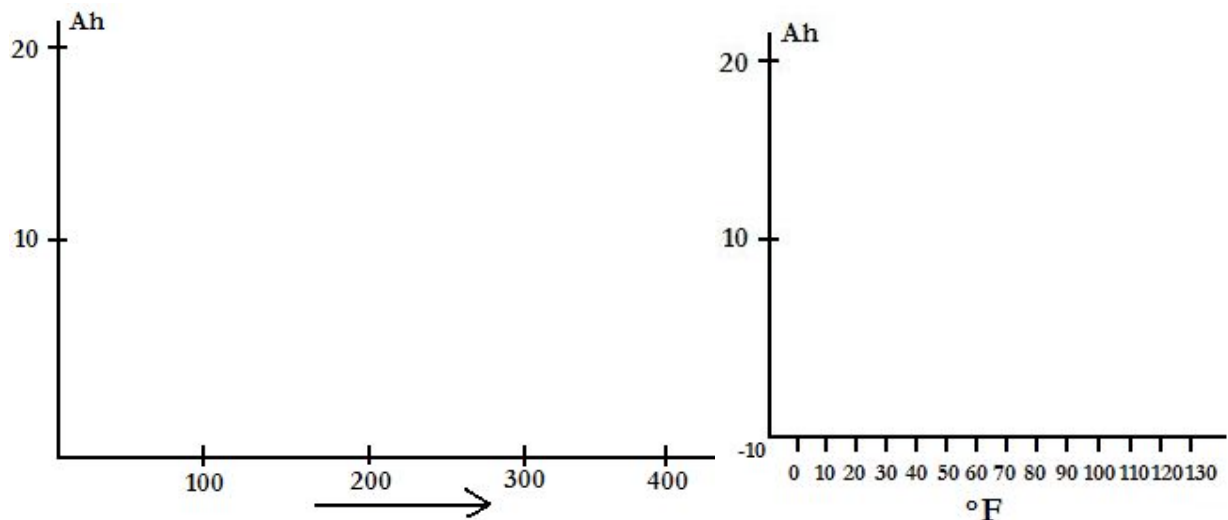
- spinning shaft creates _____ across external terminals
- terminal V and power handling capabilities > batteries
- same symbol as battery

3. Power Supplies

- uses _____ and filtering processes to obtain steady DC voltage.
- time varying voltage converted to one of fixed magnitude

Battery Life Factors

- capacity of battery (in ampere-hours) will change with the change in current demand



Draw the effect of increasing _____
_____ on Ampere hour-rating
for D-cell battery.

Draw the effect
of temp. on
Ampere hour
rating for D cell
Battery

✳ Examples:

How many hours will my 16 volt DeWalt drill be useful if it has an ampere-hour rating of 8 ampere-hours providing a current of 2.5 amps?

An RC plane runs on a battery rated at 9.6 volts. It will discharge for 15 minutes with an 1100 mAh ampere-hour rating.

1. What current is drawn with the plane motor?
2. Is this a constant or average current?
3. What energy in Joules is expended by the battery?