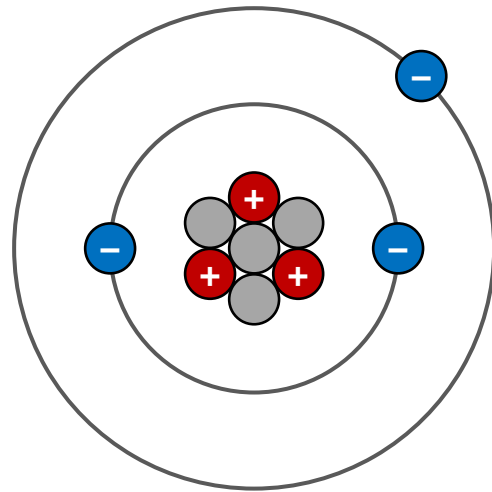


Essential Question

What is electric charge, and how do objects get charged?

Inside an Atom

- Protons (+) in the nucleus
- Neutrons have no charge
- Electrons (−) orbit outside
- Neutral: equal + and −



*neutral lithium:
3 protons, 3 electrons*

Neutral and Charged

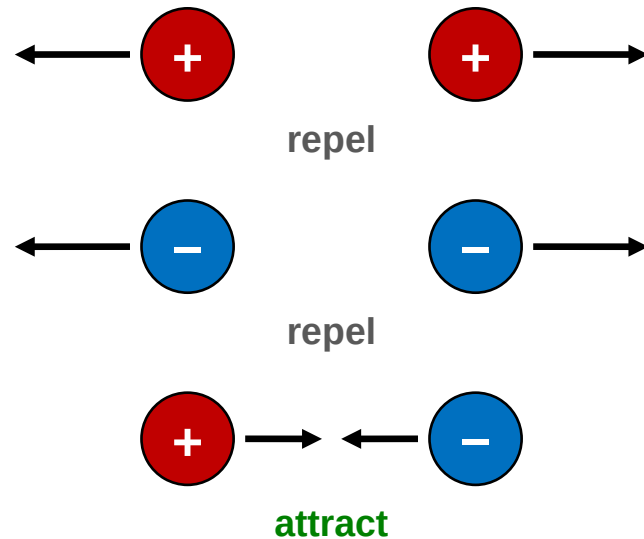
- Neutral: equal + and –
- Extra electrons: negative
- Missing electrons: positive

Neutral 3 protons 3 electrons net: 0	Negative 3 protons 4 electrons net: -1	Positive 3 protons 2 electrons net: +1
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only electrons move

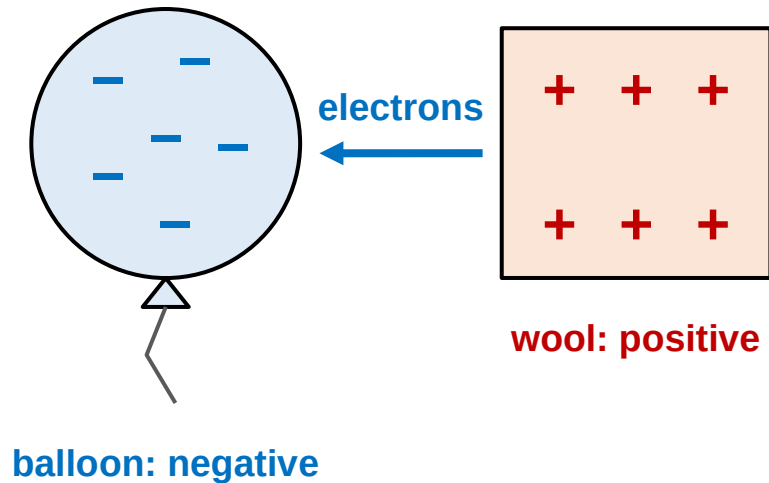
Two Types of Charge

- Like charges repel
- Opposite charges attract
- Evidence: some pairs push, some pull



Charging by Friction

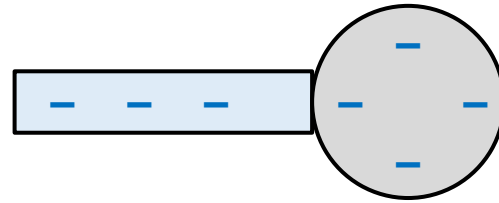
- Rubbing moves electrons
- One object gains electrons
- The other loses the same number
- Total charge stays the same



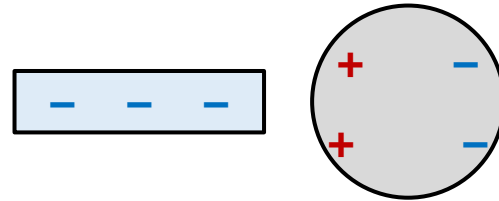
electrons gained = electrons lost

Conduction and Induction

- Conduction: touch and share charge
- Induction: bring charge near, no touch
- Nearby charge pushes electrons away



conduction (touching)



induction (not touching)

Charge Is Quantized

$$q = ne$$

q

charge (C)

n

number of electrons

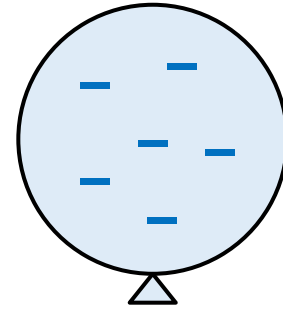
e

$1.6 \times 10^{-19} \text{ C}$

charge always comes in whole electrons

Example: Counting Charge

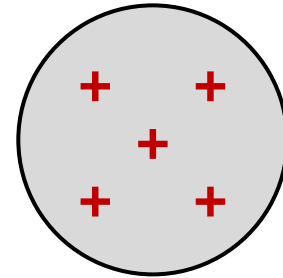
A balloon rubbed on your hair picks up 5.0×10^{12} extra electrons. What is the charge on the balloon?



5.0×10^{12} extra e^-

Example: Counting Electrons

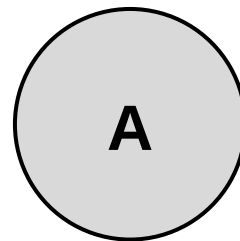
A metal sphere has a charge of $+3.2 \times 10^{-9} \text{ C}$. How many electrons did it lose?



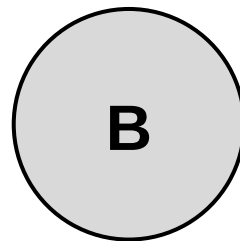
$$q = +3.2 \times 10^{-9} \text{ C}$$

Example: Touching Spheres

Two identical metal spheres touch, then separate. Sphere A starts at $+6.0 \times 10^{-9} \text{ C}$ and sphere B at $-2.0 \times 10^{-9} \text{ C}$. What is the charge on each sphere afterward?



$+6.0 \times 10^{-9} \text{ C}$



$-2.0 \times 10^{-9} \text{ C}$

identical spheres

Big Ideas

- Protons +, electrons −, neutral = equal
- Like charges repel, opposites attract
- Charging moves electrons; charge is conserved
- $q = ne$, with $e = 1.6 \times 10^{-19} \text{ C}$