Coulomb's Law

Essential Question

How strong is the push or pull between two charges?

Coulomb's Law

The Electric Force Equation

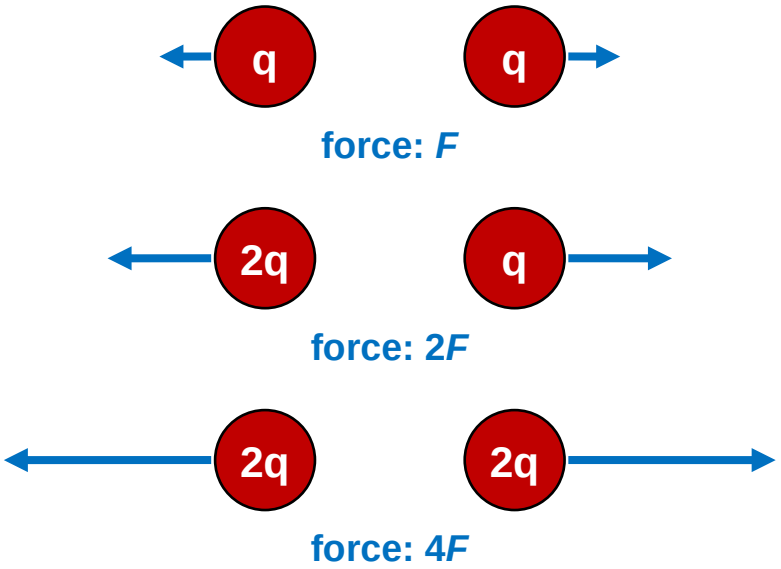
$$F_e = kq_1q_2 / d^2$$

F_e electric force (N)	**k** 9.0×10^9 N·m²/C²	**q_1, q_2** charges (C)	**d** distance between centers (m)

k is Coulomb's constant

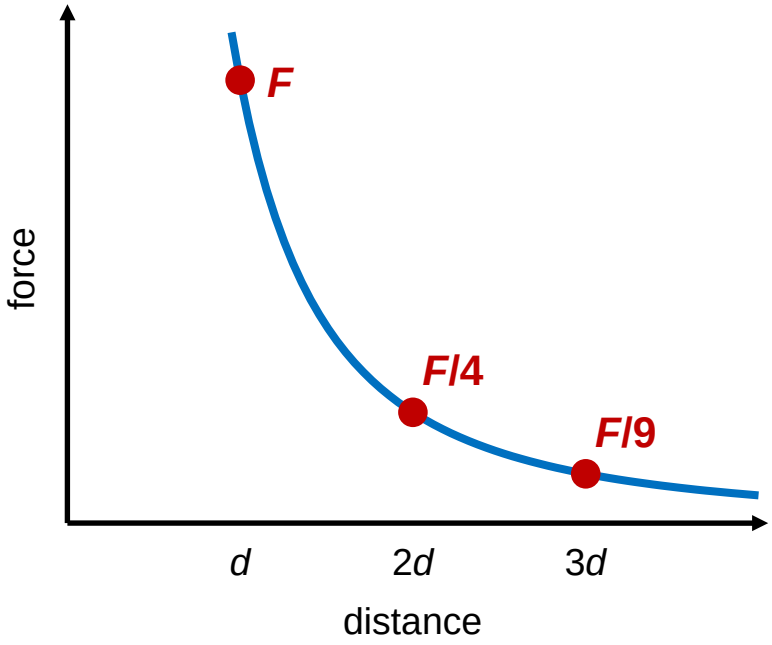
More Charge, More Force

- Force depends on both charges
- Double one charge: 2× force
- Double both: 4× force



Inverse Square Law

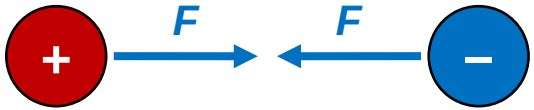
- Force drops fast with distance
- Double *d*: ¼ the force
- Triple *d*: 1/9 the force



Direction of the Force

- Like charges: repel
- Opposite charges: attract
- Plug in sizes, not signs
- Use the signs for direction

repel



attract

Scientific Notation Tips

- Multiply: add exponents
- Divide: subtract exponents
- Square: double the exponent
- Use the EE or $\times 10^{x}$ key

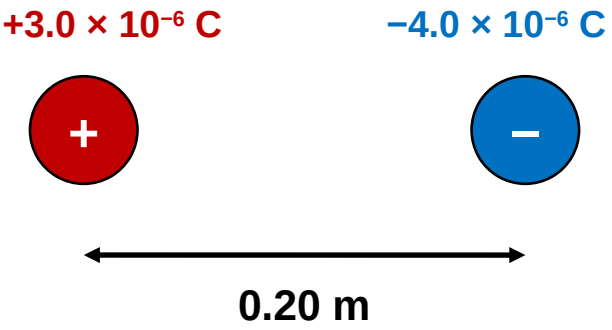
$(3.0 \times 10^{-6})(4.0 \times 10^{-6})$
$\mathbf{= 12 \times 10^{-12} = 1.2 \times 10^{-11}}$

$(6.0 \times 10^{8}) \div (2.0 \times 10^{3})$
$\mathbf{= 3.0 \times 10^{5}}$

$(2.0 \times 10^{-3})^{2}$
$\mathbf{= 4.0 \times 10^{-6}}$

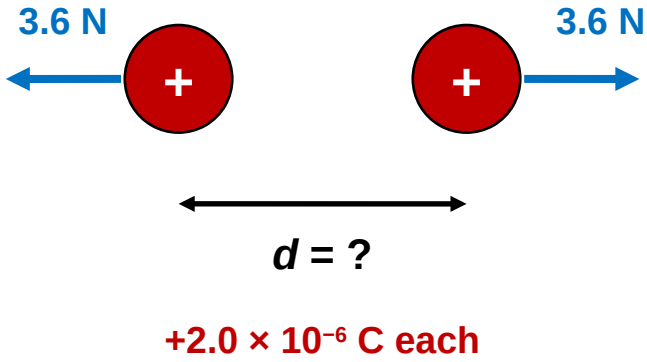
Example: Finding the Force

A charge of $+3.0 \times 10^{-6}$ C is 0.20 m from a charge of -4.0×10^{-6} C. What is the electric force between them?



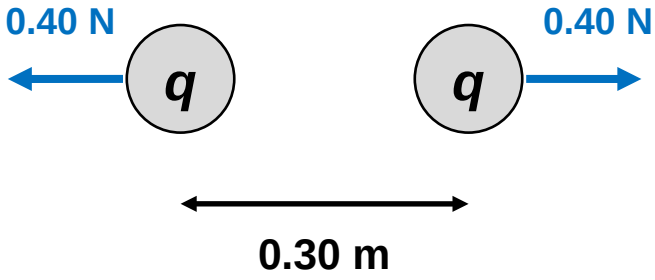
Example: Finding the Distance

Two charges of $+2.0 \times 10^{-6}$ C each repel with a force of 3.6 N. How far apart are they?



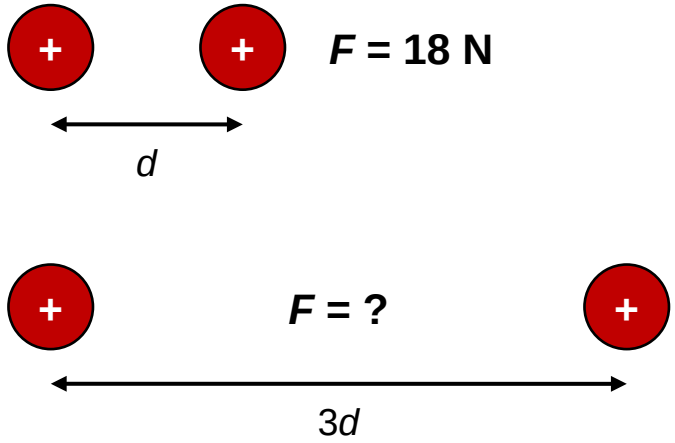
Example: Finding a Charge

Two identical charges are 0.30 m apart and repel with a force of 0.40 N. What is the size of each charge?



Example: Changing the Distance

Two charged spheres push on each other with a force of 18 N. If the distance between them is tripled, what is the new force?



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Big Ideas

- $F_e = kq_1q_2/d^2$, $k = 9.0 \times 10^9\ \text{N}\cdot\text{m}^2/\text{C}^2$
- More charge, more force
- Inverse square: 2× distance, ¼ force
- Like charges repel, opposites attract