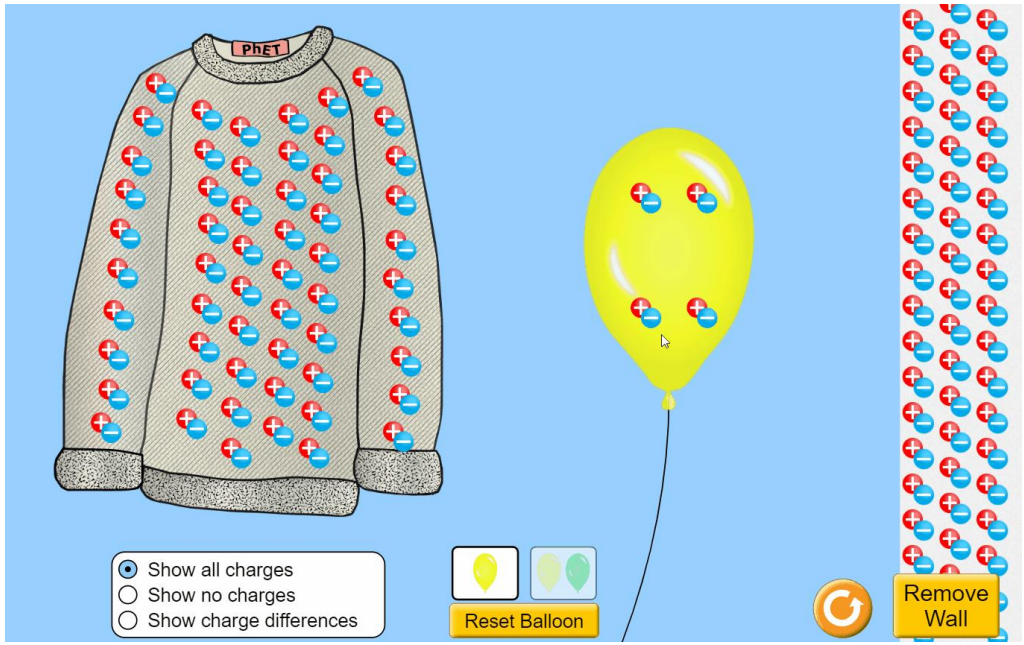
Static Electricity

IB PHYSICS | FORCE FIELDS

PhET Simulation

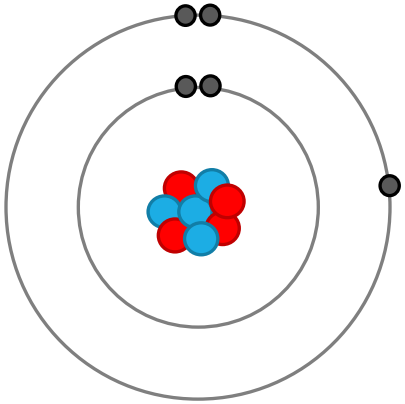


What happens when you rub the balloon on the sweater?

Click here for Simulation

Charge on an Atom

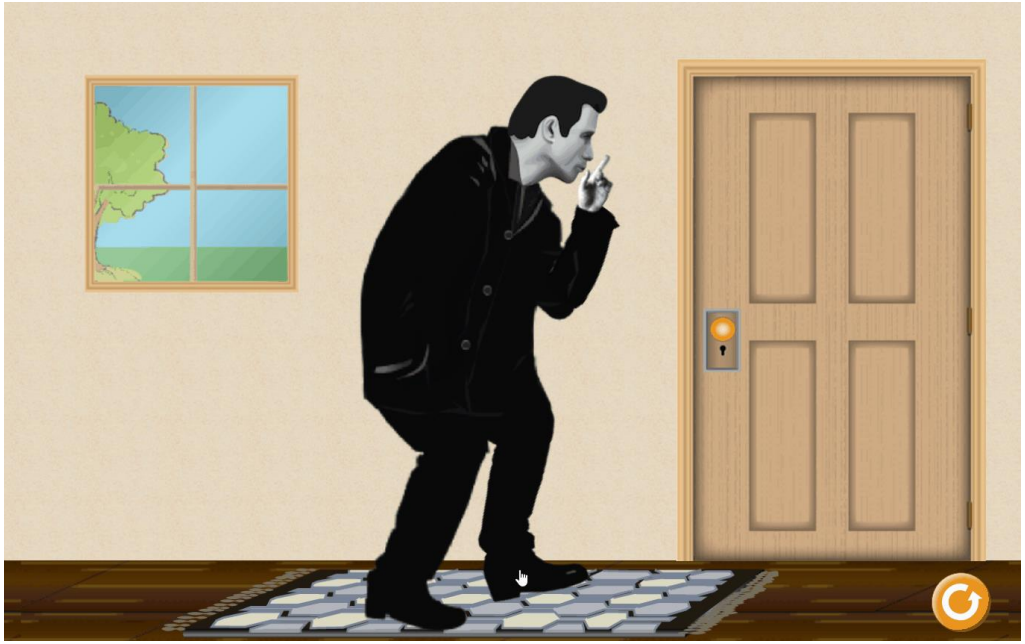
The **protons** and **neutrons** are buried deep in the nucleus and cannot easily be touched



electrons orbiting the nucleus are easily lost or gained

How do objects become charged?

Friction	Contact	Induction



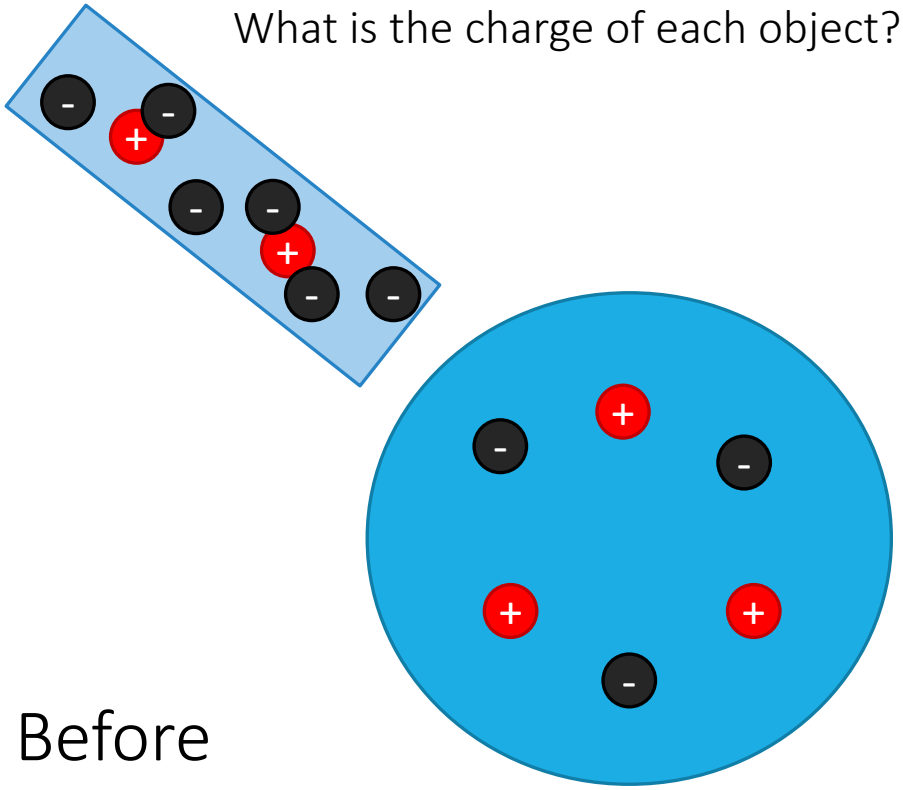
Click here for Simulation

What happens when you rub John Travoltage's foot on the rug?

How do objects become charged?

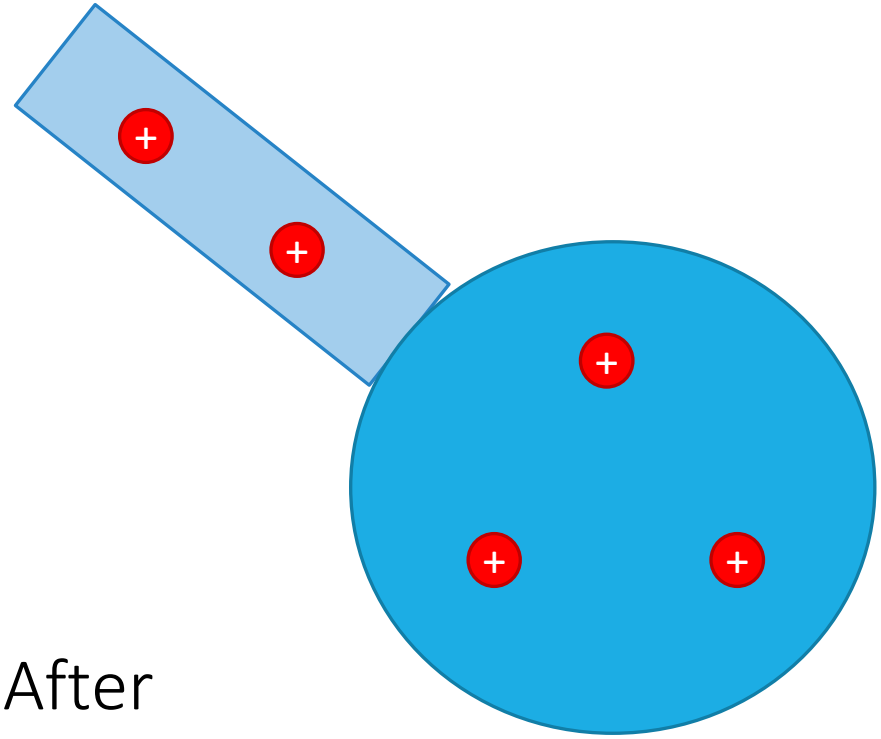
Friction	Contact	Induction

What is the charge of each object?



Before

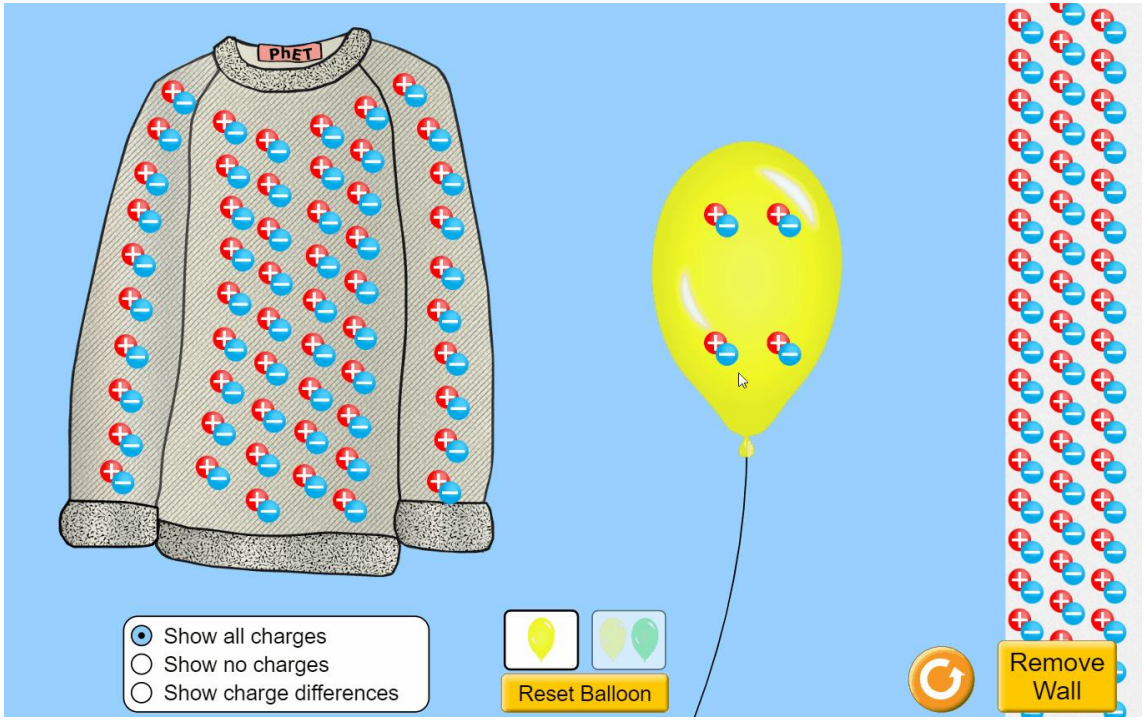
Draw in the Electrons



After

How do objects become charged?

Friction	Contact	Induction



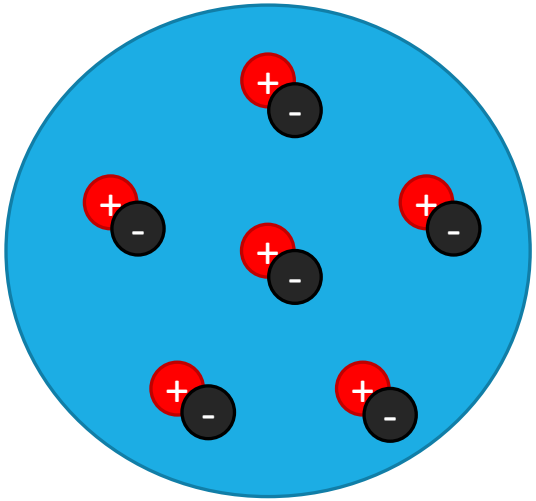
What happens when you bring the balloon over to the wall?

Click here for Simulation

How do objects become charged?

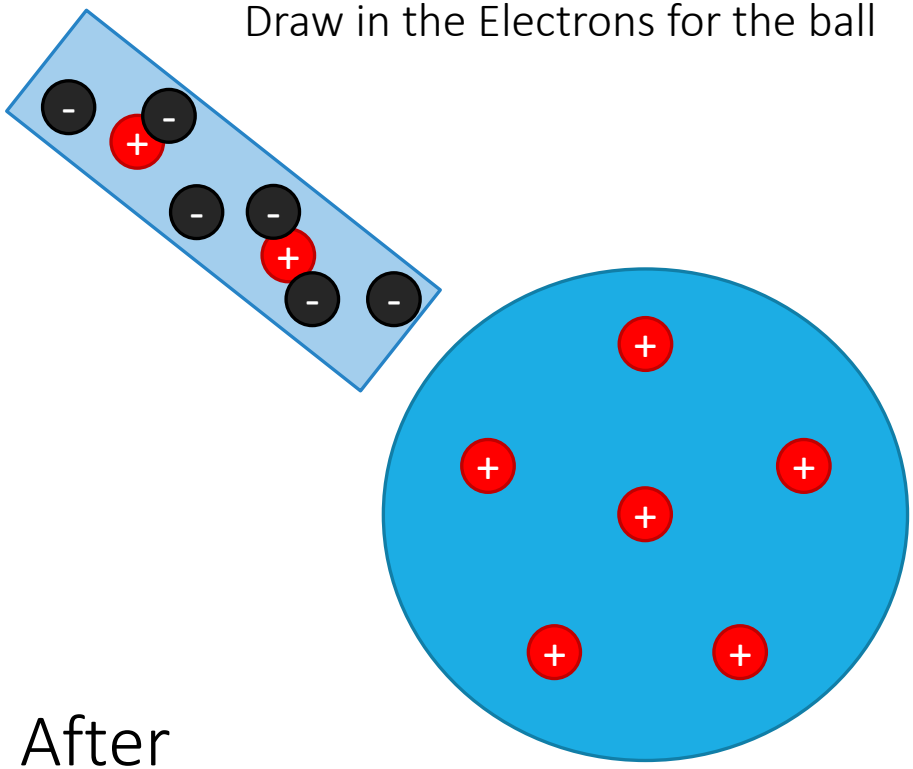
Friction	Contact	Induction

What is the charge of this object?



Before

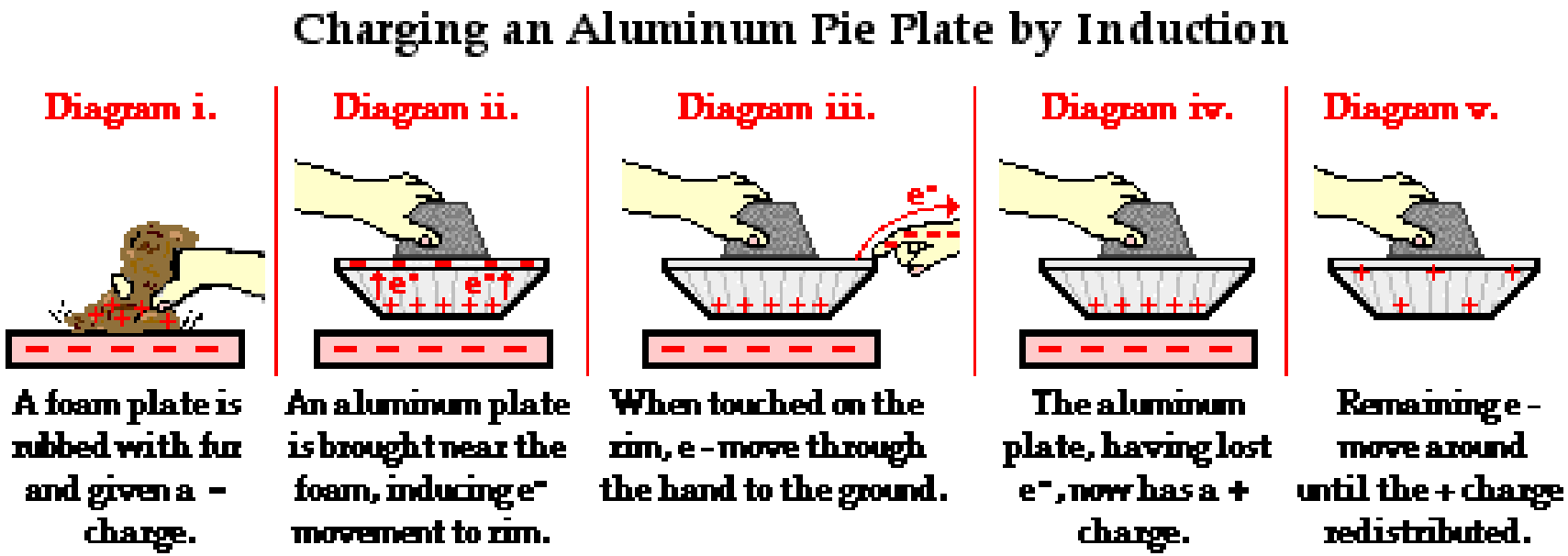
Draw in the Electrons for the ball



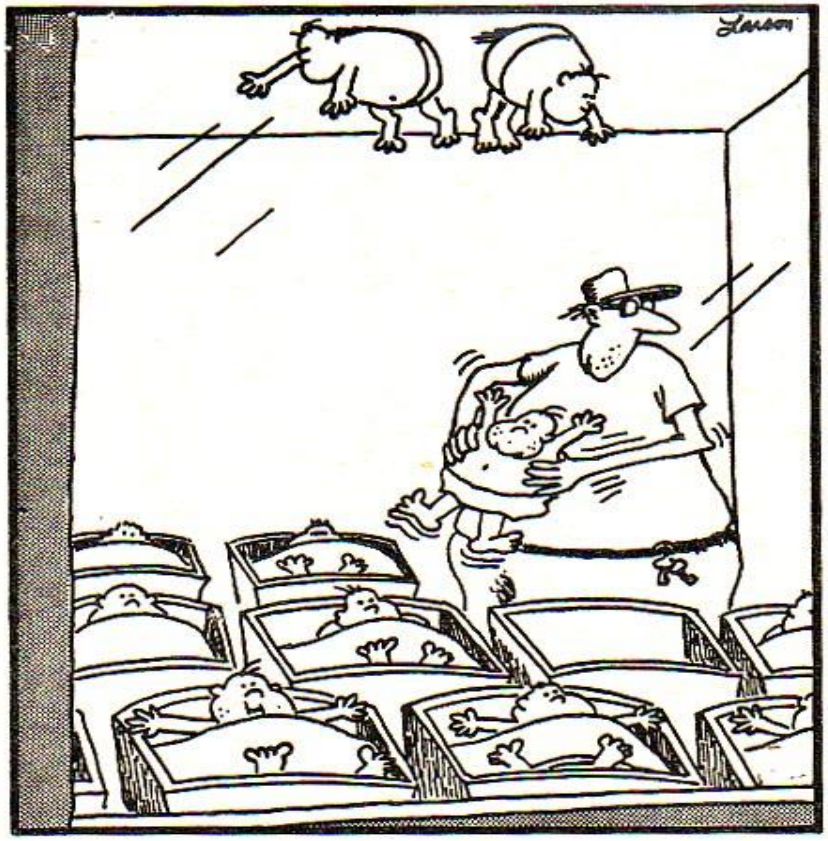
After

How do objects become charged?

Friction	Contact	Induction



Use your knowledge responsibly



Late at night and without permission, Reuben would often enter the nursery and conduct experiments in static electricity.

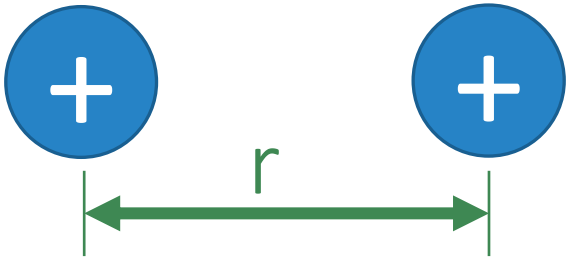
Charge Interactions

Opposite Charges

Like Charges

Which one has more force?

Which charged pair has larger electrostatic forces acting?



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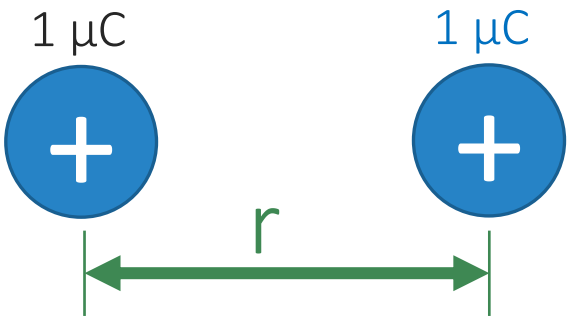
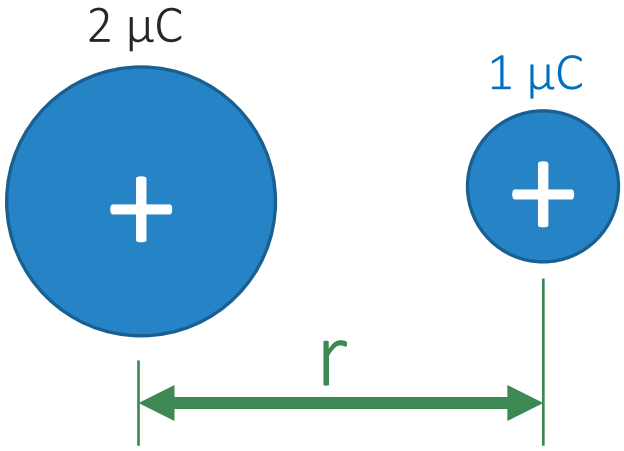
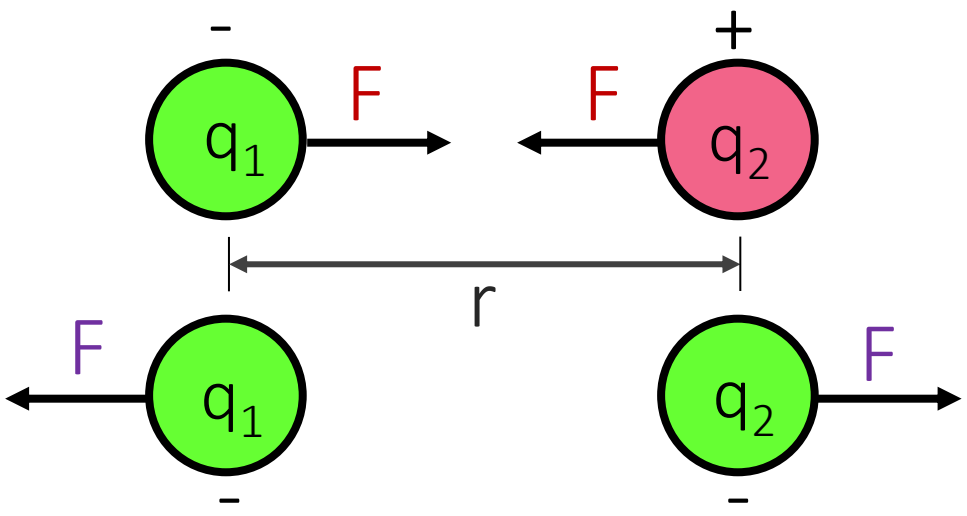




Coulomb's Law

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

The force of attraction or repulsion between two point charges is directly proportional to the product of the two charges and inversely proportional to the square of the distance between them.



	Symbol	Unit
Electrostatic Force		
Object 1 Charge		
Object 2 Charge		
Separation Distance		

Coulomb's Constant

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

$$k = 8.99 \times 10^9\ N\ m^2\ C^{-2}$$

Use unit analysis to prove the units of k:

IB Physics Data Booklet

Sub-topic 5.1 – Electric fields

$$I = \frac{\Delta q}{\Delta t}$$

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

$$k = \frac{1}{4\pi\varepsilon_0}$$

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

$$E = \frac{F}{q}$$

$$I = nAvq$$

Sub-topic 5.3 – Electric cells

$$\varepsilon = I(R + r)$$

Sub-topic 5.2 – Heating effect of electric currents

Kirchhoff's circuit laws:

$$\Sigma V = 0 \text{ (loop)}$$

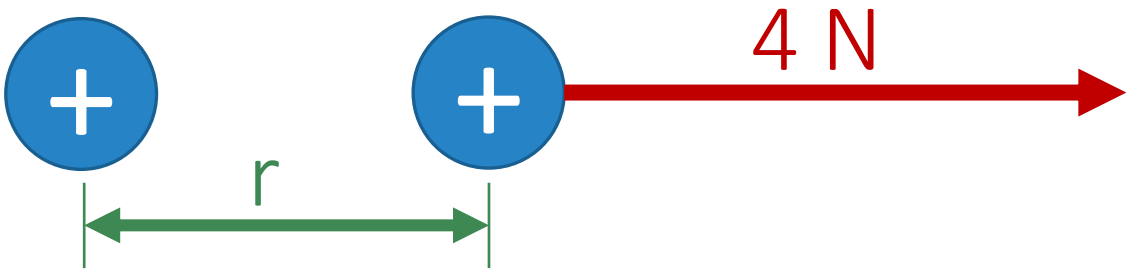
$$\Sigma I = 0 \text{ (junction)}$$

V

Quantity	Symbol	Approximate value
Acceleration of free fall (Earth's surface)	g	$9.81\ \text{m s}^{-2}$
Gravitational constant	G	$6.67 \times 10^{-11}\ \text{N m}^2\ \text{kg}^{-2}$
Avogadro's constant	N_A	$6.02 \times 10^{23}\ \text{mol}^{-1}$
Gas constant	R	$8.31\ \text{J K}^{-1}\ \text{mol}^{-1}$
Boltzmann's constant	k_B	$1.38 \times 10^{-23}\ \text{J K}^{-1}$
Stefan–Boltzmann constant	σ	$5.67 \times 10^{-8}\ \text{W m}^{-2}\ \text{K}^{-4}$
Coulomb constant	k	$8.99 \times 10^{9}\ \text{N m}^2\ \text{C}^{-2}$
Permittivity of free space	ε_0	$8.85 \times 10^{-12}\ \text{C}^2\ \text{N}^{-1}\ \text{m}^{-2}$
Permeability of free space	μ_0	$4\pi \times 10^{-7}\ \text{T m A}^{-1}$
Speed of light in vacuum	c	$3.00 \times 10^{8}\ \text{m s}^{-1}$

Conceptual Math

What is the repulsion force on the positive charge below?



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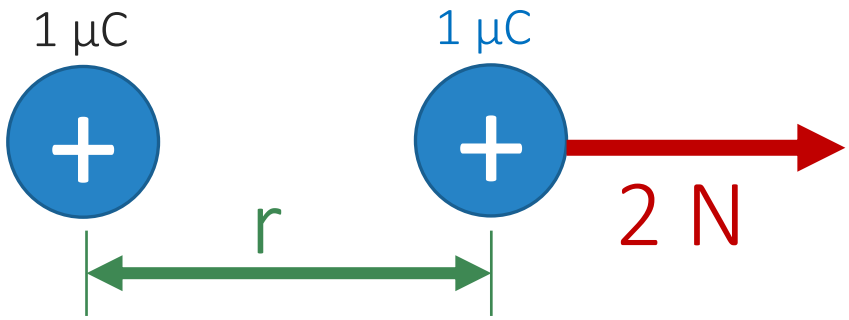

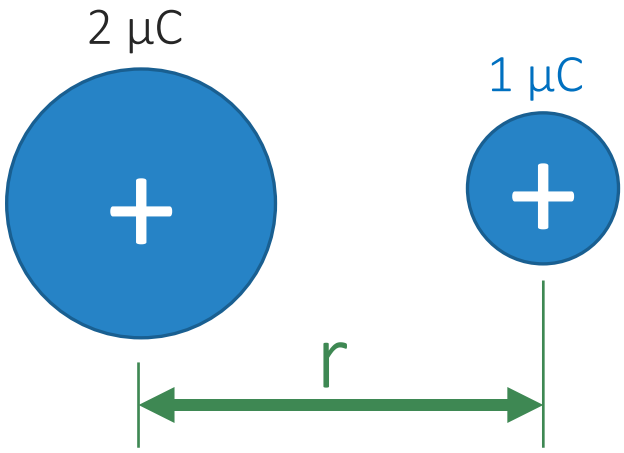

Conceptual Math

Which pair has the greater electrostatic force?