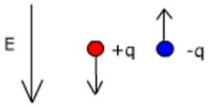
Static Electricity

Definitions

Electrons carry negative charges. A negatively charged object has had electrons rubbed on to it. A positively charged object has had electrons rubbed off it. Each electron carries 1.6 x 10^{-19} Coulombs of charge.

If charged particles are in an electric field – negative charges – such as electrons and beta particles - move towards positive plate.
Positive particles - including alpha particles – move toward the negative plate.

Electric Field: The field around charged particles that exerts a force on other charged particles.
Electric field lines: A map of an electric field representing the direction of the force that a test charge would experience; the direction of an electric field shown by lines of force,

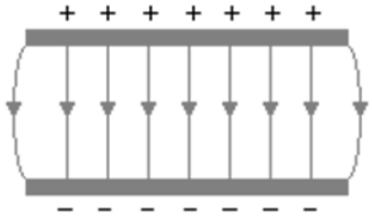


Terms

Attraction of Electric Charges: Unlike charges give negative potential energy (attractive force). Unlike charges attract one another.
Coulomb: Unit used to measure electric charge; equivalent to the charge resulting from the transfer of 6.24 billion electrons
Electrostatic charge: Accumulated electric charge on an object from a surplus or deficiency of electrons
Negative electric charge: One of the two types of electric charge; repels other negative charges and attracts positive charges.
Positive electric charge: One of the two types of electric charge; repels other positive charges and attracts negative charges.
Repulsion of Electric Charges: Like charges give positive potential energy (repulsive force). Like charges repel one another.

Equations

$E = \frac{V}{d}$	Electric Field Strength	E	V m^{-1}
	Voltage	V	V
	Distance	d	m
$F = Eq$	Force	F	N
	Electric Field Strength	E	N C^{-1}
	Charge	q	C

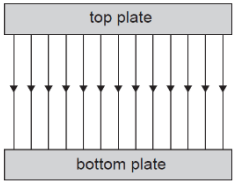


The arrows indicate the direction of the force that a positive charge would experience.

Tips

- Electrostatic rules tend to be for positive charges.
- Learn how to use the exponent button on your calculator to deal with very big and very small numbers.
- The force on a charged particle in an electric field doesn't change as you get closer to the charged plate
- In electricity, E stands for Electrical field strength (not Energy which is E_p and E_k)

Questions

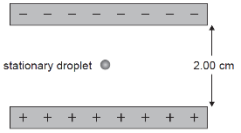


ELECTRIC FIELDS (2021;2)

The electric field lines between two parallel plates are shown:

(a) Clearly label the positive plate on the diagram.

(b) Describe the field between the plates and explain how the diagram shows this.



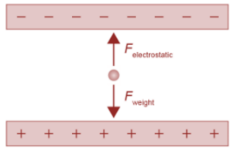
(c) An experiment is carried out on the surface of the Earth (g = 9.8 m s^{-2}). A charged droplet of mass 5.87 x 10^{-10} kg is held stationary between a different set of parallel plates. The voltage across the plates is 240 V. The distance between the plates is 2.00 cm.
(i) Add labelled arrows to show the TWO forces acting on the stationary droplet.
(ii) Calculate the number of elementary charges on the stationary droplet. You should start by calculating the weight of the droplet by using F_w = mg. Elementary charge: +1.61 x 10^{-19} C

Answers

(a) Top plate labelled positive.

(b) The electric field between the plates is uniform / constant / the same everywhere. This is shown by the field lines being parallel and evenly spaced.

(c)



(d)

$$W = mg = 5.87\times10^{-10}\times9.8 = 5.75\times10^{-9}\text{ N}$$

$$E = \frac{V}{d} = \frac{240}{0.02} = 1.2\times10^{4}\text{ V m}^{-1}$$

$$F = Eq \Rightarrow q = \frac{5.75\times10^{-9}}{1.2\times10^{4}} = 4.79\times10^{-13}\text{ C}$$

$$\text{Number of elementary charges} = \frac{4.79\times10^{-13}}{1.61\times10^{-19}} = 2.98\times10^{6}$$