Electronvolt: the amount of energy gained (or work done) moving an electron through a potential difference of one volt

3. Determine the conversion factor between joules and electronvolts.

$1 e.V. = 1.6 \times 10^{-19} J$

4. An external force does 4.0 eV of work moving an electron between two points in an electric field. How much energy in joules does the electron gain?

$4.0 eV \times \frac{1.6\times10^{-19} J}{eV} = 6.4\times10^{-19} J$

5. A proton falls through a potential difference of 30. Volts. How much kinetic energy does the proton gain? Express your answer in both joules and electronvolts.

30eV

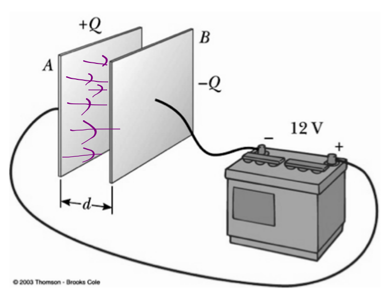
Two Parallel Plates

IB 11

Two identical metal plates, each with area A, are set a distance d apart. They are each charged by connecting them to a source of potential difference V like a battery, as shown in the diagram.

Charge on the plates = Q

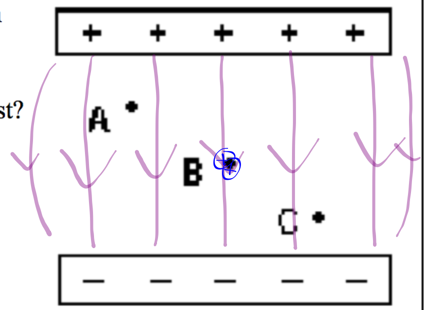
Area of the plates = A



1. a) Where is equipment like this used? capacitor

b) What is the purpose of this equipment? to store charge and energy

2. A positive test charge is placed at each of three locations between two charged metal parallel plates: A, B, and C.



a) At which location is the electric force on the test charge greatest?

same

b) At what location is the electric field strongest?

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

same

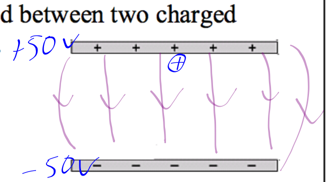
c) If the charge of the test charge is doubled, what effect will this have on the:

i) electric field?

ii) electric force?

none

3. Draw the electric field between two charged metal parallel plates.



Uniform field:

Edge effects:

4. The electric potential difference between these plates is 100 volts.

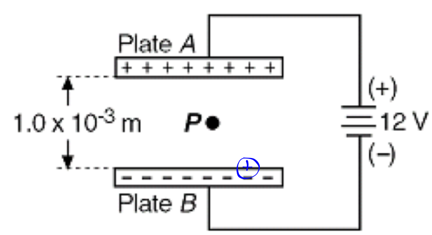
a) Which plate is at a higher electric potential? Why?

b) What is the electric potential of each plate?

Parallel Plate Formulas: Electric Field: $\vec{E} = V/d$ Potential difference:

Variable:	V	E	d
Quantity:	pot. difference	Electric field	distance
Units:	[V] = [J/C]	[N/C] = [V/m]	[m]
Type:	scalar	vector	

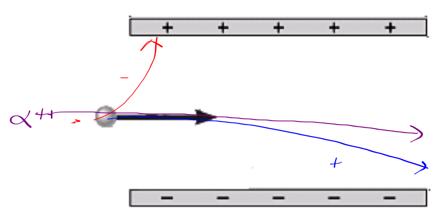
5. Two parallel plates are connected to a 12-volt battery as shown.



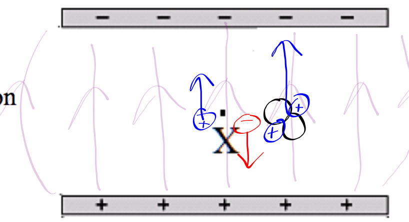
a) What is the magnitude and direction of the electric field between the two plates?

$\vec{E} = \frac{12V}{.001m} = 12,000\ V/m$

6. Sketch the trajectory of a proton, a neutron, an electron, and an alpha particle if they are all shot with the same initial velocity into the plates.



7. a) At point X, draw and label a vector to represent the electric field from the plates.



b) At point X, draw and label a vector to represent the electric force on

i) a proton   ii) an electron

c) Compare the electric force on the proton and electron.

$F = qE$

d) Compare the resulting accelerations of the proton and electron.

$m_p \sim 1000 m_{e^-}$ $a_{e^-} \propto 1000\, a_{p^+}$

e) An alpha particle is placed at point X. What is an alpha particle?

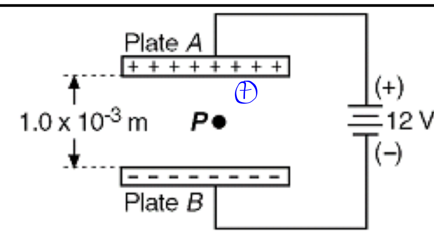
$2p^+ \; 2n^\circ \quad \alpha^{++}$

f) Compare the alpha particle to a proton. Compare the:

i) charge   ii) mass   iii) force on each   iv) acceleration of each

$2x$ $\sim 4x$ $2F = 2q\,E$ $\frac{1}{2}a = \frac{2F}{4m}$

8. A proton is released from rest at the positive plate.



a) How fast will it be traveling when it strikes the negative plate?

$F = qE = 1.6\times10^{-19}\,C \cdot 12000\,\frac{N}{C} = 1.9\times10^{-15}\,N$ $E = V/d$

$a = \frac{F}{m} = \frac{1.9\times10^{-15}\,N}{1.67\times10^{-27}\,kg} = 1.14\times10^{12}\,m/s^2$

$V_f^2 = V_o^2 + 2ad \Rightarrow \sqrt{2 \cdot 1.14\times10^{12}\,m/s^2 \cdot .001\,m} = 4.8\times10^{4}\,m/s$

b) How fast will it be traveling when it strikes the negative plate?

$v = \sqrt{\frac{2(qV)}{m}} = \sqrt{\frac{2 \; 1.6\times10^{-19}\,C \; 12V}{1.67\times10^{-27}\,kg}} =$

NOTE: Energy: $qV = \frac{1}{2}mv^2$