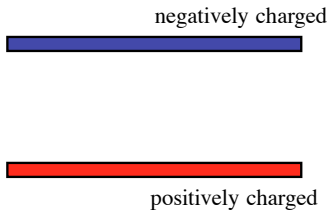
Problem 16.7

An oppositely charge set of parallel plates .00533 meters apart have a potential difference of 600 volts between them.



Preliminary questions:

i.) What's the electric field look like between the plates (draw it in)?

ii.) Which plate has the higher electrical potential?

iii.) If you were to assume the higher potential plate had a voltage of 600 volts, what assumption are you making about the lower potential plate?

iv.) In general, do negative charge move from higher to lower electrical potential, or vice versa, and do they move from higher potential energy to lower, or vice versa?

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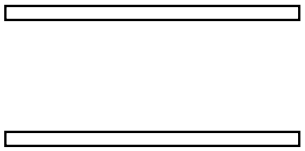
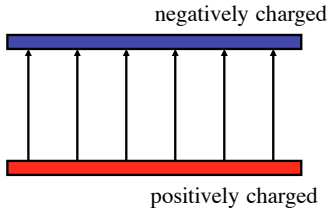


a.) What's the E fld magnitude between the plates?

b.) What's the magnitude of the force on an electron when sittting between the plates?

c.) How much work to move the electron to the negative plate from .0029 meters from the positive plate?

Preliminary questions:



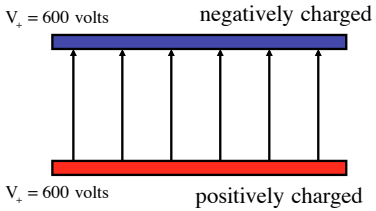
i.) What's the electric field look like between the plates? (look at sketch)

ii.) Which plate has the higher electrical potential? (The positive will always be the higher voltage.)

iii.) If you were to assume the higher potential plate had a voltage of 600 volts, what assumption are you making about the lower potential plate? (if the voltage different is 600 volts, the lower voltage plate must be assumed to be zero volts.

iv.) In general, do negative charge move from higher to lower electrical potential, or vice versa, and do they move from higher potential energy to lower, or vice versa?
(Negative charges move opposite electric field lines, so they naturally move from lower to higher voltage. ALL CHARGES, if allowed to move naturally through an electrical field, will go from HIGHER *POTENTIAL ENERGY* to lower.

An oppositely charge set of parallel plates .00533 meters (5.33 mm) apart have a potential difference of 600 volts between them.



a.) What's the E fld magnitude between the plates? (Traversing upward from high to low voltage:)

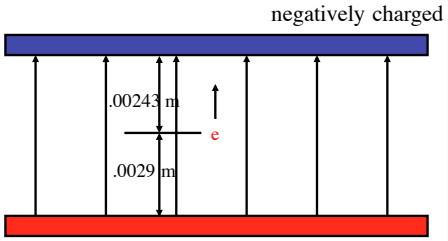
$$E \bullet d = -\Delta V$$
$$\Rightarrow \quad E\, d \cos\phi = -\left(V_{final} - V_{initial}\right)$$
$$\Rightarrow \quad E(.00533 \text{ meters}) \cos 0^{\circ} = -(0 - 600 \text{ volts})$$
$$\Rightarrow \quad E = 1.126 \times 10^{5} \text{ nt/C}$$

b.) What's the magnitude of the force on an electron when between the plates?

$$\vec{F} = q\vec{E}$$
$$= \left(-1.6 \times 10^{-9} \text{ C}\right)\left(\left(1.126 \times 10^{5} \text{ nt/C}\right)\hat{j}\right)$$
$$= 1.8 \times 10^{-14}\left(-\hat{j}\right) \text{ nts}$$

c.) How much work to move the electron to the negative plate from .0029 meters from the positive plate?

You'll have to do work to force the electron to the negative plate. If you start where the electron is shown in the sketch and proceed upward, we can write:



$$E \bullet d = -\Delta V$$

$$\Rightarrow \quad E\, d \cos\phi = -\Delta V$$

$$\Rightarrow \quad \left(1.126 \text{x} 10^{5} \text{ nt/C}\right)(.00243 \text{ meters}) \cos 0^{o} = -\Delta V$$

$$\Rightarrow \quad \Delta V = -2.74 \text{x} 10^{5} \text{ volts}$$

$$W = q\Delta V$$

$$= \left(-1.6 \text{x} 10^{-19} \text{ C}\right)\left(-2.74 \text{x} 10^{5} \text{ volts}\right)$$

$$= 4.4 \text{x} 10^{-14} \text{ joules}$$