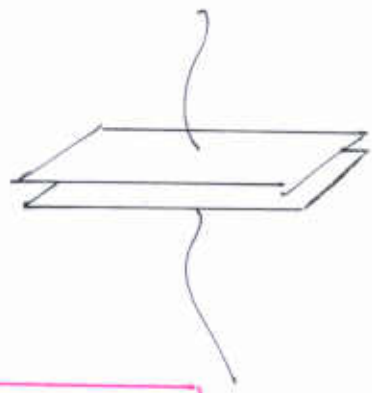
Name_____

Phys 2020, Section 1
Quiz #2 — Fall 2003



1. The plates of a (air–filled) parallel–plate capacitor have a separation of 0.500 mm. The value of the capacitance is 1.00 μF.

a) What is the area of the plates?

Use $C = \epsilon_0 A/d$ (air-filled parallel plates).

Then:

$$A = \frac{Cd}{\epsilon_0} = \frac{(1.00\times10^{-6}\,F)(0.500\times10^{-3}\,m)}{(8.85\times10^{-12}\,\frac{C^2}{N\cdot m^2})} = \boxed{56.5\ m^2}$$

b) If a potential difference of 5.00 V is applied across this capacitor, what charge is stored?

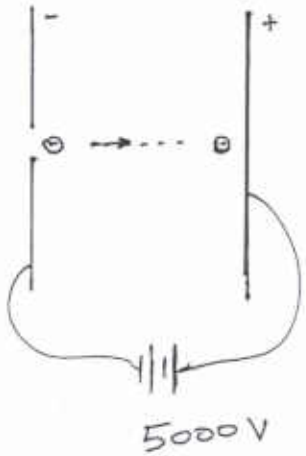
Use $q = CV$. Then:

$$q = (1.00\times10^{-6}\,F)(5.00\,V) = \boxed{5.00\times10^{-6}\,C}$$

c) With 5.00 V applied, how much energy is stored in the capacitor?

Use $\text{Energy} = \frac{1}{2}CV^2$. Then:

$$E = \tfrac{1}{2}CV^2 = \tfrac{1}{2}(1.00\times10^{-6}\,F)(5.00\,V)^2 = \boxed{1.25\times10^{-5}\,J}$$



2. An electron is accelerated through a potential difference of 5000 V.

a) What is the loss in potential energy of the electron? (Give the answer in Joules.)

Loss in pot'l energy of electron (as it moves to higher potential) is

$|\Delta EPE| = |q\Delta V| = (1.602\times10^{-19}\,C)(5000\,V)$

$= \boxed{8.01\times10^{-16}\ J}$

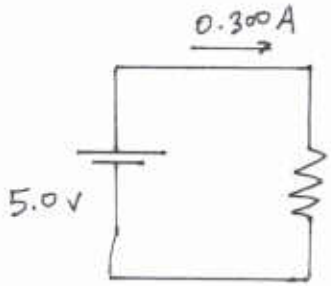
b) If the electron starts from rest, what is its final speed?

If the electron starts from rest this is equal to the final kinetic energy of the electron. Thus:

$\frac{1}{2}mv^2 = 8.01\times10^{-16}\,J$ where $m = 9.11\times10^{-31}\,kg$

$v^2 = \frac{2(8.01\times10^{-16}\,J)}{(9.11\times10^{-31}\,kg)} = 1.76\times10^{15}\,m^2/s^2$

$\rightarrow \quad v = \boxed{4.19\times10^{7}\,m/s}$



3. When a 5.0 V battery is hooked up to a certain resistor, there is a current of 0.300 A. What is the value of the resistance?

Since $V = IR$, then

$R = \frac{V}{I} = \frac{5.0\,V}{0.300\,A} = \boxed{16.7\ \Omega}$

You must show all your work and include the right units with your answers!

$k = \frac{1}{4\pi\epsilon_0} = 8.99\times10^{9}\ \frac{N\cdot m^2}{C^2}$ $\quad \epsilon_0 = 8.85\times10^{-12}\ \frac{C^2}{N\cdot m^2}$ $\quad F = k\frac{|q_1q_2|}{r^2} = \frac{1}{4\pi\epsilon_0}\frac{|q_1q_2|}{r^2}$

$\mathbf{F} = m\mathbf{a}$ $\quad KE = \frac{1}{2}mv^2$ $\quad g = 9.80\frac{m}{s^2}$ $\quad m_{elec} = 9.1094\times10^{-31}$ kg $\quad e = 1.602\times10^{-19}$ C

$\mathbf{F} = q\mathbf{E}$ $\quad E_{pt\ ch} = k\frac{|q|}{r^2}$ $\quad E_{plates} = \frac{\sigma}{\epsilon_0}$ $\quad E_{plane} = \frac{\sigma}{\epsilon_0}$ $\quad \Delta EPE = q_0\Delta V$ $\quad E_x = -\frac{\Delta V}{\Delta x}$

$1\ eV = 1.602\times10^{-19}\ J$ $\quad q = CV$ $\quad C = \epsilon_0\frac{A}{d}$ $\quad E = \frac{1}{2}CV^2 = \frac{q^2}{2C}$ $\quad V = IR$