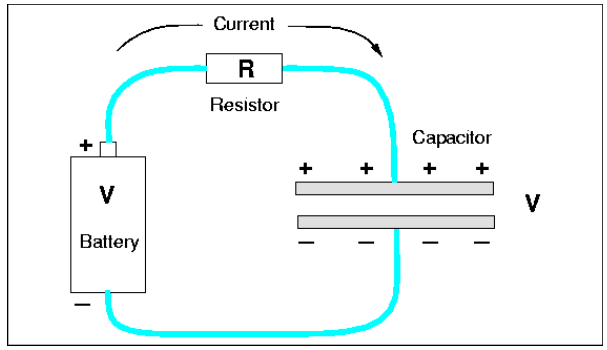
Name: ______________________________ Phys 12

6.07 Capacitors



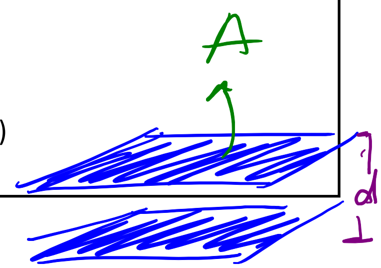
Last lesson we studied parallel conducting plates separated by small distance. One plate stores positive charges, the other stores negative charges. As a result, a potential difference is produced between the plates.

These parallel plates are also known as a **capacitor.**

The **capacitance** of these 2 parallel plates is the ability to store charge.

The more the potential difference between 2 plates, the more charge a capacitor can store. Since the charge and potential difference are proportional to each other, their ratio is the capacitance.

$C = \frac{Q}{V}$	(Farad, F)	C = Capacitance (C/V) or (Farad, F) Q = charge (C) V = potential difference (V)	



The better the capacitance, the more charge it can store per 1 volt.

In fact, capacitance determines the ratio between Q and V, not the other way around! So what determines capacitance?

The geometry of the capacitor determines capacitance!

$C = \varepsilon_0 \frac{A}{d}$	(Farad, F)	ε_0 = permittivity of free space $8.85 \times 10^{-12}\ C^2/Nm^2$ A = Area of one plate (m^2) d = distance of separation between plates (m)

A capacitor stores electric energy due to charge separation!

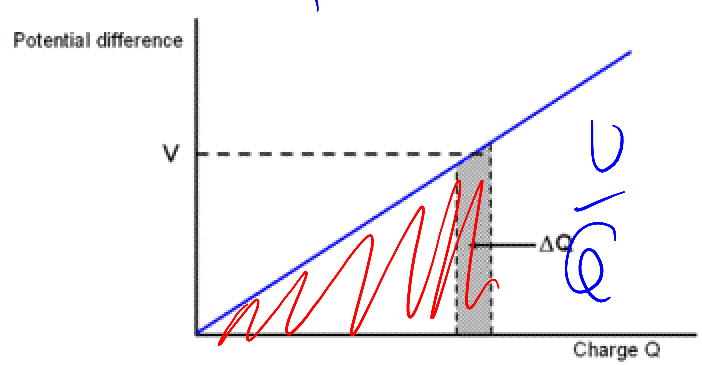
Since the work was done to move charges from one plate to another, electric potential energy is stored in the capacitor:

E = $\frac{1}{2}qV$ (J)

Which can also be written as:

E = $\frac{1}{2}CV^2$

And E = $\frac{1}{2}\frac{Q^2}{C}$



$W = Vq$

HW: Worksheet 6.07 ALL

Quiz Mon: 6.01 – 6.05 (Bonus 6.06)

Name: ______________________________ Phys 12

Worksheet 6.07 Capacitors

1) a) Calculate the capacitance of a parallel-plate capacitor whose plates are 20. cm x 3.0 cm and are separated by a 1.0-mm air gap. (53 pF)

b) What is the charge on each plate if a 12 V battery is connected across the 2 plates? (6.4×10^{-10} C)

c) What is the electric field between the plates? (1.2×10^{4} V/m)

d) Estimate the area of the plates needed to achieve a capacitance of 1 F, given the same air gap d. (10^{8} m^2)

2) A camera flash unit stores energy in a 150 µF capacitor at 200. V.
a) How much electric energy can be stored? (3.0 J)
*b) If the camera flash is about 1/1000 of a second, what would be the power output? (3000 W)

3) A parallel plate capacitor in a vacuum has a capacitance of 1.0 F. The plates are separated by a distance of 1 cm. Calculate the area of one of the capacitor plates. Comment on your answer. (1100 km^2)

4) Calculate the charge on one of the plates of a parallel plates capacitor of area 0.25 m^2. The plates are separated by a distance of 8.0 mm, in a vacuum. The potential difference across the plates is 24 V. (6.6 nC)

5) A 250 mF capacitor is charged by a 12V battery. What is the energy stored in the capacitor? (18 J)

6) A parallel plate capacitor has plates of area 0.880 m^2, separated by a distance of 4.00 mm in a vacuum. It is connected to a dc source of potential difference 6.00 kV. Calculate:

a) the capacitance of the capacitor (1.95×10^{-9} F)
b) the charge on one of the plates (1.17×10^{-5} C)
c) the electric field between the plates (1.50×10^{6} N/C)
d) the charge per unit area on one of the plates (1.33×10^{-5} C/m^2)

7) A 9.0 V battery is used to charge a 20 mF capacitor. Calculate:

a) the charge on the capacitor (180 mC)
b) the energy stored in the capacitor (0.81 J)
*c) if the capacitor discharges in a time of 50 ms, estimate the power released during the discharge (16 W)

HW: Worksheet 6.07 ALL