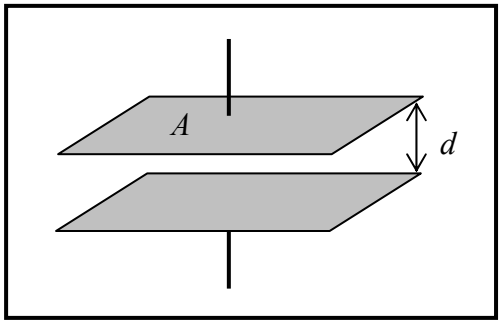
Workshop Tutorials for Technological and Applied Physics

ER5T: **Capacitance**

A. Qualitative Questions:

1. A capacitor consists of two parallel plates with area A which are separated by a distance d.
What will be the effect on the capacitance of :
a. Pushing the plates toward each other so d is halved?
b. Doubling the area, A, of both plates?
c. Doubling the area of one plate only?
d. Sliding one of the plates relative to the other so the overlap is halved?
e. Doubling the potential difference between the plates?



2. Many processes in nature follow a similar pattern of increasing and decreasing – exponentially. Examples include capacitor charging and discharging, nuclear decay and cooling of hot sunstances.
a. Sketch a graph of the magnitude of electric charge on either plate of a capacitor versus the magnitude of the potential difference between the plates.
b. What does the slope of this graph indicate? What are alternative units for the slope beside CV^{-1} (coulombs per volt)?
c. Suppose a capacitor has charges Q_o on its plates and a potential difference of magnitude $|V_0|$ between them. Indicate such a point on your graph. What is the physical significance of the area under the curve between the origin and the point (Q_o, V_0)?

B. Activity Questions:

1. Variable capacitor I – giant capacitor

Examine the variable capacitor.
How can the capacitance be varied?
What happens to the paper strips when the capacitor is turned on? Why?
Sketch the electric field between the plates.

2. Variable capacitor II – tuning capacitor

Examine the variable capacitor.
How can the capacitance be varied?
Can you think of where these devices might be used?

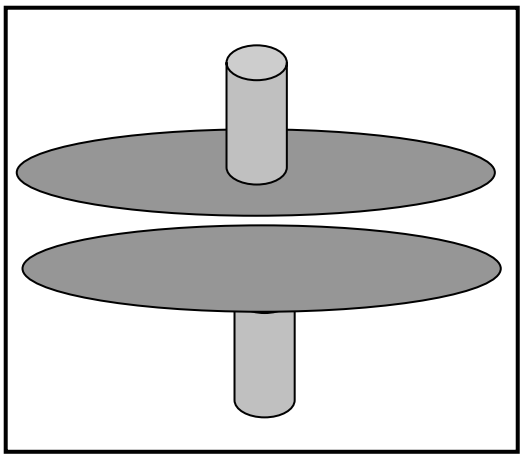
3. Energy stored by a capacitor

Examine the circuit set up to show how energy (½ CV^2) is stored by a capacitor.
Does changing the voltage supplied increase the capacity of the capacitor?
Does changing the supply voltage change the amount of energy that can be stored?
This is similar to the circuit found in the electronic flash in a camera.

C. Quantitative Questions:

1. A parallel plate capacitor has circular plates of 8.2 cm radius separated by 1.3mm of air. They are connected to a 240V power supply and allowed to charge up before being disconnected.

a. Calculate the capacitance of this capacitor.
b. What charge will appear on the plates?
c. What is the electrical energy stored between the plates?
d. If the plates (from above) are pulled apart to a separation of 2.6 mm without affecting the charge distribution, what happens to the electric field between the plates?
e. What is the potential difference between the plates with the new separation?
f. What is the electrical energy stored between the plates with the new separation?
g. Comment on your answers to parts c and f. What has happened to the energy?



2. A coaxial cable connecting a TV to an antenna socket is 3 m long. The inner conductor has an outer radius of 0.5 mm, the outer conductor has an inner radius of 3 mm. The space between the conductors is filled with plastic with $\kappa = 2.6$. What is the capacitance of this cable?