

Capacitors

Capacitors are electric components that store electric charge.

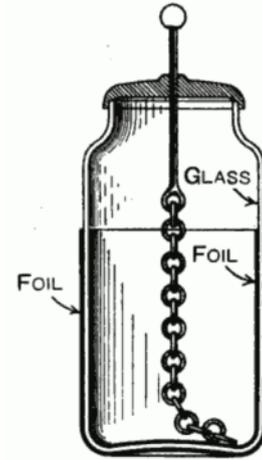


Basically a capacitor is made up of two metal plates separated by an insulator.

A famous early capacitor was called the Leyden Jar.

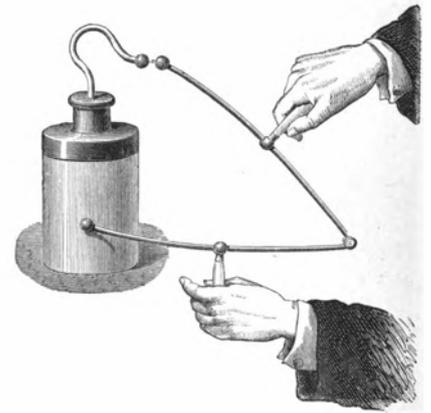
This was made of two sheets of metal foil, one on the inside of a glass jar and the other sheet of foil on the outside.

Electric charge was added to the inside foil by a metal cap and chain.

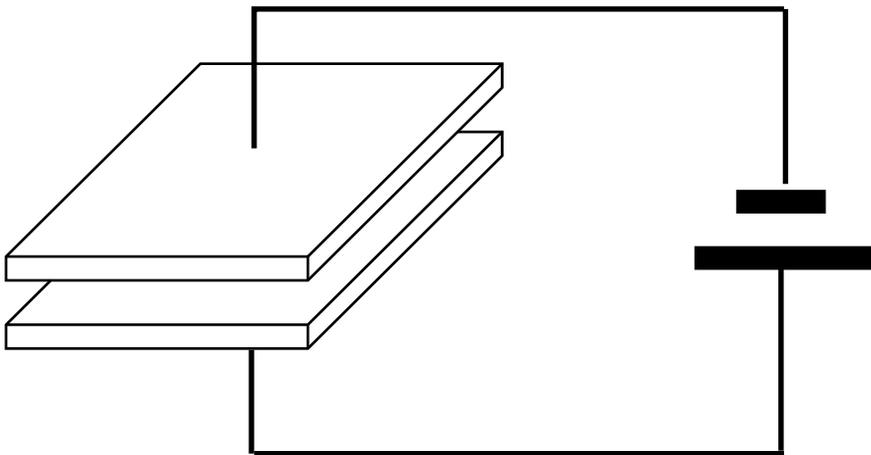


The outside foil took on the opposite charge. The jar became like a charged electric cell.

When the inner and outer foil were touched together an amazingly large spark was produced.



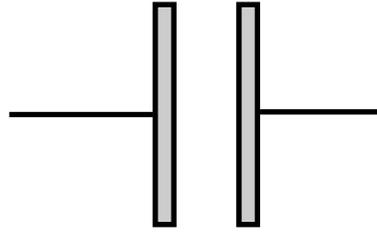
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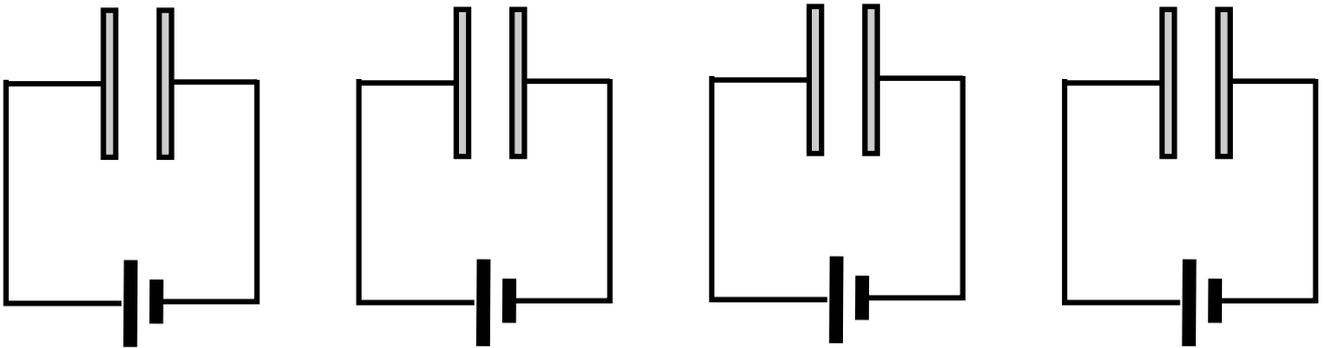
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Capacitor symbol

As the capacitor is basically two metal plates held apart by an insulator, the symbol is shown.



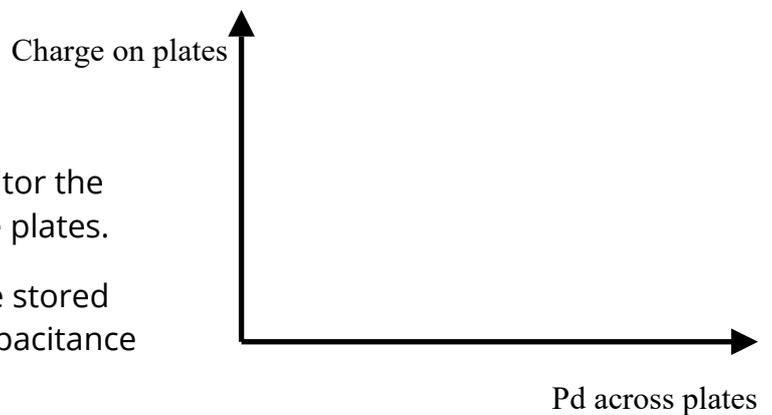
Capacitor story



Definition of a capacitor.

The more pd across the plates of a capacitor the more electric charge will be stored on the plates.

The amount of electric charge that can be stored on the plates per unit volt is called the capacitance



The capacitance of a capacitor is measured in Farads

Capacitor Examples:



A capacitor has a charge of 1.25×10^{-5} Coulombs of charge on its plates when connected to a 5 V dc supply.

Find the capacitance of the capacitor.



A capacitor has a capacitance of $1000 \mu\text{F}$.

Determine the maximum charge that can be stored in the capacitor if connected across a 10 V dc supply.

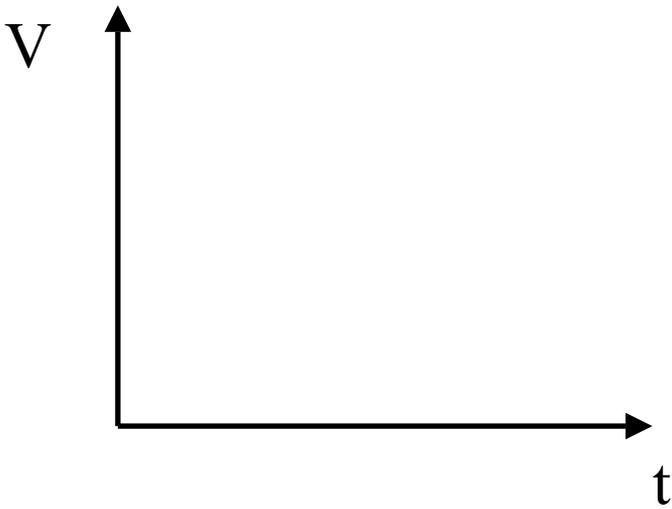
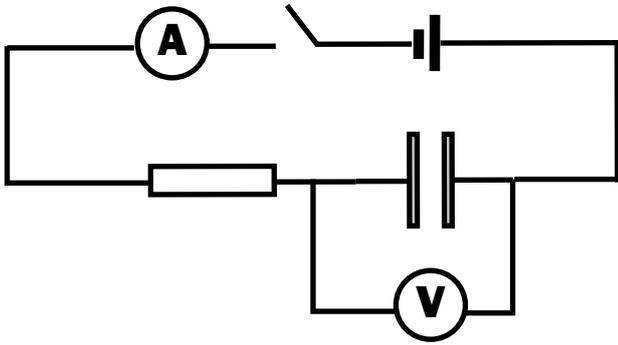


A $10 \mu\text{F}$ capacitor is connected to a 16 V dc supply.

a) Determine the maximum amount of charge that the capacitor can store..

b) If the capacitor is discharged in a time of 8 milliseconds then find the average current during discharge.

Charging a capacitor.



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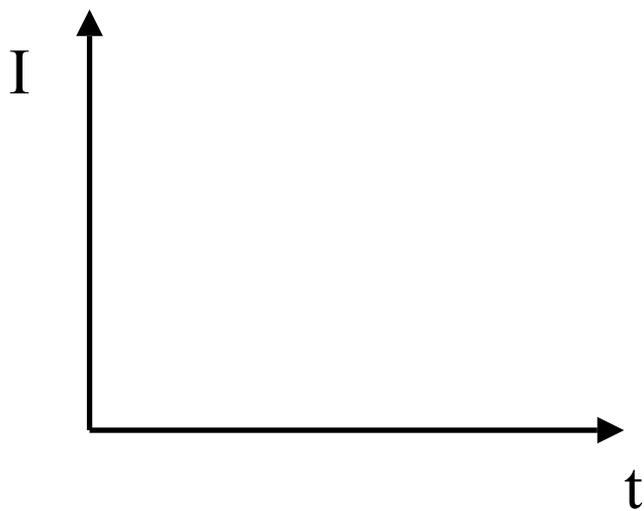
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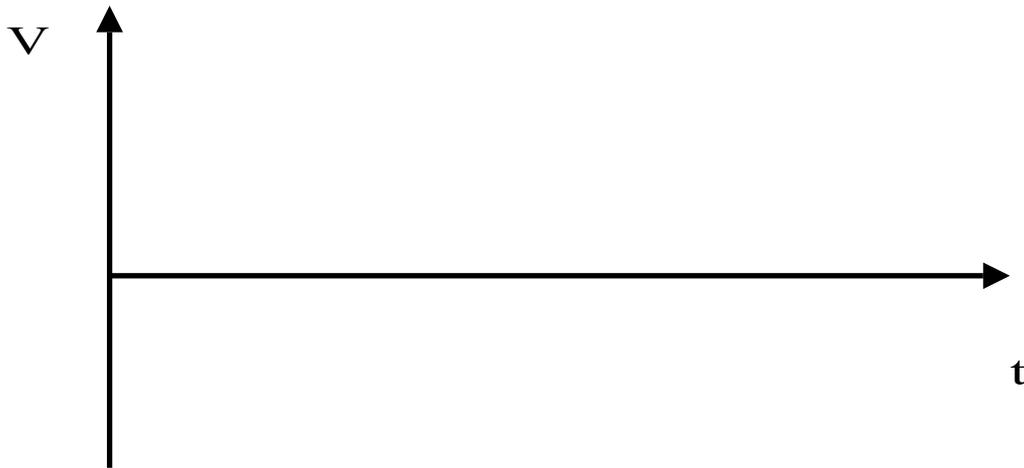
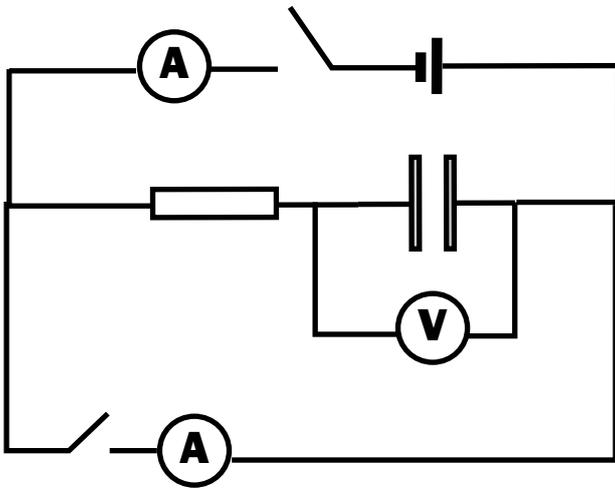
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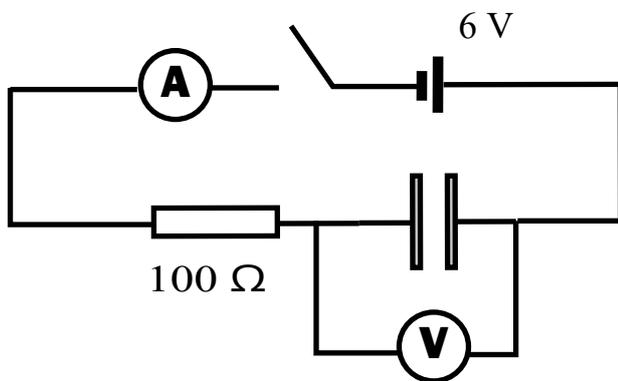
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Charging and Discharging a capacitor.



Charging and Discharging a capacitor examples



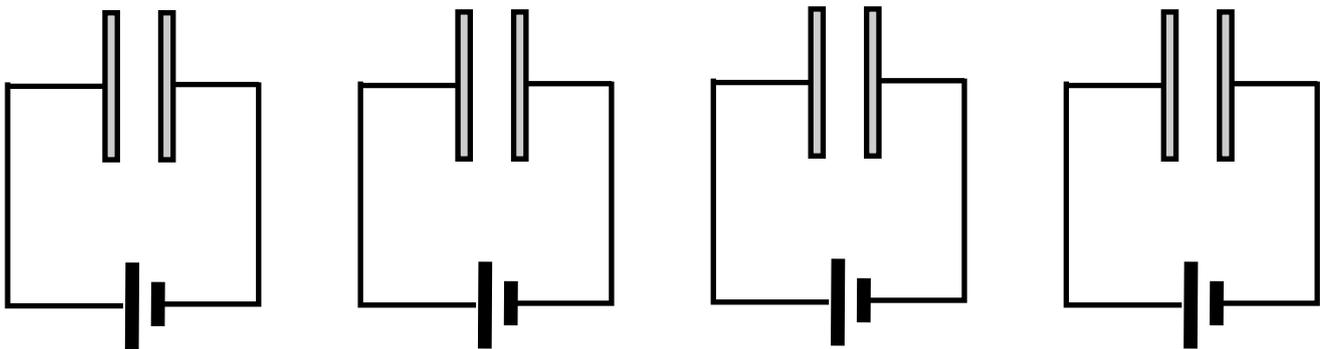
A $2200 \mu\text{F}$ capacitor is connected in series with a 100Ω resistor. The cell has a voltage of 6 V .

- Calculate the reading on the ammeter when the switch is first closed.
- When a current of 0.02 A is flowing calculate the pd across the capacitor.
- Determine the maximum charge stored in the capacitor.
- Sketch a graph of the pd across the resistor during the charging.

Capacitors Store Energy.

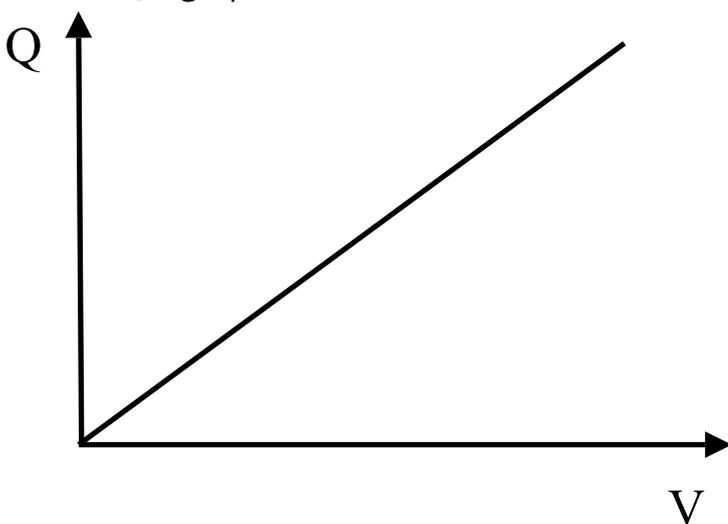
Capacitors are used as energy stores.

Defibrillators and camera flash units use capacitors to store energy and then when discharged this energy is available.



As more charge is put on the plates of the capacitor it requires more WORK to put on extra charge because of the electron electron repulsion.

The work done in building up the electric charge on the plates can be found from the area of the Q V graph.



Electrical Energy Stored in the capacitor is

The 3 Energy Equations for a capacitor.

There are three energy equations for the energy stored in a capacitor. Besides the first one the other two can be found from the first and the capacitor equation.

$$E = \frac{1}{2} QV$$

$$C = \frac{Q}{V}$$

$$E = \frac{1}{2} QV \quad E = \frac{1}{2} CV^2 \quad E = \frac{1}{2} \frac{Q^2}{C}$$

A capacitor has a value of 2200 μF and has an electric charge of 2 C on its plates.

Find the energy stored in the capacitor

A capacitor has a 12 V pd across its plates .

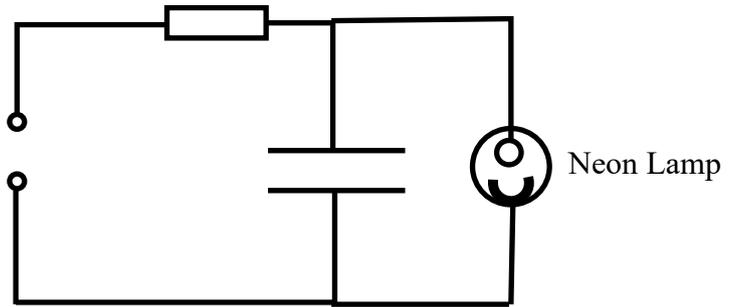
The capacitor has a value of 1000 μF .

Find the energy stored in the capacitor.

Some applications of capacitors.



Strobe lamp



Blocking d.c.

Some radio signals comprise of an ac part and a dc part.

