# Topic 11 – Practical 2

## *RC circuit – Capacitor charging*

### Safety

The capacitor should be connected in the circuit with the correct polarity.

### Apparatus and materials

* batteries or dc power supply
* resistors 10 kΩ, 22 kΩ
* capacitors 1000 μF, 2200 μF
* voltmeter or multimeter
* push-to-make switch
* connecting wires
* stopwatch
* graph paper

### Introduction

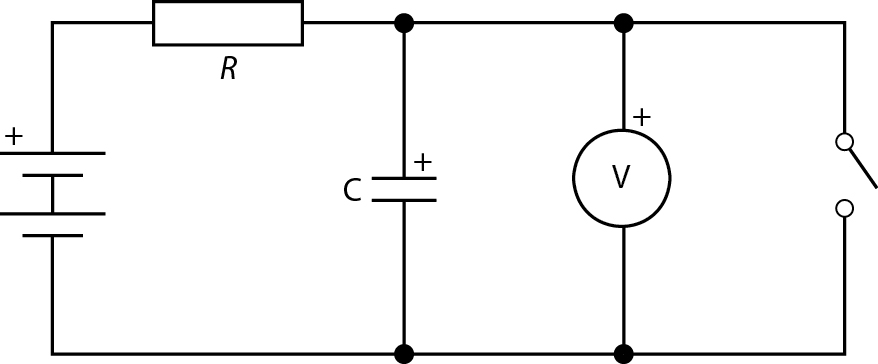
A capacitor is an electrical circuit component that can store electrical charges when connected to a source. When a capacitor is charging, it stores electric energy. Capacitance *C* is defined as

where *q* is the charge on each plate of the capacitor and *V* the potential difference applied across it.

When a capacitor is connected in series with a resistor and a source, then the amount charge *q* on the capacitor at time, *t*, after it was connected to the source is given by:

where *C* is the capacitance of the capacitor, *V* is the potential difference provided by the source and *R* is the resistance of the resistor. The product *RC* is called the time constant and it is a measure of how fast the capacitor is charging.

In this experiment you will investigate the charging of a capacitor.



### Procedure

1. Construct the circuit shown in the diagram above using *R* = 10 kΩ and *C* = 1000 μF. The dc power supply should be set to 9 V. Be careful to connect the capacitor with the correct polarity.
2. Close the switch to completely discharge the capacitor.
3. The moment you open the switch the capacitor will start charging and you will consider *t* to equal 0 seconds. Using the stopwatch and the voltmeter, measure the potential difference across the capacitor readings every 10 seconds for a total of 3 minutes.
4. Record your measurements in a suitable table.
5. Repeat the process using *R* = 10 kΩ and *C* = 2200 μF.
6. Repeat the process using *R* = 22 kΩ and *C* = 1000 μF.
7. Plot graphs of the potential across the capacitor against time for all three combinations of *RC* on the same axes.
8. From your graphs find the time it takes for the potential difference across the capacitor to reach 63% of its final value. Compare this time with the value of the product *RC* (time constant) in each case. Be careful with the units!
9. Using the boxes of your graph paper estimate the area between each graph and the x-axis. This area represents the total charge *q* on the capacitor after the given time.
10. Calculate the capacitance of each capacitor using the formula , where *V* is the potential difference across the capacitor at *t* = 3 minutes. Compare the calculated values with the ones marked on the capacitors you used.

### Questions

* 1. What is the name for the relationship demonstrated by the graph of capacitor potential difference vs time?
  2. If you wish the capacitor to charge faster, what resistor would you use?