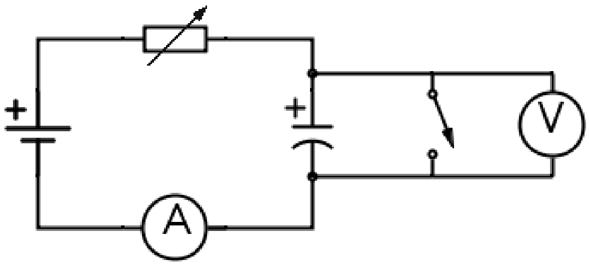
Charging a capacitor with constant current

In this experiment you will investigate the charging of a capacitor with a constant current, and use a graphical method to determine the capacitance of the capacitor.

The circuit contains a component which which regulates the current automatically - you can imagine it as a variable resistor that automatically varies its resistance to maintain the same current. The component is represented in the circuit diagram as a variable resistor, but you cannot adjust it - it adjusts itself automatically.



The circuit built in front of you is not complete - add the ammeter, switch and voltmeter as shown in the diagram. Ensure the ammeter is set to the most sensitive setting, and the voltmeter is also set to its most sensitive setting.

Close the switch across the capacitor. The ammeter should read a small current (a few microamps). Record this current - it should not change during the experiment. The voltmeter should read zero at this point, as the capacitor is short circuited and cannot charge.

current =

Open the switch across the capacitor, and watch the meter readings for about a minute. The voltage across the capacitor should increase as it charges, and the current should remain constant. Close the switch across the capacitor to discharge it. The voltage should return to zero.

Your task is to record how the voltage across the capacitor changes over time. You will then use the current previously measured to calculate the charge on the capacitor over time. Draw up a results table with three columns to record time **t**, capacitor voltage **V** and capacitor charge **Q**. Leave space for two extra columns.

Collect some readings of **t** and **V** - the range and interval is up to you. Then calculate **Q** for each value of **t**.

The relationship linking charge, capacitance and voltage is: **Q** = **CV**

Plot a suitable graph to determine **C** for your capacitor, showing clearly how you find **C** and what its units are.

capacitance =

Look again at the formula **Q** = **CV**.

Take the log of both sides, and separate out the log term on the right:

If you were to plot a graph with log **Q** on the y axis and log **V** on the x axis, what would the gradient and the y intercept represent?

gradient:

y-intercept:

Add two columns to your results table for log **Q** and log **V**, and fill in the values. Plot a graph with log **Q** on the y axis and log **V** on the x axis, and verify that the gradient and the y intercept are what you expected.