INVESTIGATION OF THE ENERGY STORED IN A CAPACITOR

Specification reference: **A level Component 2.4 – Capacitance**

Theory:

The energy stored by a capacitor is given by the equation: $U = {}^{1}/_{2}\, QV$. Given that $Q = CV$ then the equation for the energy stored can be written in the form: $U = {}^{1}/_{2}\, CV^2$. The capacitor can be charged to various values of V and then the energy stored can be determined by using a Joule meter. The energy stored can be measured as the capacitor discharges. A graph of energy stored against V^2 should be linear and the value of the capacitance can then be measured.

Apparatus:

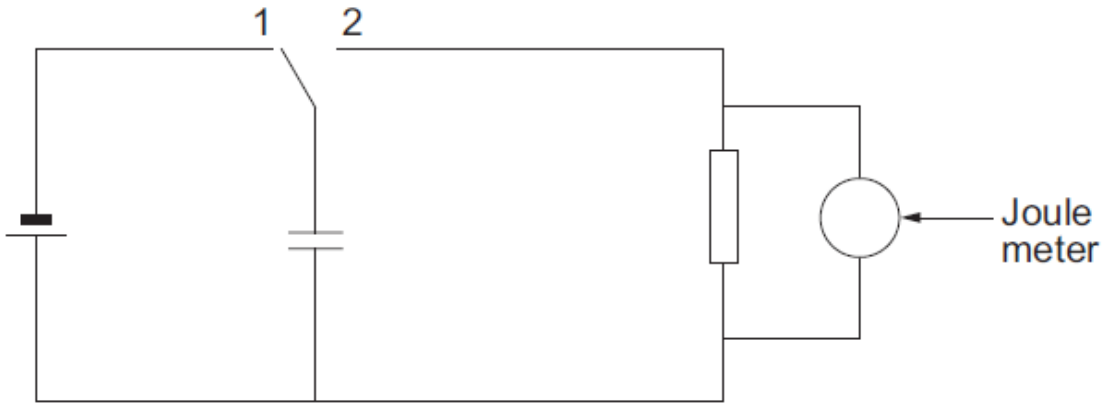
d.c. power supply
Voltmeter (multimeter set on d.c. voltage range or CRO) – resolution ± 0.01 V
Digital joule meter
4 mm leads
Suitable switches
Electrolytic capacitors e.g. a 1 000 μF or 2 200 μF
Resistors e.g. 100 kΩ or other values

Further Guidance for Technicians:

The polarity of the electrolytic capacitors should be indicated to learners so that the circuits can be set up correctly.

Experimental method:

The following circuit can be used



Learners can set up the circuit from the above diagram and by using electrolytic capacitors the correct polarity connection needs to be checked by supervisors. The two switch needs to be in position 1 so that the capacitor can be charged and then switched over to position 2 to discharge.

Extension:

The value of the capacitor could be hidden and the experimental set-up used to determine its value.

The equation ($t_{\frac{1}{2}} = 0.69RC$) i.e. the time taken for the voltage to fall to half its initial value could be investigated using the data obtained.

Data Logging: The voltage across the capacitor can be measured using a suitable voltage sensor.

Practical Techniques:

- Use signal generator and oscilloscope, including volts/division and time-base.
- Use ICT such as computer modelling, or data logger with a variety of sensors to collect data, or use of software to process data.