WJEC England Physics A Level

SP C2 04 : Capacitance

Practical notes

1. Investigation of the Charging and Discharging of a Capacitor to Determine the Time Constant
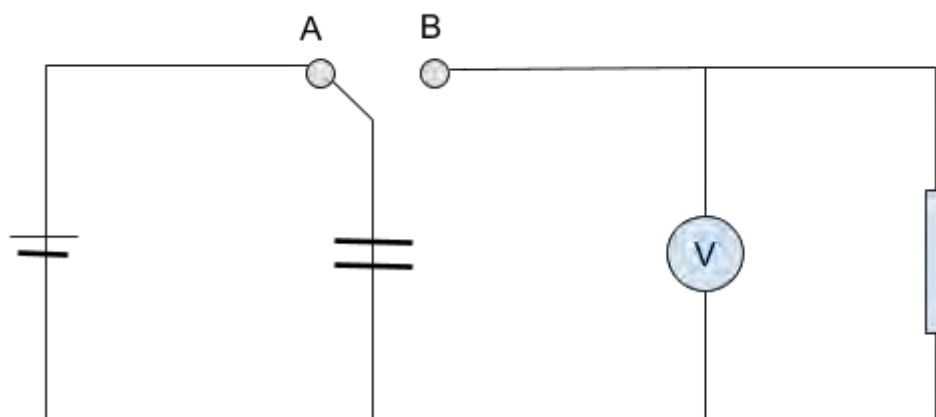
Equipment:
- Capacitor
- Resistor
- Battery
- Voltmeter
- Switch

Discharging:
Method:

1. Set up the circuit.
2. Charge the capacitor fully, with the switch at position A.
3. Start the stopwatch as you turn the switch to position B.
   Record the voltage.
4. Record the voltage every 5s until it reaches zero.
5. Repeat and obtain an average voltage for each time interval.
6. Plot a graph of ln(V) against t.
7. Draw a line of best fit. This should be straight, showing an exponential relationship.
8. Calculate the time constant, τ.
   - The gradient is equal to -1/time constant (τ).

Charging:

1. Set up the circuit
2. Close the switch and record the voltage.
3. Record the voltage at 5s time intervals for 120 seconds.
4. Repeat and calculate averages.
5. Plot a graph of V against t, which should show an exponential relationship.
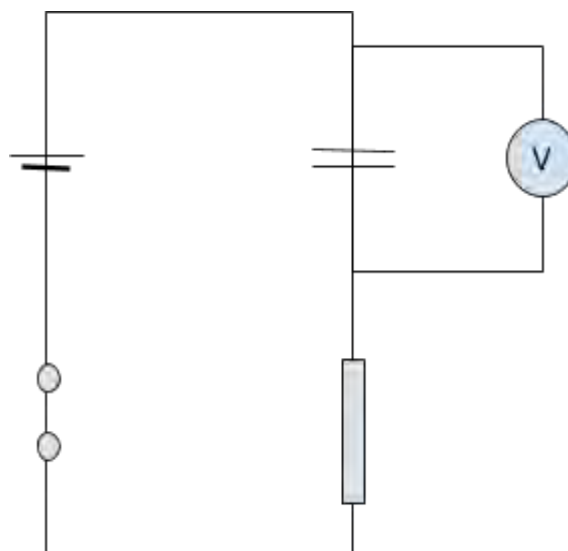
2. Investigation of the Energy Stored in a Capacitor

Equipment:
- Capacitor of known capacitance
- Voltmeter
- Leads
- Cell
- Switch

Method:
1. Set up the circuit as shown.
2. Charge the capacitor by closing the switch and then record the reading on the voltmeter.
3. Repeat this for different capacitors so that the effect of capacitance on energy stored can be evaluated.
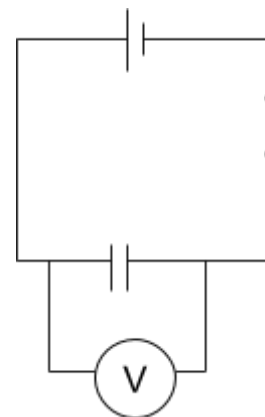
Calculations:
- The energy stored by the capacitor (E) is found by E=½ C V^2 where C is capacitance and V is the voltage across the capacitor.
- Work out the energy stored by each of the capacitors and also change the cell/battery to investigate how voltage across the capacitor affects the energy stored.

Improvements and Notes:
- The energy stored by the capacitor is also equal to half the energy supplied by the power supply, this is found by E = QV. Charging the capacitor at a fixed current (using a variable resistor to keep it constant) for a known period of time (measured on a stopwatch) and using Q = It allows charge to be found and voltage can be read from the voltmeter. Halve the product of charge and voltage to find the energy stored by the capacitor.

Safety:
- Do not use too high a voltage as it can break the capacitor and make electrocution more dangerous and likely