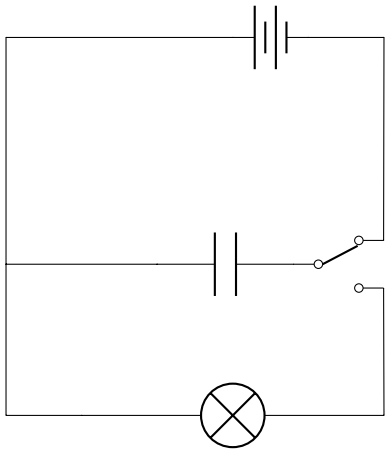
Capacitors

A capacitor is constructed from two conducting plates separated by an insulator.
Charge can flow onto and off the plates but not across the plates.

1 Charging circuit for a capacitor



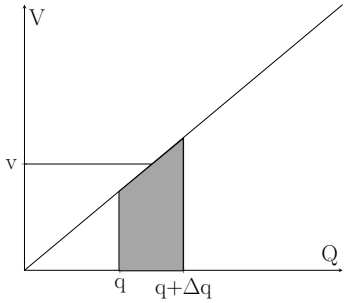
When charging the current flows round the top half of the circuit, when discharging the SPDT is changed to the other output and the current flows round the bottom half of the circuit.

Capacitors can be used as simple timers in circuits.

The time it takes to charge/discharge depends on:

- The capacitance of the capacitor **(C)**
- The resistance of the charging/discharging circuit **(R)**

2 Energy stored in a capacitor



Area under graph=work done
V is the average P.D. as charge increases from q to q+Δq
Δw=vΔq

$Q = \frac{1}{2}QV = E$ **(Work done=energy stored)**

How to answer the exam question: Show that the energy stored by a capacitor is given by $E = \frac{1}{2}QV$

1. Sketch a graph of Q against V and describe what it shows
2. Describe that electrical energy is the product of charge and voltage
3. State QV is represented by the area under the line
4. The area under the line is a triangle with area $= \frac{1}{2}QV$

5. Therefore $E = \frac{1}{2}QV$

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

The battery supplies energy QV to the circuit but the capacitor only stores $\frac{1}{2}QV$, this means that 50% of the energy provided by the battery is wasted due to resistance in the circuit.