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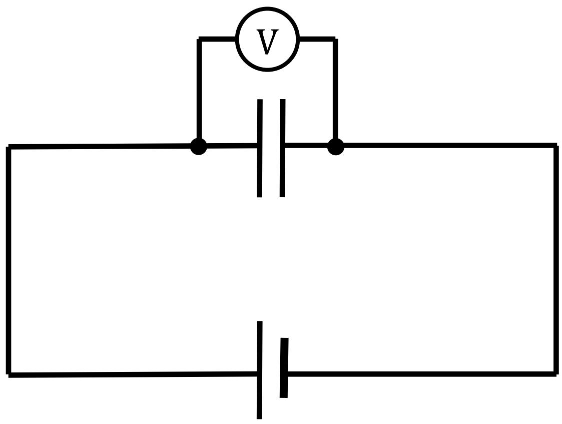
7.9 Energy stored by a capacitor

videos

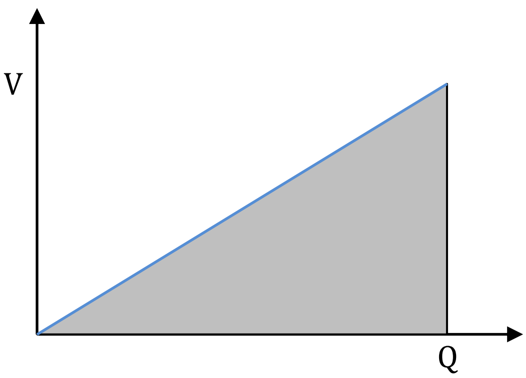
When a charge (Q) is moved through a potential difference (V) work (W) is done:

$$W = QV$$

In the following circuit, work is done by the battery in moving charge from one plate of the capacitor to the other.



As the charge builds up on the plates of the capacitor, the voltage across the plates increases.



This means that the charge is moved through a bigger and bigger potential difference, and increasing amounts of work are required.

The work done is the area underneath the V versus Q graph:

$$W = \frac{1}{2}QV$$

(1) Given the equation for capacitance $\left(C = \frac{Q}{V}\right)$*, show that work done (W) is given by the equation:*

$$W = \frac{1}{2}CV^2$$

The work done in charging a capacitor is equal to the energy stored (E) by the capacitor:

$$E = \frac{1}{2}CV^2$$

(2)🖉Show that an alternative formula for the energy stored by a capacitor is:

$$E = \frac{Q^2}{2C}$$

(3)🖉A 50000μF capacitor is charged using a steady current of 30mA for 30s. Work out i) the energy stored, and ii) the voltage across the capacitor after 30s of charging.

(4)🖉The circuit below is used in the flash for a camera. A 40000μF capacitor is charged from a 9V battery. It is then discharged through a bulb in a flash lasting 0.15s. Calculate i) the charge and energy stored in the capacitor before discharge, ii) the average power supplied to the light bulb.