

10 Capacitor energy and dielectrics – Part 2

Name: _____ Class: _____ Date: _____

Recall

In Part A you saw a capacitor stores charge. It also stores **energy**:

- A charged capacitor can release energy in a quick burst (a camera flash).
- The more you charge it, the more energy it holds.

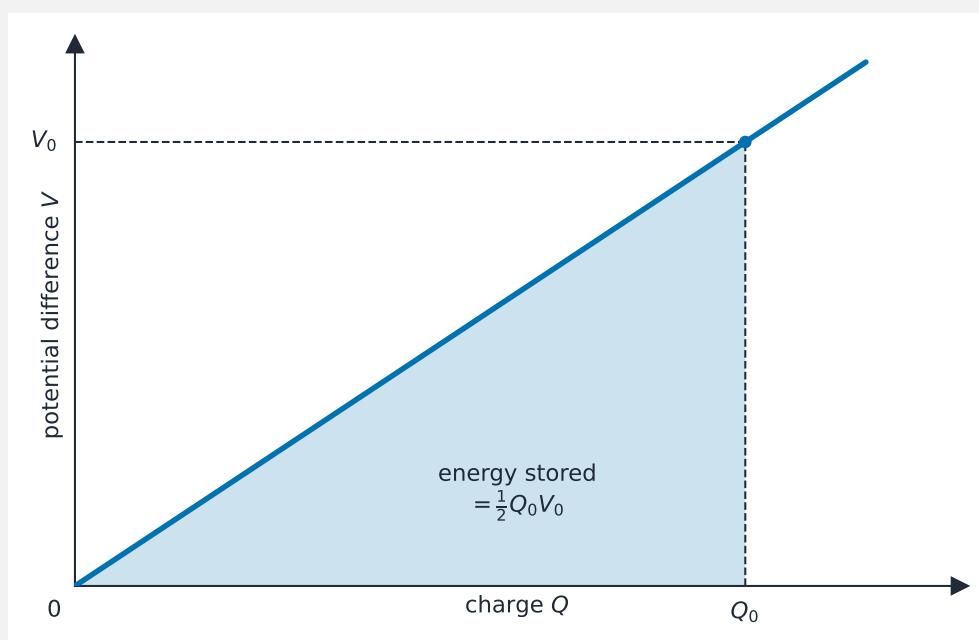
Each idea has a worked example before the Practice.

New ideas

■ 1 Stored energy

A charged capacitor stores energy

$$U = \frac{1}{2}CV^2.$$



Worked example. A $100\ \mu\text{F}$ capacitor at $12\ \text{V}$ stores $U = \frac{1}{2} \times 100 \times 10^{-6} \times 12^2 = 7.2 \times 10^{-3}\ \text{J}$.

■ 2 Energy depends on V squared

Because of the V^2 , **doubling** the voltage stores **four times** the energy.

■ 3 A quick release

A capacitor can release its stored energy very quickly –far faster than a battery – which is why it powers a camera flash.

■ 4 Dielectrics

Putting an insulating material (a **dielectric**) between the plates increases the capacitance, so more charge and energy can be stored at the same voltage.

Watch out: the stored energy depends on the **square** of the voltage ($U = \frac{1}{2}CV^2$), so a small rise in voltage gives a large rise in energy –double the voltage, quadruple the energy.

Practice

Try these in order. The methods are all above.

2.1 Write the formula for the energy stored in a capacitor. [1]

2.2 A $200\ \mu\text{F}$ capacitor is charged to 10 V. Find the energy stored. [3]

2.3 A capacitor's voltage is doubled. State the factor by which the stored energy changes. [1]

2.4 State one everyday use of a capacitor's quick energy release. [1]

2.5 State what adding a dielectric between the plates does. [2]
