Exercise walk-through

Capacitors ▪ 10.6

eXercise

You must be able to

- describe a **capacitor 电容器** as two conductors storing equal and opposite charge
- apply the defining relation for **capacitance 电容**, $C = Q/V$
- relate a parallel-plate capacitor's capacitance to plate area and separation
- calculate the **energy stored** in a capacitor, $U = \frac{1}{2}CV^2$

Method — Capacitance

$C = \dfrac{Q}{V}$, measured in farads. A bigger capacitor stores more charge at the same voltage.

Method — Parallel plates

Capacitance rises with a **larger plate area** and a **smaller separation**.

Method — Energy stored

$U = \frac{1}{2}CV^2$. A $2.0\ \mu$F capacitor at 10 V: $Q = CV = 2.0 \times 10^{-5}$ C,
$U = \frac{1}{2}(2.0 \times 10^{-6})(10)^2 = 1.0 \times 10^{-4}$ J.

Practice 2.1 ▪ 2 marks

A capacitor stores 6.0×10^{-4} C at 12 V. Find its capacitance.

Solution 2.1

Worked steps

$$C = \frac{Q}{V} = \frac{6.0 \times 10^{-4}}{12} = 5.0 \times 10^{-5}\ \text{F}$$ M1 A1.

Practice 2.2 ▪ 1 mark

State how the capacitance changes if the plates are moved closer together.

Solution 2.2

Method: Parallel plates

Worked steps

it increases (smaller separation gives larger capacitance) B1.

Practice 2.3 ▪ 2 marks

Find the energy stored in a $5.0\ \mu$F capacitor at 20 V.

Solution 2.3

Method: Energy stored

Worked steps

$U = \frac{1}{2}CV^2 = \frac{1}{2}(5.0 \times 10^{-6})(20)^2 = 1.0 \times 10^{-3}$ J M1 A1.

Exam-style 3.1 ▪ 1 mark

Capacitance is defined as

A QV

B Q/V

C V/Q

D $\frac{1}{2}QV$

Solution 3.1

A QV

B Q/V ✓

C V/Q

D $\frac{1}{2}QV$

Worked steps

B.

Exam-style 3.2 ▪ 1 mark

The energy stored in a capacitor is

A CV

B $\frac{1}{2}CV^2$

C Q/V

D QV^2

Solution 3.2

Method: Energy stored

A CV

B $\frac{1}{2}CV^2$ ✓

C Q/V

D QV^2

Worked steps

B.

Exam-style 3.3 ▪ 2 marks

A $100\ \mu$F capacitor is charged to 50 V.
(a) Find the charge stored.
(b) Find the energy stored.

Solution 3.3

Method: Energy stored

Worked steps

(a) $Q = CV = (100 \times 10^{-6})(50) = 5.0 \times 10^{-3}$ C M1 A1. (b) $U = \frac{1}{2}CV^2 = \frac{1}{2}(100 \times 10^{-6})(50)^2 = 0.125$ J M1 A1.