

10.6 Capacitors

Name: _____ Class: _____ Date: _____

Total: 11 marks

Objective

Build the skills to answer exam questions on **capacitors**.

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

1 Worked examples

Study these first. Each one shows the method for a question type used later.

■ Capacitance

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

■ Parallel plates

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

■ Energy stored

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

2 Practice

2.1 A capacitor stores $6.0 \times 10^{-4} \text{ C}$ at 12 V. Find its capacitance. [2]

2.2 State how the capacitance changes if the plates are moved closer together. [1]

2.3 Find the energy stored in a $5.0\ \mu\text{F}$ capacitor at $20\ \text{V}$. [2]

3 Exam-style questions

3.1 Capacitance is defined as [1]

- **A** QV
- **B** Q/V
- **C** V/Q
- **D** $\frac{1}{2}QV$

3.2 The energy stored in a capacitor is [1]

- **A** CV
- **B** $\frac{1}{2}CV^2$
- **C** Q/V
- **D** QV^2

3.3 A $100\ \mu\text{F}$ capacitor is charged to $50\ \text{V}$.

(a) Find the charge stored. [2]

(b) Find the energy stored. [2]

4 Go further

- work through the **10.6 Capacitors** lesson on the **Learn** page;
- read the **Electric Force, Field, and Potential** section of the AP Physics 2 handout on the **Know** page.

Solutions

2.1 $C = \frac{Q}{V} = \frac{6.0 \times 10^{-4}}{12} = 5.0 \times 10^{-5} \text{ F}.$

2.2 it increases (smaller separation gives larger capacitance).

2.3 $U = \frac{1}{2}CV^2 = \frac{1}{2}(5.0 \times 10^{-6})(20)^2 = 1.0 \times 10^{-3} \text{ J}.$

3.1 B.

3.2 B.

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