

# 10.3 Capacitors

Name: \_\_\_\_\_ Class: \_\_\_\_\_ Date: \_\_\_\_\_

**Total: 11 marks**

**KEY WORDS** capacitor 电容器 • capacitance 电容 • series 串联  
• parallel-plate capacitor 平行板电容器 • series and parallel 串联和并联

## Objective

Build the skills to answer exam questions on **capacitors**.**You must be able to:**

- define **capacitance** 电容 as  $C = \frac{Q}{V}$
- use the parallel-plate result  $C = \frac{\epsilon_0 A}{d}$
- calculate the **energy stored**,  $U = \frac{1}{2} CV^2 = \frac{1}{2} \frac{Q^2}{C}$
- combine capacitors in **series and parallel** 串联和并联

## 1 Worked examples

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

### ■ Capacitance

$C = \frac{Q}{V}$  (farads). For parallel plates,  $C = \frac{\epsilon_0 A}{d}$  — larger area or smaller gap gives more capacitance.

### ■ Energy stored

$U = \frac{1}{2} CV^2 = \frac{1}{2} \frac{Q^2}{C}$ , stored in the field (energy density  $u = \frac{1}{2} \epsilon_0 E^2$ ).

### ■ Combining capacitors

- Parallel:**  $C = C_1 + C_2 + \dots$
- Series:**  $\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} + \dots$  (less than the smallest).

## 2 Practice

**2.1** A parallel-plate capacitor has area  $0.020 \text{ m}^2$  and separation  $1.0 \text{ mm}$  ( $\epsilon_0 = 8.85 \times 10^{-12}$ ). Find its capacitance. [2]

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**2.2** Two  $4.0 \mu\text{F}$  capacitors are connected in parallel. Find the total capacitance. [1]

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**2.3** Find the energy stored in a  $10 \mu\text{F}$  capacitor at  $12 \text{ V}$ . [2]

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## 3 Exam-style questions

**3.1** The capacitance of a parallel-plate capacitor is [1]

- |   |                          |
|---|--------------------------|
| A | $\frac{\epsilon_0 d}{A}$ |
| B | $\frac{\epsilon_0 A}{d}$ |
| C | $\epsilon_0 A d$         |
| D | $\frac{A}{\epsilon_0 d}$ |

**3.2** Two capacitors in series have a total capacitance that is [1]

- |   |                       |
|---|-----------------------|
| A | the sum of the two    |
| B | less than either one  |
| C | the larger of the two |
| D | zero                  |

**3.3** A  $5.0\ \mu\text{F}$  capacitor is charged to  $100\ \text{V}$ .

(a) Find the charge stored. [2]

(b) Find the energy stored. [2]