10.3 Capacitors

Name: _____ Class: _____ Date: _____ **Total: 11 marks**

KEY WORDS capacitor • capacitance • series • parallel-plate capacitor • series and parallel

Objective

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

You must be able to:

- define **capacitance** as $C = \dfrac{Q}{V}$
- use the parallel-plate result $C = \dfrac{\varepsilon_0 A}{d}$
- calculate the **energy stored**, $U = \frac{1}{2}CV^2 = \frac{1}{2}\dfrac{Q^2}{C}$
- combine capacitors in **series and parallel**

1 Key knowledge and worked examples

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

Capacitance

$C = \dfrac{Q}{V}$ (farads). For parallel plates, $C = \dfrac{\varepsilon_0 A}{d}$ – larger area or smaller gap gives more capacitance.

Energy stored

$U = \frac{1}{2}CV^2 = \frac{1}{2}\dfrac{Q^2}{C}$, stored in the field (energy density $u = \frac{1}{2}\varepsilon_0 E^2$).

Combining capacitors

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

2 Practice

2.1 A parallel-plate capacitor has area 0.020 m^2 and separation 1.0 mm ($\varepsilon_0 = 8.85 \times 10^{-12}$). Find its capacitance. [2]

2.2 Two 4.0 μF capacitors are connected in parallel. Find the total capacitance. [1]

2.3 Find the energy stored in a 10 μF capacitor at 12 V. [2]

3 Exam-style questions

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

- ☐ **A** $\frac{\varepsilon_0 d}{A}$
- **B** $\frac{\varepsilon_0 A}{d}$
- **C** $\varepsilon_0 A d$
- **D** $\frac{A}{\varepsilon_0 d}$

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 μF capacitor is charged to 100 V.

(a) Find the charge stored. [2]

(b) Find the energy stored. [2]