

19.1 Capacitors and capacitance

Name: _____ Class: _____ Date: _____

Total: 24 marks

KEY WORDS capacitance 电容 • capacitor 电容器 • potential difference 电势差 • resistor 电阻器
• farad 法拉

Objective

Build the skills to answer exam questions on **capacitance** — $C = Q/V$ and combining capacitors.

You must be able to:

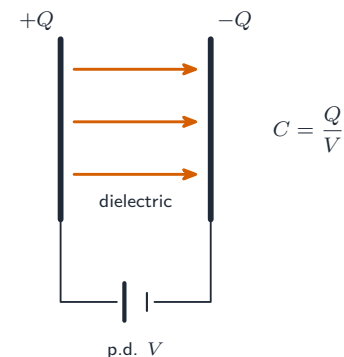
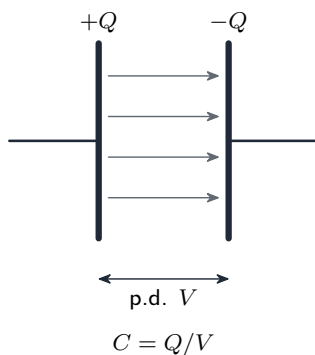
- define **capacitance** and use $C = Q/V$
- combine capacitors in **series** and **parallel**

1 Worked examples

Study these first. Each one shows the method for a question type used later — follow the steps and you can do the Practice and Exam-style questions yourself.

■ Capacitance

A **capacitor** stores charge: $+Q$ on one plate, $-Q$ on the other, with p.d. V across the gap:



A parallel-plate capacitor

$$C = \frac{Q}{V} \quad (\text{farad, F} = \text{C V}^{-1}).$$

■ Combining capacitors (opposite to resistors)

- parallel:** $C = C_1 + C_2 + \dots$
- series:** $\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} + \dots$

2 Practice

Now apply the methods above.

2.1 Define capacitance. [1]

2.2 State the unit of capacitance. [1]

2.3 A capacitor holds $60 \mu\text{C}$ of charge at 12 V. Find its capacitance. [2]

2.4 Write the formula for capacitors in **parallel**. [1]

3 Exam-style questions

3.1 The unit of capacitance is the: [1]

- A

B

C

D
- A coulomb

B farad

C volt

D ohm

3.2 A $100\ \mu\text{F}$ capacitor is charged to $9.0\ \text{V}$. Calculate the **charge** stored. [2]

3.3 A $4.0\ \mu\text{F}$ and a $2.0\ \mu\text{F}$ capacitor are connected in **series**. Calculate the combined capacitance. [3]

3.4 Write the formula for capacitors in **series**. [1]

3.5 Three capacitors are available: $C_1 = 120\ \mu\text{F}$, $C_2 = 180\ \mu\text{F}$ and $C_3 = 220\ \mu\text{F}$.

(a) C_1 and C_2 are connected in **series** across a supply. **Complete** the table to show how the charge on each and the p.d. across each relate to the total charge Q_{S} and the supply p.d. V_{S} . [2]

quantity	relationship
charges Q_1 , Q_2 and Q_{S}	_____
p.d.s V_1 , V_2 and V_{S}	_____

(b) **Determine** the combined capacitance of C_1 and C_2 in series. [2]

(c) The supply provides $12\ \text{V}$. **Calculate** the charge stored by that series combination, and the p.d. across C_1 . [3]

(d) C_3 is now connected in **parallel** with the series pair. **Determine** the total capacitance of the whole network, and the total charge it now stores at $12\ \text{V}$. [3]

(e) **State and explain** which single capacitor in the network stores the **most** charge.[2]