



QUESTION WORKBOOK

Charging and discharging

Capacitance · Year 13

AQA 3.7.4.4 · CIE 19.3.1 · OCR A 6.1.1(b), 6.1.3(a)(i)

18 questions · 46 marks

PRINT EDITION

SECTION A · Warm-up

A1 Describe the shape of the charge-time graph for a capacitor discharging through a resistor. [2]

A2 Describe how the current changes with time while a capacitor charges through a resistor. [2]

A3 State how the current in a capacitor circuit can be found from the charge-time graph. [1]

A4 State what is represented by the area under a current-time graph for a capacitor discharging through a resistor. [1]

A5 A capacitor is charged through a resistor from a 5.0 V supply. When charging is complete, state the potential difference across the capacitor and the potential difference across the resistor. [2]

- A6** An initially uncharged capacitor is charged through a resistor. Describe how the potential difference across the resistor varies with time. [2]

SECTION B · Standard

- B1** A capacitor charged to 12 V is discharged through a 1.0 k Ω resistor. Calculate the initial discharge current. [2]

- B2** A capacitor is charged from a 6.0 V supply through a 2.0 k Ω resistor. State the value of the charging current at the start of charging and when the capacitor is fully charged. [2]

- B3** A capacitor is charged through a fixed resistor. Describe and explain the shapes of the graphs of potential difference across the capacitor against time and of current against time. [4]

- B4** A $100\ \mu\text{F}$ capacitor is fully charged to $9.0\ \text{V}$. Calculate the charge stored and the energy stored. [3]

- B5** A student discharges a capacitor through a resistor and uses a datalogger to record the charge-time graph. The tangent to the graph at $t = 0$ has a gradient of $-4.0 \times 10^{-4}\ \text{C s}^{-1}$. The initial potential difference across the capacitor is $6.0\ \text{V}$. Determine the resistance of the resistor. [3]

- B6** An initially uncharged capacitor is fully charged from a 9.0 V supply through a resistor. The area under the current–time graph for the whole charging process is 5.4 mC. Determine the capacitance of the capacitor. [2]

- B7** A 12 V supply charges a capacitor through a 15 k Ω resistor. At one instant the potential difference across the capacitor is 7.5 V. Calculate the potential difference across the resistor and the charging current at this instant. [3]

SECTION C · Stretch

- C1** A 470 μ F capacitor charged to 10 V is discharged through a 2.2 k Ω resistor. Calculate the initial charge stored and the initial discharge current. [4]

- C2** A $1000\ \mu\text{F}$ capacitor is charged to $12\ \text{V}$ and then fully discharged through a resistor. Determine the total energy dissipated in the resistor. [3]

- C3** Explain why the current decreases with time as a capacitor discharges through a resistor. [3]

- C4** A $2200\ \mu\text{F}$ capacitor in an emergency door alarm is charged to $6.0\ \text{V}$. The sounder stops working when the pd across the capacitor has fallen to $3.0\ \text{V}$. Calculate the energy transferred to the sounder circuit between these two pds. [3]

- C5** A student is building a circuit in which a $4700\ \mu\text{F}$ capacitor charges from a $12\ \text{V}$ supply through a single resistor. Two resistors are available: $100\ \Omega$ and $100\ \text{k}\Omega$. The student wants the capacitor to charge as quickly as possible, but the charging current must never exceed $50\ \text{mA}$. Deduce which resistor the student should use.

[4]