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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

NAVY SCREEN EDITION

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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 kΩ resistor. Calculate the initial discharge current. [2]

B2 A capacitor is charged from a 6.0 V supply through a 2.0 kΩ 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 µF capacitor is fully charged to 9.0 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 -4.0×10^{-4} C s^{-1}. The initial potential difference across the capacitor is 6.0 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 kΩ 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 µF capacitor charged to 10 V is discharged through a 2.2 kΩ resistor. Calculate the initial charge stored and the initial discharge current. [4]

C2 A 1000 μF capacitor is charged to 12 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 μF capacitor in an emergency door alarm is charged to 6.0 V. The sounder stops working when the pd across the capacitor has fallen to 3.0 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 μF capacitor charges from a 12 V supply through a single resistor. Two resistors are available: 100 Ω and 100 kΩ. The student wants the capacitor to charge as quickly as possible, but the charging current must never exceed 50 mA. Deduce which resistor the student should use.

[4]