InkPhysics

QUESTION WORKBOOK

The time constant and exponential decay

Capacitance · Year 13

AQA 3.7.4.4 · CIE 19.3 · OCR A 6.1.3

10 questions · 30 marks

PRINT EDITION

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SECTION A · Warm-up

A1 State the equation for the time constant of an RC circuit and what it represents. [2]

A2 A 100 μF capacitor discharges through a 10 kΩ resistor. Calculate the time constant. [2]

A3 State the equation for the charge on a capacitor discharging through a resistor. [2]

SECTION B · Standard

B1 A 470 μF capacitor discharges through a 2.2 kΩ resistor. Calculate the time constant, and state what fraction of the initial charge remains after one time constant. [3]

B2 A 100 µF capacitor is charged to 12 V and discharged through a 47 kΩ resistor. Calculate the potential difference across it after 5.0 s. [4]

B3 For that circuit (RC = 4.7 s), calculate the half-life of the discharge using $T_{½}$ = 0.69RC. [3]

B4 A capacitor of 220 µF is to have a time constant of 2.0 s. Calculate the resistance required. [3]

SECTION C · Stretch

C1 A capacitor discharges through a resistor with a time constant of 3.0 s. Calculate the time taken for the voltage to fall from 20 V to 5.0 V. [4]

C2 A 470 µF capacitor is charged from a 9.0 V supply through a 10 kΩ resistor. Calculate the potential difference across the capacitor after 10 s, using $V = V_0(1 - e^{-t/RC})$. [4]

C3 Explain how the time constant RC can be found from a graph of ln(V) against time for a discharging capacitor. [3]