

11.8 RC Circuits

Name: _____ Class: _____ Date: _____

Total: 9 marks**KEY WORDS** capacitor 电容器 • time constant 时间常数 • rc circuit RC 电路 • resistance 电阻

Objective

Build the skills to answer exam questions on **RC circuits**.**You must be able to:**

- describe how a **capacitor** 电容器 charges and discharges through a resistor over time
- relate the **time constant** 时间常数 $\tau = RC$ to how quickly the circuit responds
- describe the current and voltage at the start and after a long time

1 Worked examples

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

■ Charging and discharging

A capacitor charges up through a resistor, its voltage rising toward the supply value; it discharges the same way in reverse.

■ Time constant

$\tau = RC$ (seconds) sets the pace: a bigger R or C means slower charging.

■ Start and steady state

At $t = 0$ the uncharged capacitor acts like a **wire** (maximum current); after a long time it is **fully charged** and the current is **zero**.

2 Practice

2.1 Find the time constant of a $2000\ \Omega$ resistor and a $50\ \mu\text{F}$ capacitor. [2]

2.2 State the current through the capacitor a long time after charging begins. [1]

2.3 State what happens to the charging rate if the resistance is increased. [1]

3 Exam-style questions

3.1 The time constant of an RC circuit is [1]

- **A** R/C
 - **B** RC
 - **C** $R + C$
 - **D** C/R
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3.2 A long time after charging begins, the current in an RC circuit is [1]

- **A** at its maximum
 - **B** zero
 - **C** constant and large
 - **D** negative
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3.3 A $10\text{ k}\Omega$ resistor charges a $100\text{ }\mu\text{F}$ capacitor from a 9.0 V supply.

(a) Find the time constant. [2]

(b) State the final voltage across the capacitor. [1]

Solutions

2.1 $\tau = RC = 2000 \times 50 \times 10^{-6} = 0.10 \text{ s}$.

2.2 zero (the capacitor is fully charged).

2.3 it slows down (a larger $\tau = RC$).

3.1 B.

3.2 B.

3.3 (a) $\tau = RC = (10 \times 10^3)(100 \times 10^{-6}) = 1.0 \text{ s}$. (b) 9.0 V (the supply voltage).