

Investigating charging and discharging capacitors

Introduction

This practical activity supports the theory on charging and discharging capacitors.

Aim

- To observe the pattern of charging and discharging a capacitor.
- To take measurements to allow confirmation of exponential formulae learned.

Intended class time

- 60 to 90 minutes

Links to Specification

Physics A

- 6.1.1(a) capacitance: $C = \frac{Q}{V}$; the unit farad
- 6.1.1(b) charging and discharging of a capacitor or capacitor plates with reference to the flow of electrons
- 6.1.1(c)(i) analysis of circuits containing capacitors, including resistors
- 6.1.3(a)(i) charging and discharging capacitor through a resistor
- 6.1.3(a)(ii) techniques and procedures to investigate the charge and the discharge of a capacitor using both meters and data-loggers
- 6.1.3(b) time constant of a capacitor–resistor circuit: $\tau = RC$
- 6.1.3(c) equations of the form $x = x_0 e^{-\frac{t}{\tau}}$ and $x = x_0 (1 - e^{-\frac{t}{\tau}})$ for capacitor-resistor circuits
- 6.1.3(e) exponential decay graph; constant-ratio property of such a graph.

Physics B

- 5.1.1(a)(i) capacitance as the ratio $C = \frac{Q}{V}$
- 5.1.1(a)(ii) the exponential form of the decay of charge on a capacitor as due to the rate of removal of charge being proportional to the charge remaining $\frac{dQ}{dt} = -\frac{Q}{RC}$
- 5.1.1(b)(i) for a capacitor; the term: time constant τ
- 5.1.1(c)(i) solving equations of the form $\frac{dN}{dt} = -\lambda N$ by iterative numerical or graphical methods.
- 5.1.1(c)(ii) calculating time constant λ of a capacitor circuit from data: $\tau = RC$; $Q = Q_0 e^{-\frac{t}{RC}}$

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Lingjun Ying



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1. Understanding the eBook Ocr As Physics G48january 21paper
 - The Rise of Digital Reading Ocr As Physics G48january 21paper
 - Advantages of eBooks Over Traditional Books
2. Identifying Ocr As Physics G48january 21paper
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Ocr As Physics G48january 21paper
 - User-Friendly Interface
4. Exploring eBook Recommendations from Ocr As Physics G48january 21paper
 - Personalized Recommendations
 - Ocr As Physics G48january 21paper User Reviews and Ratings
 - Ocr As Physics G48january 21paper and Bestseller Lists
5. Accessing Ocr As Physics G48january 21paper Free and Paid eBooks
 - Ocr As Physics G48january 21paper Public Domain eBooks
 - Ocr As Physics G48january 21paper eBook Subscription Services
 - Ocr As Physics G48january 21paper Budget-Friendly Options
6. Navigating Ocr As Physics G48january 21paper eBook Formats

- ePub, PDF, MOBI, and More
- Ocr As Physics G48january 21paper Compatibility with Devices
- Ocr As Physics G48january 21paper Enhanced eBook Features
- 7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Ocr As Physics G48january 21paper
 - Highlighting and Note-Taking Ocr As Physics G48january 21paper
 - Interactive Elements Ocr As Physics G48january 21paper
- 8. Staying Engaged with Ocr As Physics G48january 21paper
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Ocr As Physics G48january 21paper
- 9. Balancing eBooks and Physical Books Ocr As Physics G48january 21paper
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Ocr As Physics G48january 21paper
- 10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
- 11. Cultivating a Reading Routine Ocr As Physics G48january 21paper
 - Setting Reading Goals Ocr As Physics G48january 21paper
 - Carving Out Dedicated Reading Time
- 12. Sourcing Reliable Information of Ocr As Physics G48january 21paper
 - Fact-Checking eBook Content of Ocr As Physics G48january 21paper
 - Distinguishing Credible Sources
- 13. Promoting Lifelong Learning
 - Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
- 14. Embracing eBook Trends
 - Integration of Multimedia Elements
 - Interactive and Gamified eBooks

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