Investigating charging and discharging capacitors

Introduction

In this practical activity you will be observing the exponential nature of potential difference and current as a capacitor is charged and discharged.

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

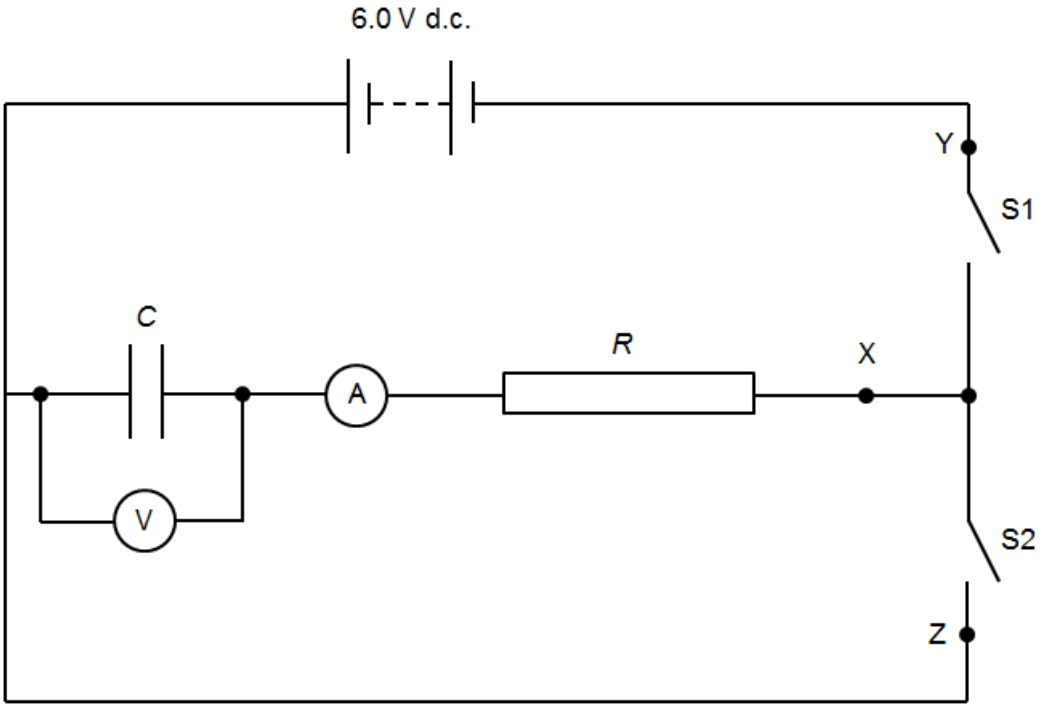
Equipment

- unmarked capacitor
- multimeter with μA scale
- voltmeter
- resistance decade box, or range of resistors
- leads
- power supply limited to 6 V d.c.
- stop clock
- alternatively; data logger with voltage and current sensors

Health and Safety

- Electrolytic capacitors must be connected with the correct polarity.
- Do not exceed the limit of 6 V d.c. from the power supply.
- Do not have switches S1 and S2 closed at the same time as this short circuits the power supply.

Procedure



1. Connect the circuit as shown.
2. Start with both switches open. Close switch S1 to charge.

   Alternatively, connect a flying lead from X to Y to charge.
3. Open switch S1 and then close switch S2 to discharge.
   Alternatively, disconnect the flying lead from Y and reconnect with X connected to Z to discharge.
4. Determine a value for the resistance, *R*, so that the time taken to charge is sufficient to enable readings of potential difference across the capacitor and current to be recorded. If using a decade box start with the highest possible resistance and gradually decrease to avoid blowing the decade box fuse (if fitted).
5. Record p.d. and current at different times as the capacitor charges.
6. Using the same value of resistor, collect comparable figures as data for the discharge of the capacitor.
7. Plot curves for charging and discharging the capacitor.
8. Determine a value for *C*, the capacitance of the capacitor.

Extension Opportunity

Compare the graphs for charging and discharging and comment on any observations.

Recording

As evidence for the Practical Endorsement you should have the data collected from your group. All work should be clearly dated.

Additionally, using the data collected to plot charging and discharging characteristics and calculating a value for the capacitor will support your preparation for the assessment in the written examination.