

WJEC (Eduqas) Physics A Level

SP2.4a - Investigation of the Charging and Discharging of a Capacitor to Determine the Time Constant

Practical Flashcards

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What must always be checked when using an electrolytic capacitor in a circuit?



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The electrolytic capacitor is a polarised component and so must be connected with the correct polarity in the circuit. If connected incorrectly, it can overheat and perhaps explode, thus becoming a safety hazard.



What equation is used to calculate the time constant of a resistor-capacitor circuit?



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Time Constant = Resistance x
Capacitance

$$\tau = RC$$



What information does the time constant tell us?



What information does the time constant tell us?

The time constant tells us how long it takes for the capacitor to charge to 63% of its full capacity, as well as how long it takes for it to discharge to 37% of its full capacity.



What device is used to measure the potential difference across a capacitor and how should be connected?



What device is used to measure the potential difference across a capacitor and how should be connected?

A voltmeter should be connected in parallel across the ends of the capacitor.



What equation shows how the potential difference across a capacitor varies with time as it discharges?



What equation shows how the potential difference across a capacitor varies with time as it discharges?

$$V = V_0 e^{-\frac{t}{RC}}$$

Where V_0 is the initial pd across the capacitor.



What graph can be plotted to confirm that the change in the potential difference, across a capacitor as it discharges, follows an exponential decay trend?



What graph can be plotted to confirm that the change in the potential difference, across a capacitor as it discharges, follows an exponential decay trend?

A graph of $\ln(V/V_0)$ against t can be plotted. This should form a straight line graph.



What is the advantage of taking logarithms before plotting an exponential relationship?



What is the advantage of taking logarithms before plotting an exponential relationship?

Taking logarithms allows the exponential relationship to be more easily confirmed when plotted. It also allows the graph to be matched to the equation of a straight line, which means desired variables can be more easily ascertained.



When plotting a discharge graph of $\ln(V/V_0)$ against t , how can the capacitor's time constant be obtained?



When plotting a discharge graph of $\ln(V/V_0)$ against t , how can the capacitor's time constant be obtained?

The graph will have an equation of

$$\ln(V) = \ln(V_0) - t/RC$$

and so the time constant (RC) is given by $-1/\text{gradient}$



What is the benefit of doing a trial discharge before carrying out this experiment in full?



What is the benefit of doing a trial discharge before carrying out this experiment in full?

A trial discharge with your chosen values of R and C allows you to choose a suitable time interval to take recordings at, depending on how quickly the capacitor discharges.



What equation shows how the potential difference across a capacitor varies with time as it charges?



What equation shows how the potential difference across a capacitor varies with time as it charges?

$$V = V_0 \left(1 - e^{\frac{-t}{RC}} \right)$$

Where V_0 is the pd across the fully-charged capacitor.



How does the charge across a capacitor vary with time as it discharges?



How does the charge across a capacitor vary with time as it discharges?

$$Q = Q_0 e^{\frac{-t}{RC}}$$



What is the relationship between a capacitor's time constant and the time taken for its voltage to fall to half its initial value?



What is the relationship between a capacitor's time constant and the time taken for its voltage to fall to half its initial value?

$$t_{\frac{1}{2}} = 0.69RC$$

