OCR (B) Physics A-level

PAG 09.1 - Investigating Charging and Discharging Capacitors

Practical Flashcards

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

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

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 become a safety hazard.

State the equation 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?

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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?

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

State the equation that shows how the potential difference across a capacitor varies with time as it discharges.

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

Where V_0 is the initial pd across the capacitor.

What graph can be plotted to confirm the exponential decay of a capacitor's potential difference as it discharges?

What graph can be plotted to confirm the exponential decay of a capacitor's potential difference as it discharges?

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

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/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.

State the equation that shows how the potential difference across a capacitor varies with time as it charges.

State the equation that 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.

What is the maximum voltage that you should use in this experiment?

What is the maximum voltage that you should use in this experiment?

Capacitors have voltage ratings - the voltage you use should not exceed this value.

How can the time constant of a discharging capacitor be measured using an oscilloscope and stop-clock?

How can the time constant of a discharging capacitor be measured using an oscilloscope and stop-clock?

Use the lap function on the stop-clock to record the times that the voltage falls to predetermined values on the oscilloscope. This data can then be plotted on a graph to determine the time constant.

What is the advantage of using the lap-function, rather than just writing the time down at each voltage interval?

What is the advantage of using the lap-function, rather than just writing the time down at each voltage interval?

Using the lap-function avoids you having to continually look between the screens of the oscilloscope and the stop-clock. This may result in lower uncertainties.

What measuring device could be used to measure the resistance of an unknown resistor?

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You could measure the unknown resistance of a resistor with a multimeter or ohmmeter.

How can you determine the length of your error bars for time?

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The length that your error bars should be can be determined by picking a mid-range time measurement and calculating the range of the repeat readings at that time. This range should be used as the error bar length.