# Edexcel Physics IAL

## CP11 - Capacitor Charging and Discharging

Practical Flashcards

# 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.

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 full capacity, as well as how long it takes for it to discharge to 37% of full capacity.

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 that the change in the potential difference, across a capacitor as it discharges, follows an exponential decay trend?

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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 time constant of the capacitor be found?

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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?

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Using the lap-function avoids you having to continually look between the screens of the oscilloscope and the stop-clock. This should 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 potential difference readings at that time. This range should be used as the error bar length (half the range on either side).