

Capacitors

Question Paper

Level	A Level
Subject	Physics
Exam Board	Edexcel
Topic	Electric & Magnetic Fields
Sub Topic	Capacitors
Booklet	Question Paper
Paper Type	Open-Response 3

Time Allowed: 42 minutes

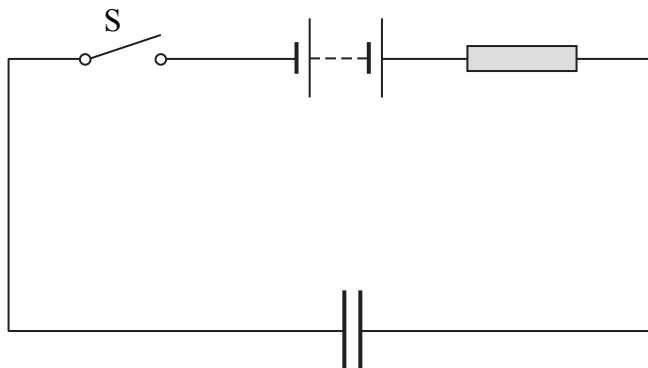
Score: /35

Percentage: /100

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

1 An uncharged capacitor is connected into a circuit as shown.



(a) Describe what happens to the capacitor when the switch S is closed.

(2)

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(b) A student models the behaviour of the circuit using a spreadsheet. The student uses a 100 μF capacitor, a 3.00 $\text{k}\Omega$ resistor and 5.00 V power supply. The switch is closed at time $t = 0$ s.

	A	B	C	D	E
1	t / s	I / mA	$\Delta Q / \mu\text{C}$	$Q / \mu\text{C}$	p.d. across capacitor/V
2	0	1.67	167	167	1.67
3	0.1	1.11	111	278	2.78
4	0.2	0.74	74	352	3.52
5	0.3	0.49	49	401	4.01
6	0.4	0.33	33	434	4.34
7	0.5	0.22	22	456	4.56
8	0.6	0.15	15	471	4.71
9	0.7	0.10	10	480	4.80
10	0.8	0.07	7	487	4.87

(i) Explain how the value in cell C4 is calculated.

(2)

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(ii) Explain how the value in cell E3 is calculated.

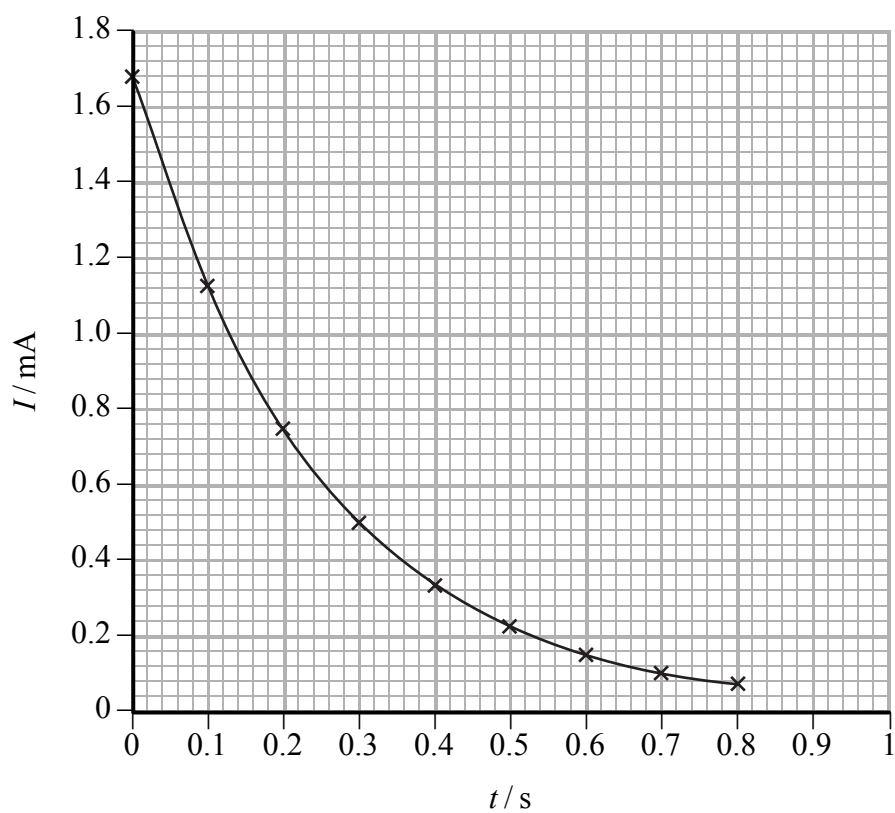
(2)

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(c) The graph shows how the spreadsheet current varies with time.



- (i) Use the graph to show that the time constant is approximately consistent with the component values.

(4)

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- (ii) The student thinks that the graph is an exponential curve. How would you use another graph to confirm this?

(3)

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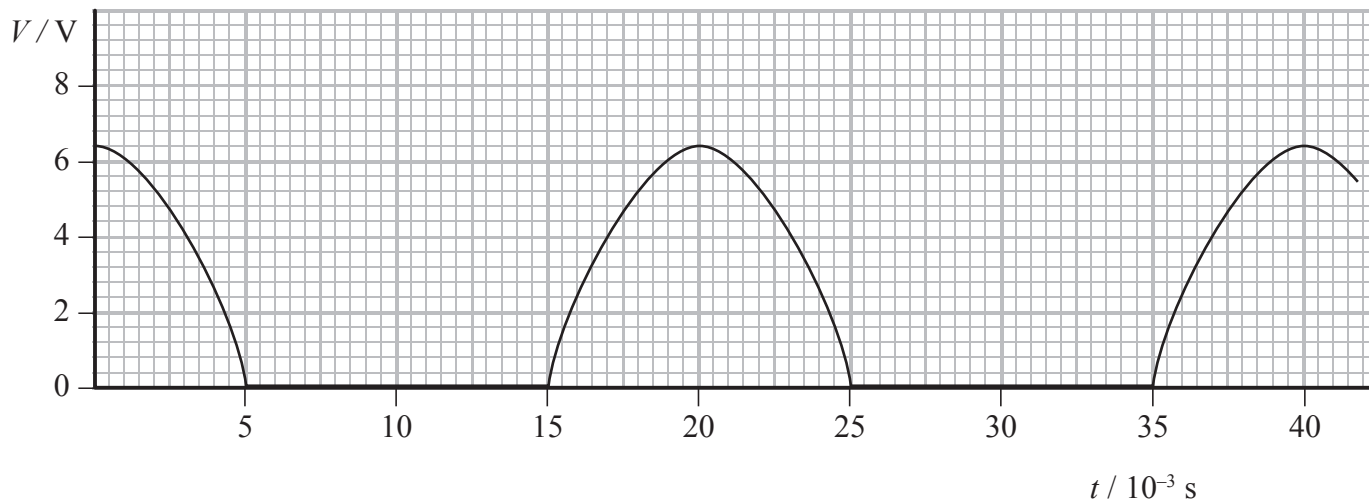
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(Total for Question = 13 marks)

- 2 The graph shows how the output V from the terminals of a power supply labelled d.c. (direct current) varies with time t . This type of supply will not allow current to flow backwards through it.



- (a) A student connects a capacitor across the terminals of this power supply in order to try to produce a constant voltage.

Suggest how this produces a constant voltage.

(2)

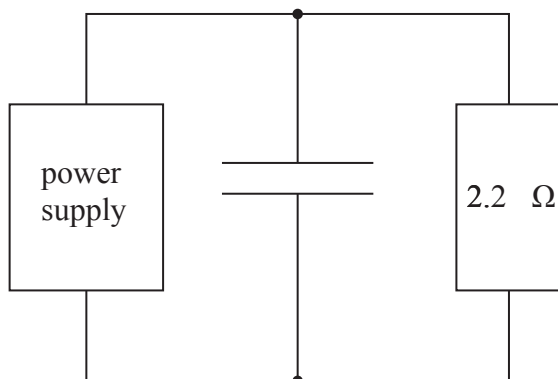
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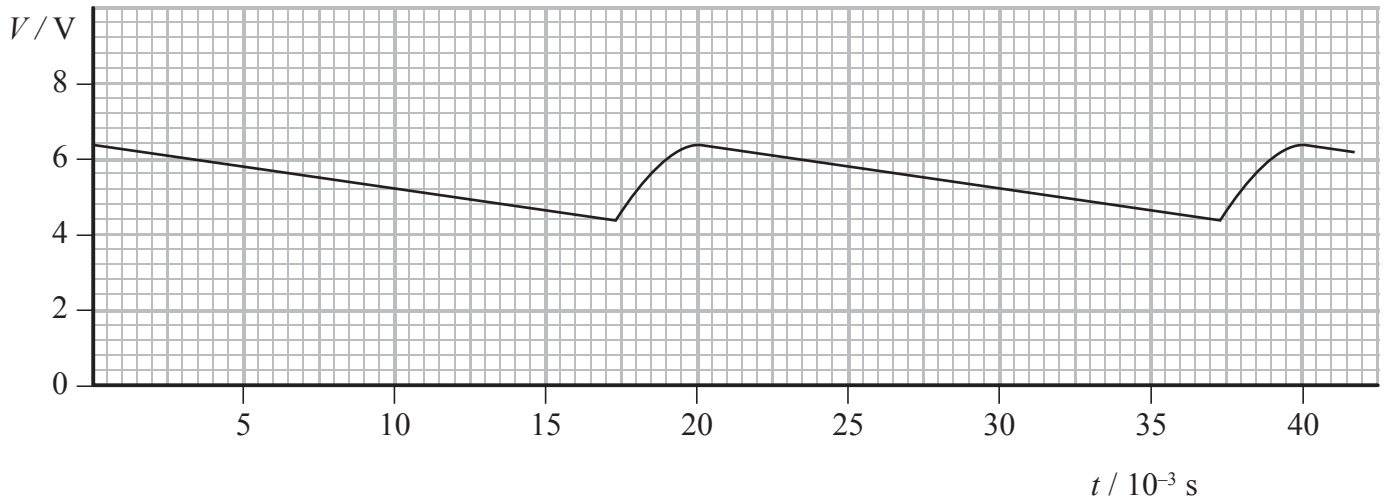
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- (b) The student then connects a resistor across the capacitor as shown.



The graph shows the variation of the potential difference V across the resistor with time t .



(i) Estimate the average potential difference across the resistor.

(1)

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Average potential difference =

(ii) Calculate the average current in the resistor.

(2)

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Average current =

(iii) Determine the time in each cycle for which the capacitor discharges through the resistor.

(1)

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Discharge time =

(iv) Calculate the charge passing through the resistor during one discharge of the capacitor and hence determine the capacitance of the capacitor.

(4)

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Charge =

Capacitance =

(c) The student wants to produce a potential difference across the same resistor that has less variation in magnitude.
State, with a reason, what the student could do to achieve this.

(2)

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(Total for Question = 12 marks)

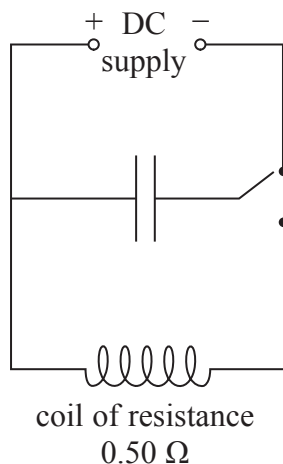
3 A particular experiment requires a very large current to be provided for a short time.

(a) An average current of 2.0×10^3 A is to be supplied to a coil of wire for a time of 1.4×10^{-3} s. The resistance of the coil is 0.50Ω .

(i) Show that the charge that flows through the coil during this time is about 3 C.

(2)

(ii) The circuit shows how a capacitor could be charged and then discharged through the coil to provide the current.



The circuit contains a capacitor of capacitance $600 \mu\text{F}$. This capacitor is suitable to provide the current for 1.4×10^{-3} s.

Explain why the capacitor is suitable.

(3)

(b) It can be assumed that the $600 \mu\text{F}$ capacitor completely discharges in $1.4 \times 10^{-3} \text{ s}$.

(i) Calculate the potential difference of the power supply.

(2)

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Potential difference =

(ii) Calculate the average power delivered to the coil in this time.

(3)

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Average power =

(Total for Question = 10 marks)