Capacitors

Queston paper

Level	International A Level
Subject	Physics
Exam Board	Edexcel
Topic	Physics on the move
Sub Topic	Capacitors
Booklet	Question paper

Time Allowed: **53 minutes**

Score: **/44**

Percentage: **/100**

Grade Boundaries:

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

1 A 500 μF capacitor is charged to a potential difference V_1. A second capacitor of capacitance 50 μF is charged to a potential difference V_2 so that the two capacitors store the same amount of energy.

The value of $\left(\frac{V_1}{V_2}\right)^2$ is

☒ **A** 100

☒ **B** 10

☒ **C** 0.1

☒ **D** 0.01

(Total for Question 1 = 1 mark)

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2 The unit for capacitance is the farad.
The farad can also be written as

☒ **A** $A\ s\ V^{-1}$

☒ **B** $A\ s^{-1}\ V^{-1}$

☒ **C** $A^{-1}\ s^{-1}\ V$

☒ **D** $A^{-1}\ s\ V$

(Total for Question 2 = 1 mark)

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3 Two capacitors of capacitance 1000 μF and 10 μF are charged so that they store the same amount of energy. The potential difference (p.d.) across the 1000 μF capacitor is V_1 and the p.d. across the 10 μF capacitor is V_2.

The value of $\left(\frac{V_1}{V_2}\right)^2$ is

☒ **A** 1×10^{-4}

☒ **B** 1×10^{-2}

☒ **C** 1×10^{2}

☒ **D** 1×10^{4}

(Total for Question 3 = 1 mark)

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4 A capacitor is charged to a potential difference of 12 V and stores a charge of 600 μC. What would the potential difference across the plates have to be in order for the capacitor to store 50% more charge?

☒ **A** 3 V

☒ **B** 9 V

☒ **C** 18 V

☒ **D** 24 V

(Total for Question 4 = 1 mark)

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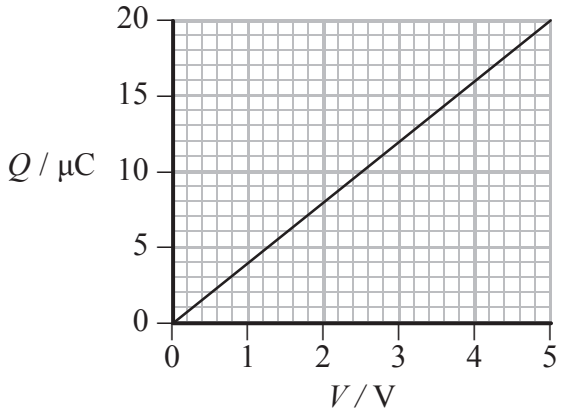
5 The graph shows how the charge Q stored on a capacitor varies with the potential difference p.d. V across it.

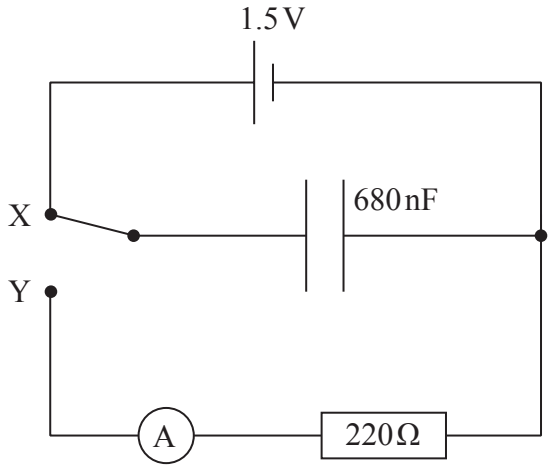


The values of the capacitance of the capacitor and the energy stored when the p.d. is 5 V are

		Capacitance / μF	Energy / μJ
☒	**A**	4	100
☒	**B**	4	50
☒	**C**	20	100
☒	**D**	20	50

(Total for Question 5 = 1 mark)

6 A capacitor can be charged and discharged using the following circuit. It can be assumed that the ammeter has zero resistance.



(a) Initially the switch makes contact at X.
Calculate the charge stored by the capacitor when it is fully charged.

(2)

Charge = ...

(b) The switch is moved to make contact at Y so that the fully charged capacitor is discharged through the 220 Ω resistor.

Calculate the charge remaining on the capacitor after it has been discharging for 1.0 ms and comment on your answer.

(4)

Charge = ...

Comment .....

(c) The capacitor is charged and discharged 500 times per second.

Calculate the average current through the ammeter.

(2)

.....

.....

.....

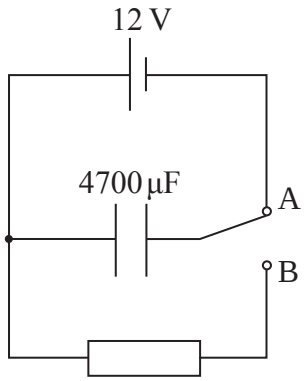
.....

Average current = ...

(Total for Question 6 = 8 marks)

7 Some lights are designed to dim gradually after being switched off. This can be done using a capacitor in a timer circuit.

The circuit diagram shows how a potential difference (p.d.) can be supplied across a resistor for a limited time.



(a) When the switch is at position A, the capacitor charges.

(i) In terms of the movement of electrons, explain what happens to the capacitor as it becomes fully charged.

(2)

.....

.....

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.....

(ii) Calculate the energy stored in the charged capacitor.

(2)

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.....

.....

.....

.....

Energy = ...

(b) The switch is moved to position B and the capacitor discharges through the resistor.

(i) Describe what happens to the current through the resistor.

(2)

.....

.....

.....

.....

(ii) For the circuit shown, the p.d. across the capacitor falls to 10% of the supply p.d. after 25 s.

Calculate the resistance of the resistor in the circuit.

(3)

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.....

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.....

.....

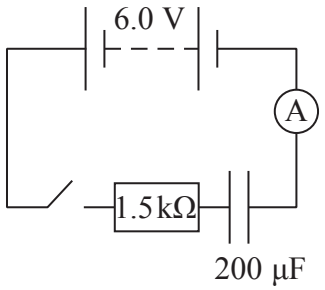
.....

Resistance = ...

(Total for Question 7 = 9 marks)

8 A student was investigating the charge and discharge of a capacitor.

He set up the following circuit.



(a) Calculate the time constant for the circuit.

(2)

.....

.....

.....

Time constant = ...

(b) The student wanted to plot a current-time graph as the capacitor charged, but found that the current changed too rapidly for him to take readings.

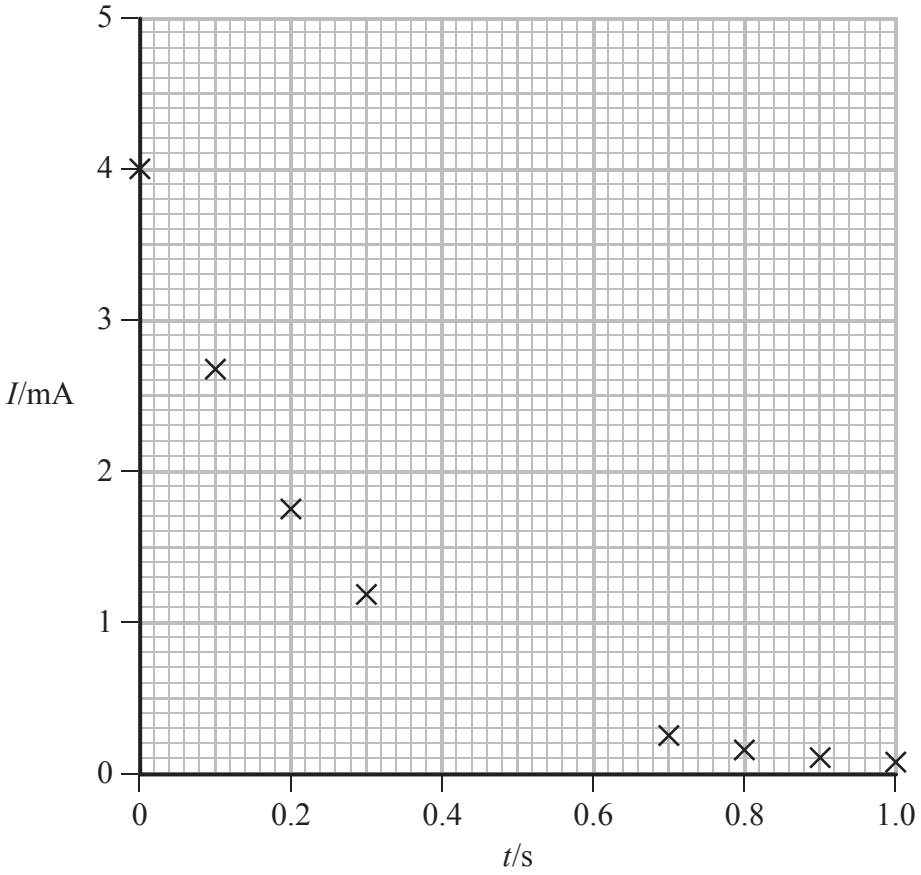
Instead, he modelled the experiment using a spreadsheet. The switch was closed at time $t = 0$ s. V is the potential difference across the capacitor.

	A	B	C	D	E
1	t/s	I/mA	ΔQ/μC	Q/μC	V/V
3	0.0	4.00	400	400	2.00
4	0.1	2.67	267	667	3.33
5	0.2	1.78	178	844	4.22
6	0.3	1.19	119	963	4.81
7	0.4	0.79	79	1042	5.21
8	0.5	0.53	53	1095	5.47
9	0.6	0.35	35	1130	5.65
10	0.7	0.23	23	1153	5.77
11	0.8	0.16	16	1169	5.84
12	0.9	0.10	10	1179	5.90
13	1.0	0.07	7	1186	5.93

Explain how the value in cell B5 is calculated.

(2)

(c) Some of the data from the spreadsheet has been plotted on a graph of current I against time t.



(i) Plot the missing points and draw a line of best fit.

(2)

(ii) Use the graph to determine a second value for the time constant.

(2)

Time constant = ...

(iii) Suggest how the student might change his spreadsheet to give a more accurate model of the charging of the capacitor.

(1)

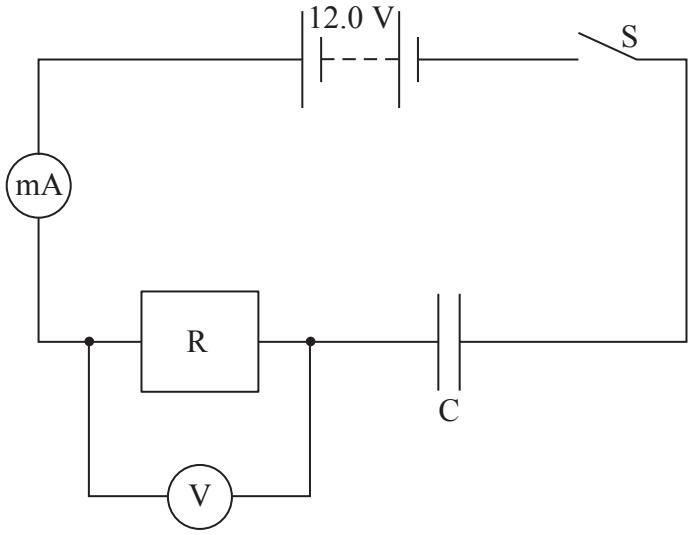
*(d) An alternative method of determining the time constant is to use a straight line graph.

State and explain the variables that the student should plot and how he should determine the time constant from this graph.

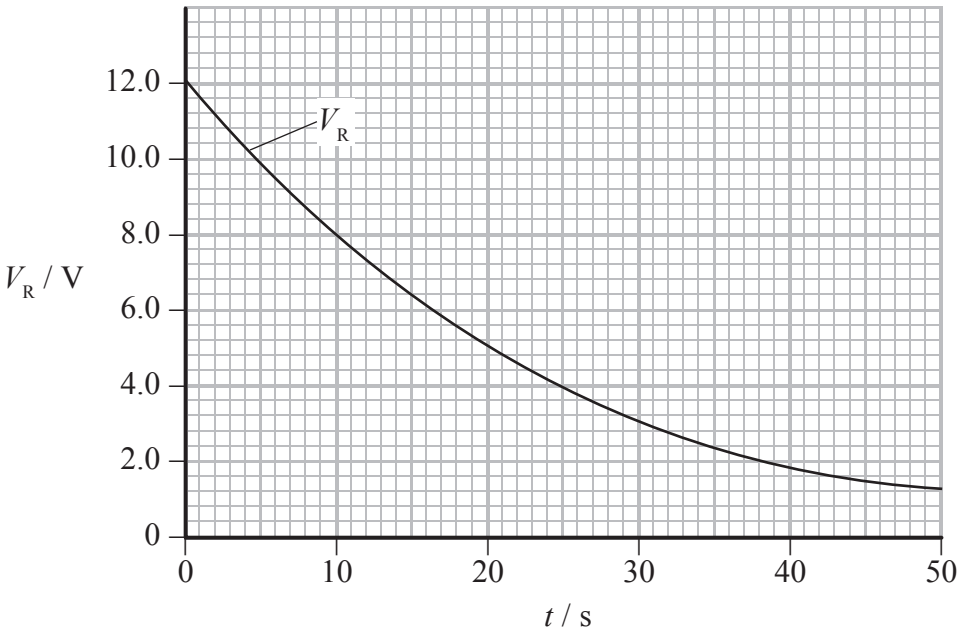
(3)

(Total for Question 8 = 12 marks)

9 A capacitor circuit is set up as shown in the diagram.



The capacitor is initially uncharged and the switch is closed at time $t = 0$. The graph shows how the potential difference V_R across the resistor varies with time t.



(a) (i) Explain the shape of the graph.

(2)

(ii) On the same axes draw a graph to show how the potential difference V_C across the capacitor varies with time.

(2)

(b) The time constant for this circuit is 25 s.

(i) Describe how you could have determined the value of the time constant from the graph.

(2)

(ii) The initial current is 0.25 mA.
Calculate the resistance R of the resistor and the capacitance C of the capacitor.

(4)

R = ...

C = ...

(Total for Question 9 = 10 marks)