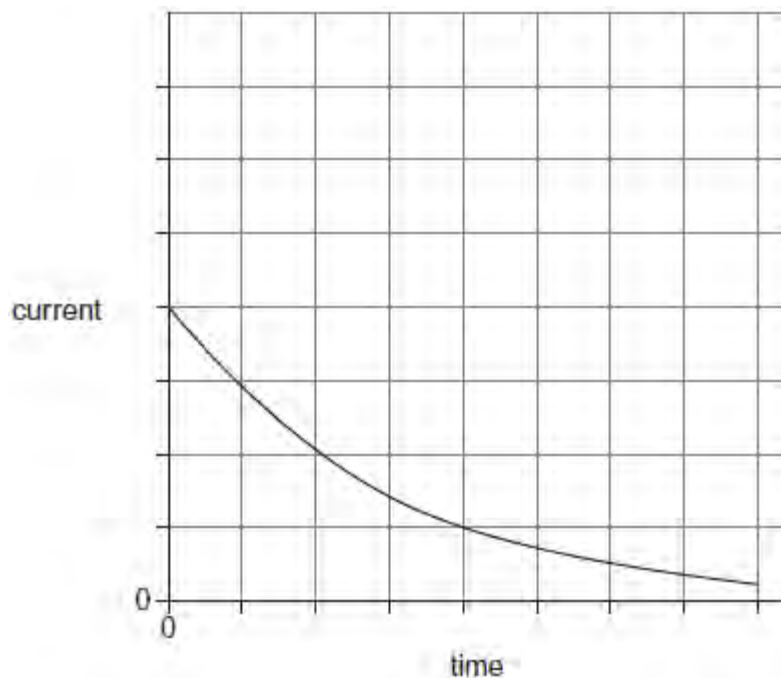


Q1. When fully charged the 2.0 mF capacitor used as a backup for a memory unit has a potential difference of 5.0 V across it. The capacitor is required to supply a constant current of 1.0 μA and can be used until the potential difference across it falls by 10%. For how long can the capacitor be used before it must be recharged?

- A** 10 s
- B** 100 s
- C** 200 s
- D** 1000 s

(Total 1 mark)

Q2.(a) The graph shows how the current varies with time as a capacitor is discharged through a 150 Ω resistor.



(i) Explain how the initial charge on the capacitor could be determined from a graph of current against time.

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(1)

- (ii) The same capacitor is charged to the same initial potential difference (pd) and then discharged through a $300\text{ k}\Omega$ resistor. Sketch a second graph on the same axes above to show how the current varies with time in this case.

(3)

- (b) In an experiment to show that a capacitor stores energy, a student charges a capacitor from a battery and then discharges it through a small electric motor. The motor is used to lift a mass vertically.

- (i) The capacitance of the capacitor is 0.12 F and it is charged to a pd of 9.0 V . The weight of the mass raised is 3.5 N . Calculate the maximum height to which the mass could be raised. Give your answer to an appropriate number of significant figures.

maximum height m

(4)

- (ii) Give **two** reasons why the value you have calculated in part (i) would not be achieved in practice.

1

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2

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(2)
(Total 10 marks)

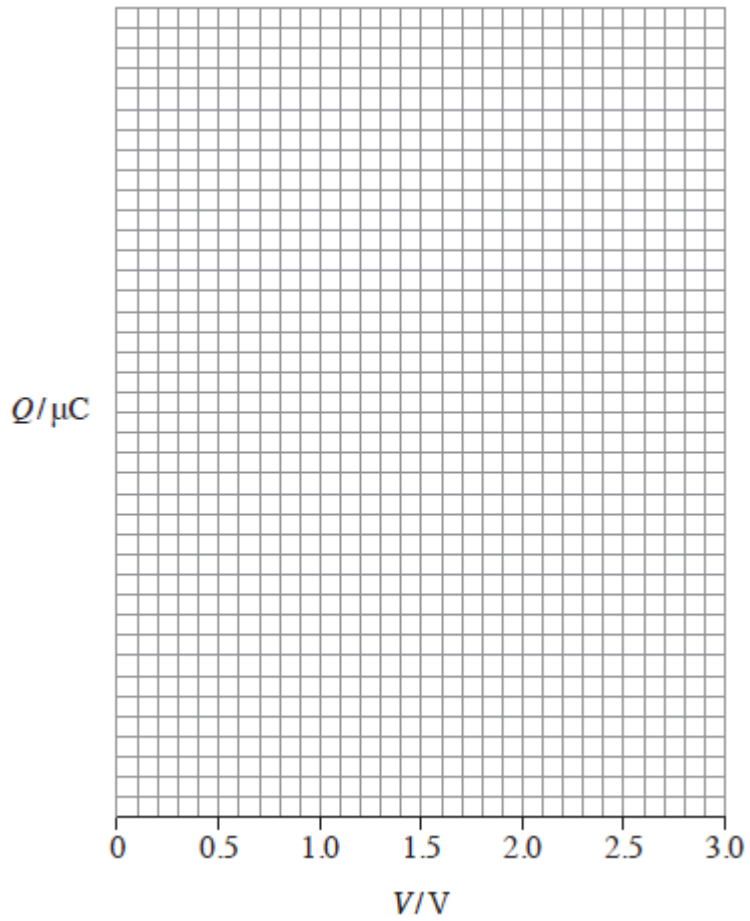
Q3. The specification for a pacemaker requires a suitable charge to be delivered in 1.4 ms. A designer uses a circuit with a capacitor of capacitance $3.0 \mu\text{F}$ and a 2.5 V power supply to deliver the charge. The designer calculates that a suitable charge will be delivered to the heart as the capacitor discharges from a potential difference (pd) of 2.5 V to a pd of 1.2 V in 1.4 ms.

(a) (i) Calculate the charge on the capacitor when it is charged to a pd of 2.5 V.

charge C

(1)

(ii) Draw a graph showing how the charge, Q , on the capacitor varies with the pd, V , as it discharges through the heart. Include an appropriate scale on the charge axis.



(3)

- (b) Calculate the energy delivered to the heart in a single pulse from the pacemaker when the capacitor discharges to 1.2 V from 2.5 V.

energy J

(3)

- (c) (i) Calculate the resistance of the heart that has been assumed in the design.

resistance Ω

(3)

- (ii) Explain why the rate of change of pd between the capacitor plates decreases as the capacitor discharges.

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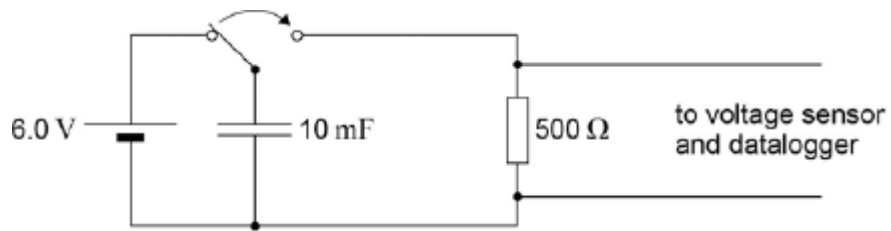
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(2)

(Total 12 marks)

Q4. A voltage sensor and a datalogger are used to record the discharge of a 10 mF capacitor in series with a 500 Ω resistor from an initial pd of 6.0 V. The datalogger is capable of recording 1000 readings in 10 s.



After a time equal to the time constant of the discharge circuit, which one of the rows gives the pd and the number of readings made?

	Potential difference / V	Number of readings	
A	2.2	50	<input type="checkbox"/>
B	3.8	50	<input type="checkbox"/>
C	3.8	500	<input type="checkbox"/>
D	2.2	500	<input type="checkbox"/>

(Total 1 mark)

