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

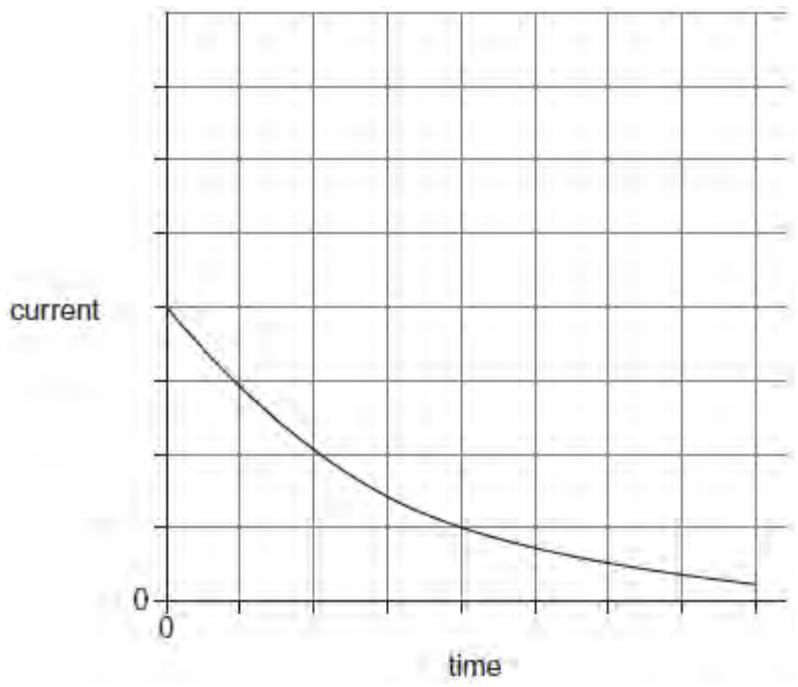
B 100 s

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 kΩ 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)

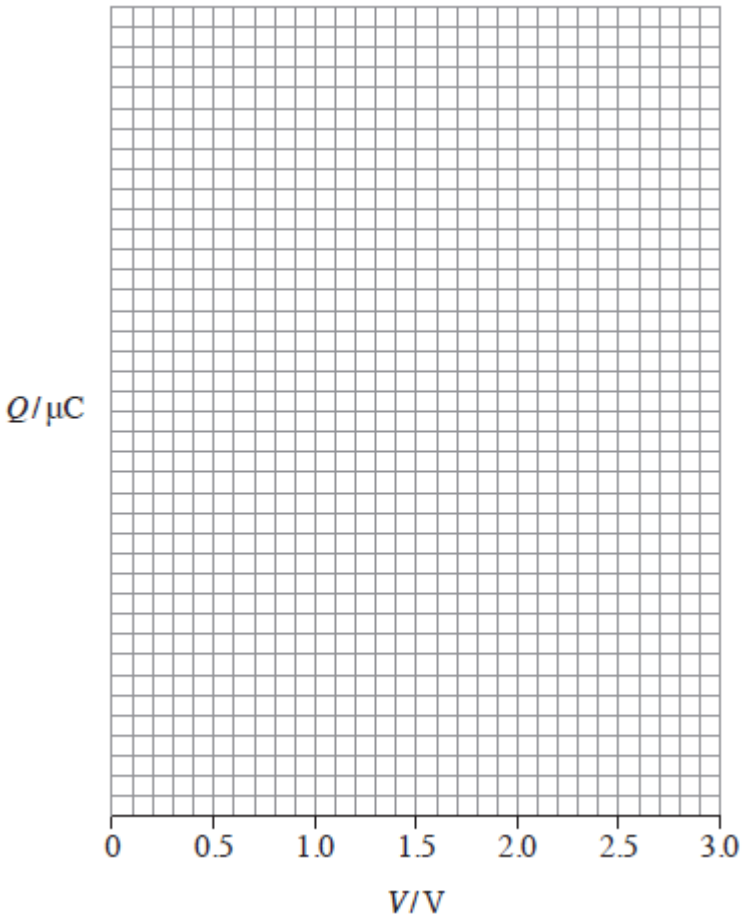
Q3. The specification for a pacemaker requires a suitable charge to be delivered in 1.4 ms. A designer uses a circuit with a capacitor of capacitance 3.0 μF and a 2.5 V power supply to deliver the charge. The designer calculates that a suitable charge will be delivered to the heart as the capacitor discharges 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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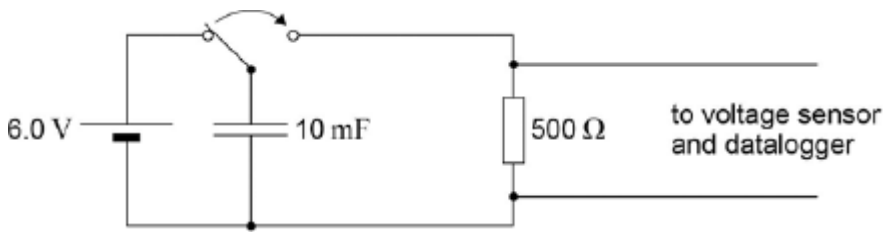
(2)

(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	⬭
B	3.8	50	⬭
C	3.8	500	⬭
D	2.2	500	⬭

(Total 1 mark)