Practice Question Set For A-Level
Subject : Physics
Paper-1 Topic :7_ Electric Field

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Student:_____
Max. Marks : 25 Marks **Time : 25 Minutes**

Q1.
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 0.50 Ω.

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

(2)

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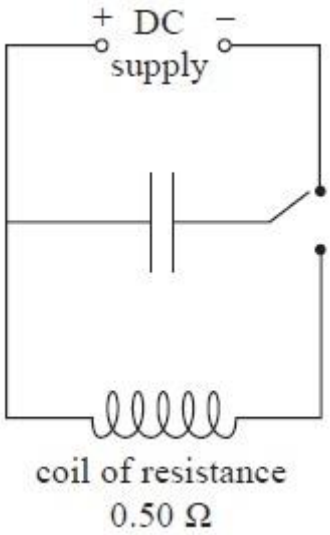
(ii) The circuit shows how a capacitor could be charged and then discharged through the coil to provide the current.



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

Explain why the capacitor is suitable.

(3)

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(b) It can be assumed that the 600 μF capacitor completely discharges in 1.4×10^{-3} 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)

Q2.

In recent years there has been a development of ultracapacitors which have much higher capacitance than traditional capacitors. Capacitors store energy due to charge in an electric field whereas batteries store energy due to a chemical reaction. There are several applications where ultracapacitors have an advantage over batteries; for example storing energy from rapidly fluctuating supplies or delivering charge very quickly.

(a) A typical ultracapacitor has a capacitance of 1500 F and a maximum operating potential difference of 2.6 V.

(i) Show that the charge on this capacitor when fully charged is about 4000 C.

(2)

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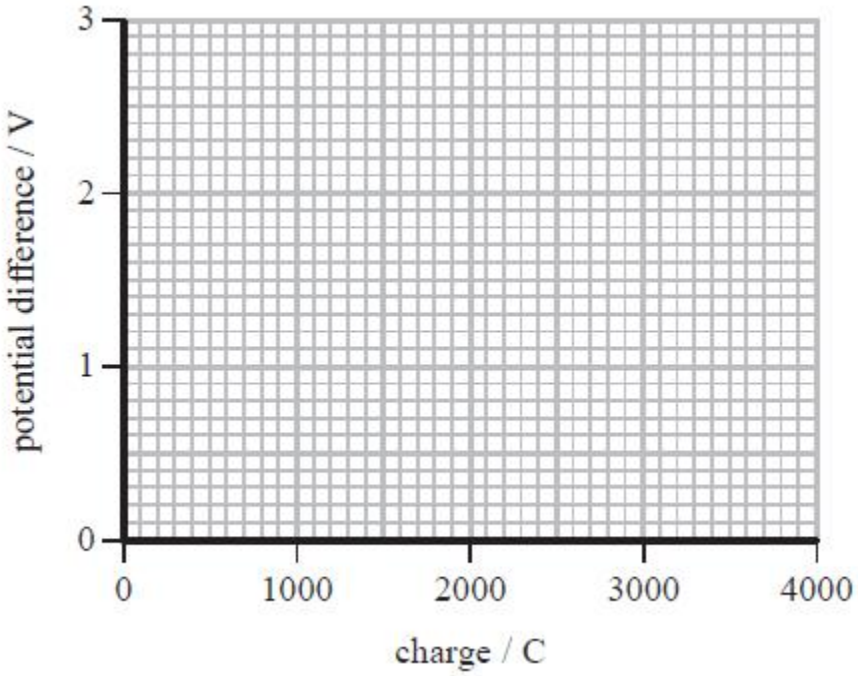
(ii) Complete the graph on the axes below to show how the potential difference varies with charge for this capacitor.

(2)



(iii) Calculate the energy stored in this capacitor when fully charged.

(2)

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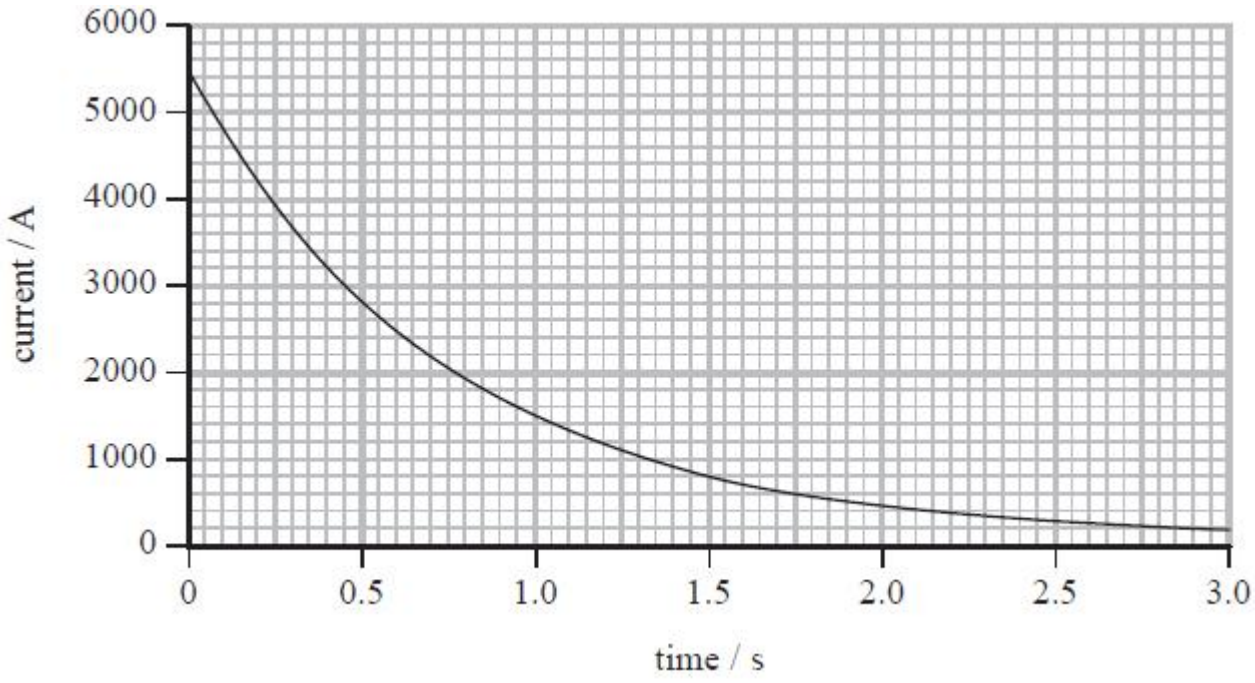
Energy = ...

(b) The graph below shows how the current varies with time as the capacitor is discharged through a circuit.



(i) Describe and explain the shape of the graph.

(2)

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(ii) Calculate the resistance of the circuit.

(4)

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Resistance = ...

(c) There is a limit to the amount of charge an ultracapacitor can hold but it can deliver the charge very quickly. A battery can deliver much more charge but only at a slower rate. For electric powered vehicles it is suggested that using a combination of batteries and ultracapacitors would give the best performance.

Suggest, with reasons, which stages of a journey would be more suited to ultracapacitors and which would be more suited to batteries.

(3)

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(Total for question = 15 marks)