Capacitors

Have a go at the following exam questions.

OCR A, G485, Jun 10

1 **(a)** Define *capacitance*.

.....

..... **[1]**

(b) Fig. 1.1 shows a circuit consisting of a resistor and a capacitor of capacitance 4.5 μF.

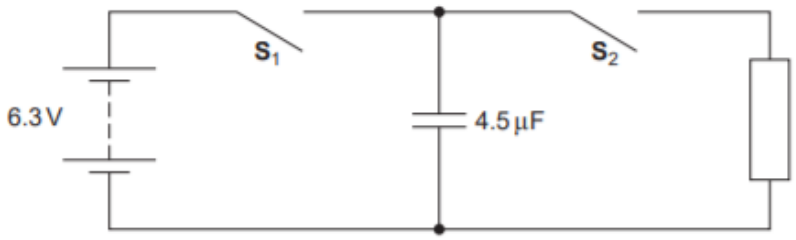


Fig. 1.1

Switch S_1 is closed and switch S_2 is left open. The potential difference across the capacitor is 6.3V.

Calculate

(i) the charge stored by the capacitor

charge = ... μC **[1]**

(ii) the energy stored by the capacitor.

energy = ... J **[2]**

(c) Switch S_1 is opened and switch S_2 is closed.

(i) Describe and explain in terms of the movement of electrons how the potential difference across the capacitor changes.

.....

.....

.....

..... **[3]**

(ii) The energy stored in the capacitor decreases to zero. State where the initial energy stored in the capacitor is dissipated.

.....

..... **[1]**

(d) Fig.1.2 shows the 4.5 μF capacitor now connected in parallel with a capacitor of capacitance 1.5 μF. Both switches are open and both capacitors are uncharged.

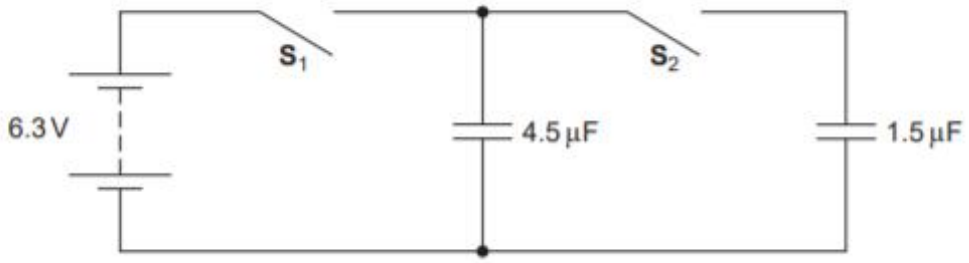


Fig. 1.2

Switch S_1 is closed. The potential difference across the 4.5 μF capacitor is now 6.3V. Switch S_1 is opened and then switch S_2 is closed.

(i) Calculate the total capacitance of the circuit when S_2 is closed.

capacitance = ... μF **[1]**

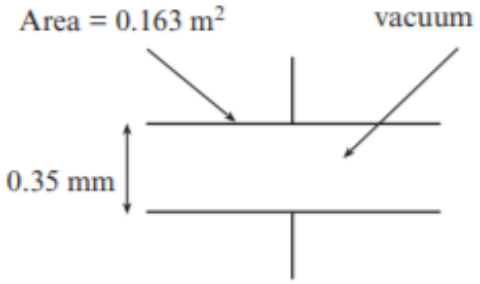
(ii) Calculate the final potential difference across the capacitors.

potential difference = ... V **[2]**

[Total: 11]

A3. *(a)* Calculate the capacitance of the capacitor shown. [2]

$$C = \frac{\varepsilon_0 A}{d}$$



(b) The capacitor is charged so that there is a p.d. of 1.2 kV across the plates. Calculate

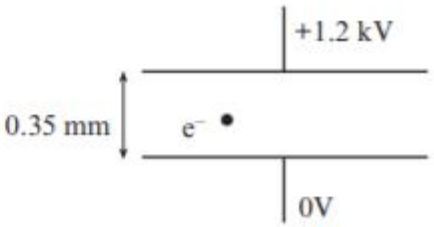
(i) the charge stored, [1]

(ii) the energy stored in the capacitor. [1]

(c) The capacitor is discharged through a 670 kΩ resistor. Calculate the time the capacitor takes to lose half its charge. [3]

(d) Explain briefly whether or not the time the capacitor takes to lose half its energy is longer or shorter than your answer to *(c)*. [2]

(e) An electron is located between the plates of the charged capacitor. Show that the acceleration experienced by the electron is approximately $6 \times 10^{17}\ m\,s^{-2}$. [3]



(f) The electron starts from rest halfway between the plates.

(i) Use the acceleration ($6 \times 10^{17}\ m\,s^{-2}$) to calculate the speed of the electron when it strikes the upper plate of the capacitor. [2]

(ii) Show that the speed of the electron (when it strikes the upper plate of the capacitor) corresponds to a kinetic energy of 0.6 keV and explain briefly another method for obtaining this answer of K.E. = 0.6 keV. [3]

(iii) Calculate the time the electron takes to travel to the upper plate. [3]

Edexcel IAL, Unit 4, Jun 2011

13 A student needs to order a capacitor for a project. He sees this picture on a web site accompanied by this information: capacitance tolerance ±20%.

Taking the tolerance into account, calculate

(a) the maximum charge a capacitor of this type can hold.

(3)

Maximum charge = ...

(b) the maximum energy it can store.

(2)

Maximum energy = ...

(Total for Question 13 = 5 marks)