1 (a) Define the capacitance of a capacitor.

_____

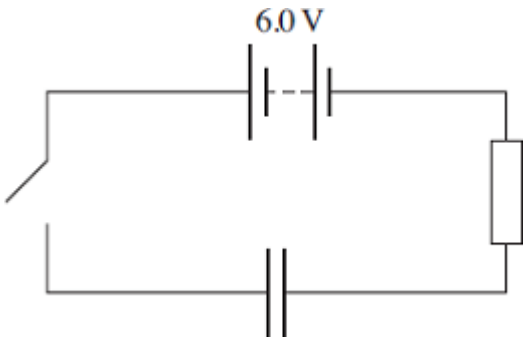
_____

_____

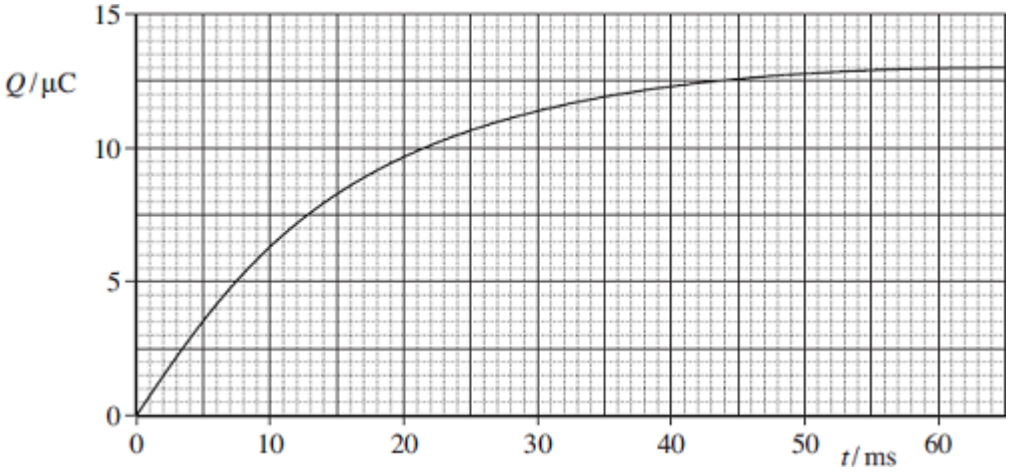
_____

(2)

(b) The circuit shown in the figure below contains a battery, a resistor, a capacitor and a switch.



The switch in the circuit is closed at time $t = 0$. The graph shows how the charge Q stored by the capacitor varies with t.



(b) (i) When the capacitor is fully charged, the charge stored is 13.2 μC. The electromotive force (emf) of the battery is 6.0 V. Determine the capacitance of the capacitor.

answer = _____ F

(2)

(ii) The time constant for this circuit is the time taken for the charge stored to increase from 0 to 63% of its final value. Use the graph to find the time constant in milliseconds.

answer = _____ ms

(2)

(iii) Hence calculate the resistance of the resistor.

answer = _____ Ω

(1)

(iv) What physical quantity is represented by the gradient of the graph?

_____

_____

(1)

(c) (i) Calculate the maximum value of the current, in mA, in this circuit during the charging process.

answer = _____ mA

(1)

(ii) Sketch a graph on the outline axes to show how the current varies with time as the capacitor is charged. Mark the maximum value of the current on your graph.

(2)

(Total 11 marks)

2 (a) State the **three** factors upon which the capacitance of a parallel plate capacitor depends.

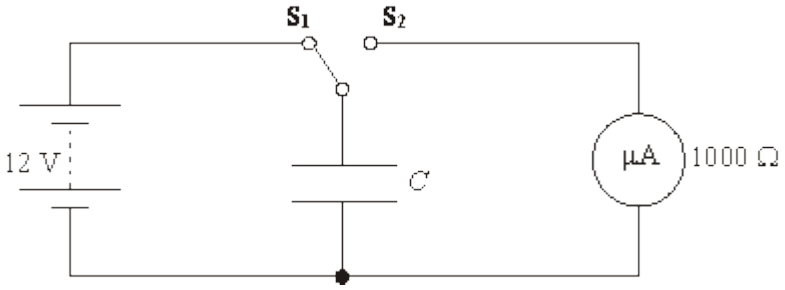
_____

_____

_____

(2)

(b) The figure below shows a circuit for measuring the capacitance of a capacitor.



The switch is driven by a signal generator and oscillates between S_1 and S_2 with frequency *f*.

When the switch is in position S_1 the capacitor charges until the potential difference across it is equal to the supply emf. When the switch moves to position S_2 the capacitor discharges through the microammeter which has a resistance of 1000 Ω.

In one experiment a 0.047 μF capacitor is used with a 12 V supply.

(i) Calculate the charge stored by the capacitor when the switch is in position S_1.

(2)

(ii) Calculate the time for which the switch must remain in contact with S_2 in order for the charge on the capacitor to fall to 1% of its initial charge.

(3)

(iii) Assuming that the capacitor discharges all the stored charge through the microammeter, calculate the reading on the meter when the switch oscillates at 400 Hz.

(1)

(Total 8 marks)

3 A capacitor of capacitance C has a charge of Q stored on the plates. The potential difference between the plates is doubled.

What is the change in the energy stored by the capacitor?

A $\frac{Q^2}{2C}$ ⬭

B $\frac{Q^2}{C}$ ⬭

C $\frac{3Q^2}{2C}$ ⬭

D $\frac{2Q^2}{C}$ ⬭

(Total 1 mark)

4 A parallel-plate capacitor has square plates of length l separated by distance d and is filled with a dielectric.

A second capacitor has square plates of length $2l$ separated by distance $2d$ and has air as its dielectric.

Both capacitors have the same capacitance.

What is the relative permittivity of the dielectric in the first capacitor?

A $\frac{1}{2}$ ⬭

B 1 ⬭

C 2 ⬭

D 8 ⬭

(Total 1 mark)

5 A parallel-plate capacitor is fully charged and then disconnected from the power supply.
A dielectric is then inserted between the plates.

Which row correctly identifies the charge on the plates and the electric field strength between the plates?

	Charge	Electric field strength	
A	Stays the same	Increases	⬭
B	Increases	Decreases	⬭
C	Increases	Increases	⬭
D	Stays the same	Decreases	⬭

(Total 1 mark)