Name of the Student:_____
Max. Marks : 22 Marks **Time : 22 Minutes**

Q1.

(a) A capacitor is marked '2200 μF 15 V'.

(i) Explain what is meant by a capacitance of 2200 μF.

_____

_____

(2)

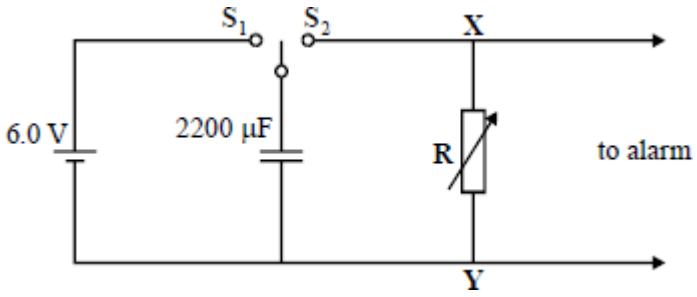
(ii) What is the significance of the 15 V marking?

_____

_____

(1)

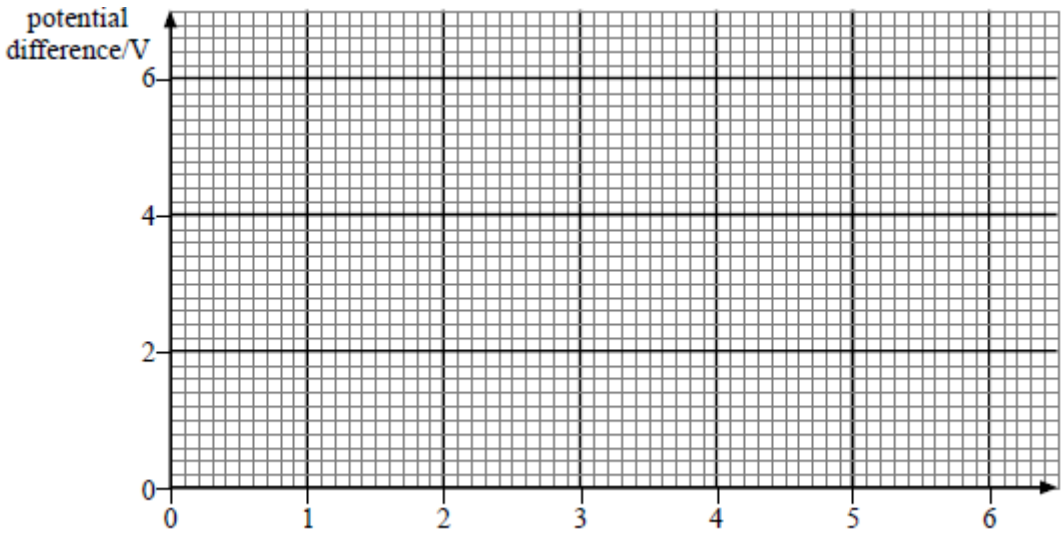
(b) An egg-timer is designed to produce a sound when an egg has been boiled for a sufficient time. The time which elapses before the alarm sounds is controlled by the circuit shown below. The circuit is operated from a 6.0 V cell of negligible internal resistance.



The time is set by means of the variable resistor **R**.

The capacitor is charged by moving the two-way switch to position $\mathbf{S_1}$ for a short time. The timing is then started automatically when the two-way switch is moved to position $\mathbf{S_2}$. An alarm rings when the potential difference between terminals **XY** reaches 2.0 V.

(i) In one setting the time constant of the circuit when the capacitor is discharging is 3.0 minutes. Sketch a graph to show how the potential difference between the terminals **X** and **Y** varies with time for the first 6.0 minutes after the switch moves to the position $\mathbf{S_2}$.



(2)

(ii) How long after timing commences will the alarm sound for the setting in part (i)?

_____

(1)

(iii) Calculate the resistance of the variable resistor when the time constant is 3.0 minutes.

(2)

(iv) The system is designed to measure cooking times up to 5.0 minutes. Determine the maximum value of the resistance **R** that is needed.

(2)

(v) State how a suitable capacitor would be connected to increase the measurable cooking time.

_____

_____

(1)

(Total 11 marks)

Q2.

(a) (i) A label on a capacitor shows it to have a capacitance of 0.020 F. Explain what this tells you about the capacitor.

_____

_____

(1)

(ii) Sketch on **Figure 1** the graph that shows how the charge on the 0.020 F capacitor varies with the potential difference across it over the voltage range given. Insert an appropriate scale on the charge axis.

(2)

(iii) Explain how your graph could be used to obtain the energy stored for a given potential difference.

_____

_____

_____

(2)

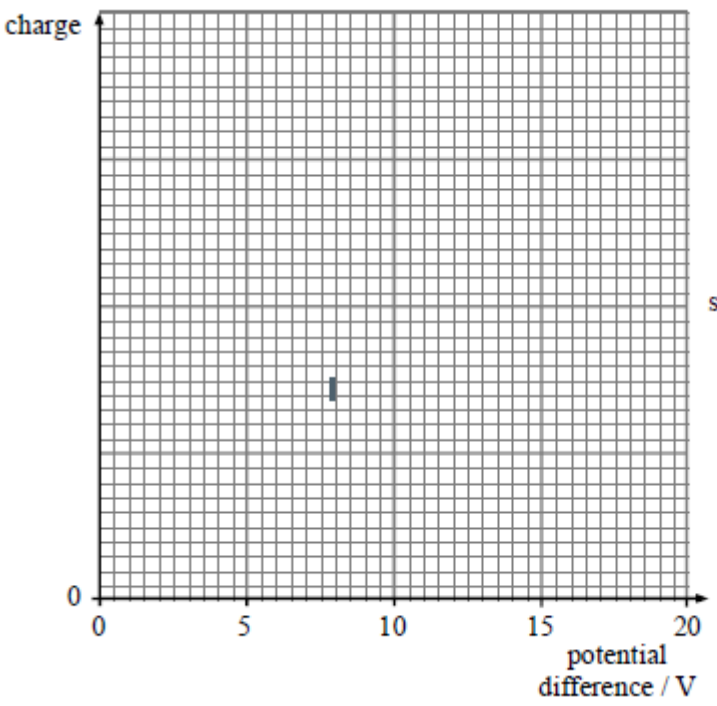


Figure 1

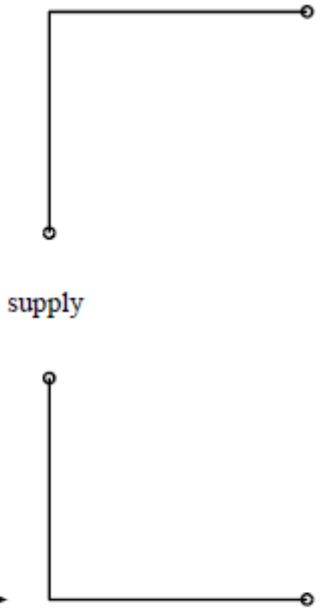


Figure 2

(iv) Show on **Figure 2** how **two** similar capacitors could be connected to a supply to store more energy for the same potential difference.

(1)

(b) **Figure 3** shows one 0.020 F capacitor connected to a 20 V supply. By means of the changeover switch **S**, the capacitor is disconnected from the supply and connected to a small motor. The motor lifts an object of mass 0.15 kg through a height of 0.80 m, after which the energy left in the capacitor is negligible.

acceleration of free fall, g = 9.8 m s^{-2}

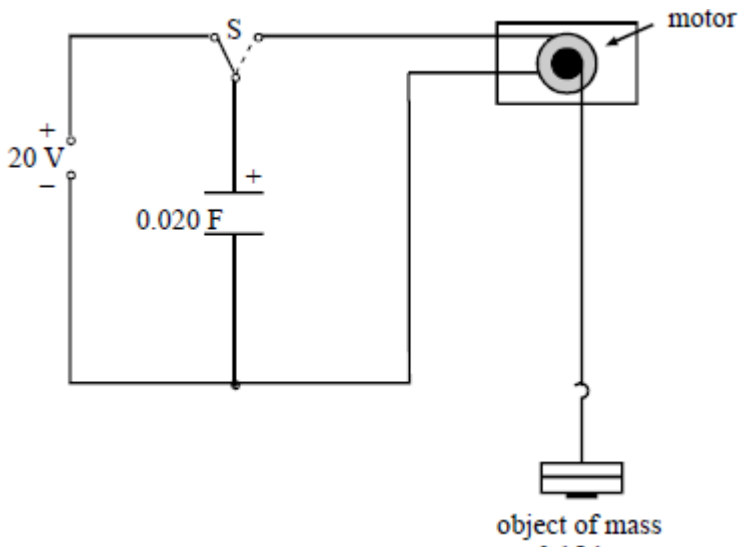


Figure 3

Calculate:

(i) the initial energy stored by the capacitor;

(2)

(ii) the efficiency of the energy conversion.

(3)
(Total 11 marks)