OCR

A Level

A Level Physics

Capacitors

Name:

MME

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Total Marks: /30

1. George wishes to explore the rules for multiple capacitors. To do this, he constructs a circuit using three: C_1 is connected in series with C_2; these are both connected in parallel with C_3. All are connected to a 6 V power supply. $C_1 = 10 \ \mu F, C_2 = 20 \ \mu F$ and $C_3 = 50 \ \mu F$.

Total for Question 1: 13

(a) Explain in terms of the flow of electrons how a potential difference is built up across a capacitor. [3]

(b) Outline a different experiment George could perform to confirm the rule for capacitance in series circuits. Include a circuit diagram. [3]

(c) Calculate the following for George's circuit.

    i. The total capacitance of the circuit. [3]

    ii. The reading on a voltmeter placed across capacitor 1. [3]

    iii. The reading on a voltmeter placed across capacitor 2. [1]

2.

(a) What is represented by the area underneath a graph of the potential difference across a resistor against the charge stored by it? [1]

(b) From the equation $W = \frac{1}{2}QV$, derive two other equations for the energy stored in capacitor. One should not include the term V and one should not include the term Q. [3]

(c) State the effect of each of the following on the energy stored by a capacitor. [2]

    i. Doubling the potential difference across it.

    ii. Halving the capacitance.

3. Ella charges a 50 μF capacitor using a 6 V power supply. She then discharges it through a resistor of resistance R (connected in parallel).

(a) Outline an experiment that Ella could perform to demonstrate the discharge characteristics of a capacitor when it is discharging through a resistor. Include a circuit diagram. [3]

(b) After 10 s, the charge has reduced by 99 μC from its initial value of 300 μC. Calculate R. [2]

(c) Calculate the current in the circuit 2τ after the switch has been turned on. [2]

(d) Once it has completely discharged, Ella recharges the capacitor using the same 6 V power supply. Calculate the potential difference across the capacitor after 5 s. [2]

(e) Sketch, on a single set of axes, the variation of V_c, V_R and V_0 with time during charging. V_C, V_R and V_0 are the potential differences across the capacitor, the resistor and the power supply respectively. [2]