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

## Q1.

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

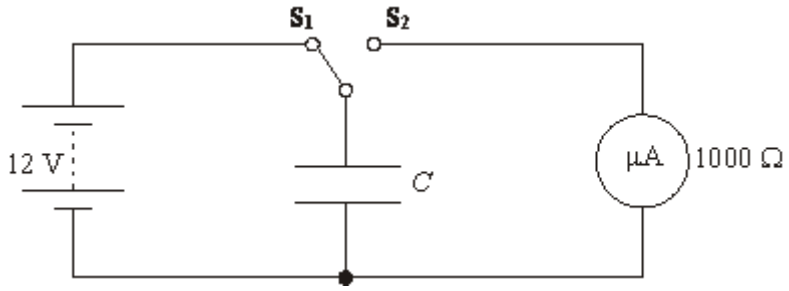
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**(2)**

(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 $\mathbf{S_1}$ and $\mathbf{S_2}$ with frequency *f*.

When the switch is in position $\mathbf{S_1}$ the capacitor charges until the potential difference across it is equal to the supply emf. When the switch moves to position $\mathbf{S_2}$ 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 $\mathbf{S_1}$.

**(2)**

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

**(3)**

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(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)**

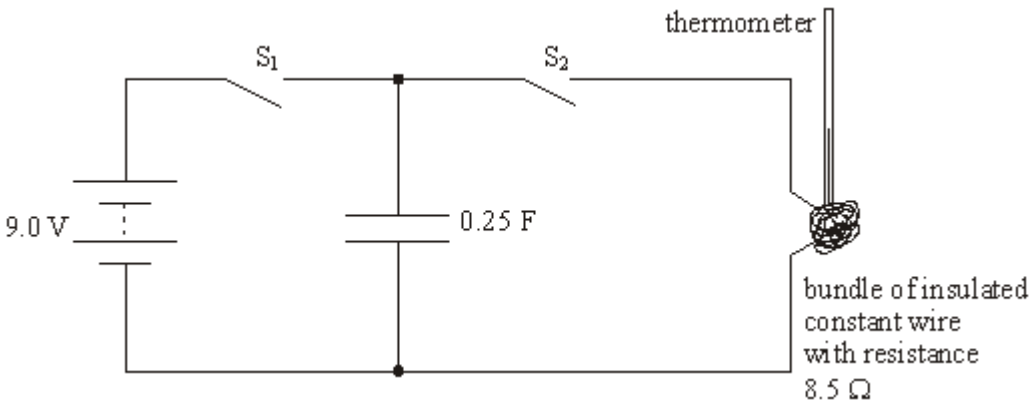
**(Total 8 marks)**

## Q2.

(a) A 500 µF capacitor and a 1000 µF capacitor are connected in series. Calculate the total capacitance of the combination.

**(2)**

(b) The figure below shows a diagram of an arrangement used to investigate the energy stored by a capacitor.




The bundle of constantan wire has a resistance of 8.5 Ω. The capacitor is initially charged to a potential difference of 9.0 V by closing $\mathbf{S_1}$.

(i) Calculate the charge stored by the 0.25 F capacitor.

(ii) Calculate the energy stored by the capacitor.

(iii) Switch $\mathbf{S}_1$ is now opened and $\mathbf{S}_2$ is closed so that the capacitor discharges through the constantan wire. Calculate the time taken for the potential difference across the capacitor to fall to 0.10 V.

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**(7)**

(c) The volume of constantan wire in the bundle in the figure above is $2.2 \times 10^{-7}$ $m^3$.

density of constantan = 8900 kg $m^{-3}$

specific heat capacity of constantan = 420 J $kg^{-1}$ $K^{-1}$

(i) Assume that all the energy stored by the capacitor is used to raise the temperature of the wire. Use your answer to part (b)(ii) to calculate the expected temperature rise when the capacitor is discharged through the constantan wire.

(ii) Give **two** reasons why, in practice, the final temperature will be lower than that calculated in part (c)(i).

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**(5)**

**(Total 14 marks)**

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