

6 (a) Two parallel plate capacitors C_1 and C_2 are connected to a supply that has a potential difference (p.d.) V_S . The capacitors may be connected in series or in parallel.

The supply provides charge Q_S and the plates of the two capacitors acquire charges Q_1 and Q_2 respectively. The p.d.s across the plates of the capacitors are V_1 and V_2 respectively.

Complete Table 6.1 to indicate how Q_S , Q_1 and Q_2 relate to each other, and how V_S , V_1 and V_2 relate to each other, for series and parallel connections of the capacitors to the supply.

Table 6.1

	relationship between charges	relationship between p.d.s
series		
parallel		

[4]

(b) An isolated capacitor of capacitance $470\text{ }\mu\text{F}$ stores 19 mJ of energy.

(i) Calculate the p.d. across the capacitor.

p.d. =V [2]

(ii) Calculate the charge on the capacitor.

charge = C [2]

(iii) The capacitor is now connected in parallel with a capacitor of capacitance $180\text{ }\mu\text{F}$ that is initially uncharged.

Determine the total energy, in mJ, now stored in the two capacitors.

energy = mJ [3]

[Total: 11]

- 5 (a)** A capacitor of capacitance C_1 is connected in series with a second capacitor of capacitance C_2 .

Show that the combined capacitance C of the two capacitors is given by

$$\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2}.$$

[2]

- (b)** Three identical capacitors, each of capacitance C , are connected in a network as shown in Fig. 5.1.

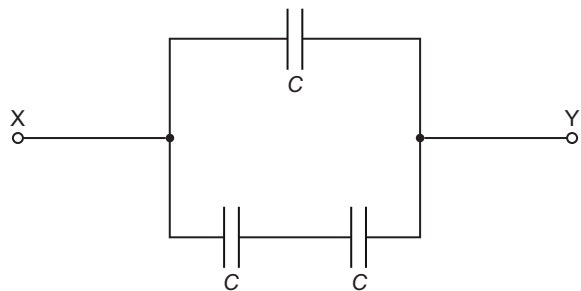


Fig. 5.1

The variation of the charge Q with the potential difference (p.d.) V between the terminals X and Y is shown in Fig. 5.2.

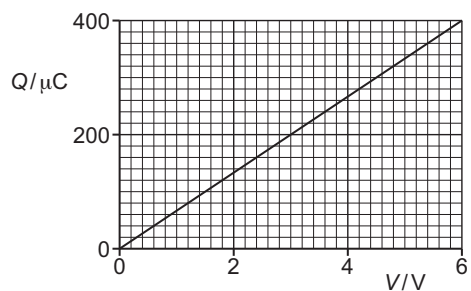


Fig. 5.2

Show that C is equal to $44\ \mu\text{F}$.

[3]

- (c)** The capacitor network in Fig. 5.1 is charged and then connected to a resistor of resistance $54\ \text{k}\Omega$. The capacitor network discharges through the resistor.

- (i)** Determine the time constant τ of the circuit. Give a unit with your answer.

$\tau = \dots\dots\dots$ unit $\dots\dots\dots$ [2]

- (ii)** Determine the time taken for the discharge current to reduce to 15% of the initial discharge current.

time = $\dots\dots\dots$ s [2]

[Total: 9]