

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 $470\mu\text{F}$ 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 $180\mu\text{F}$ that is initially uncharged.

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

energy = mJ [3]

[Total: 11]

- 4 (a) Three capacitors are connected as shown in Fig. 4.1.

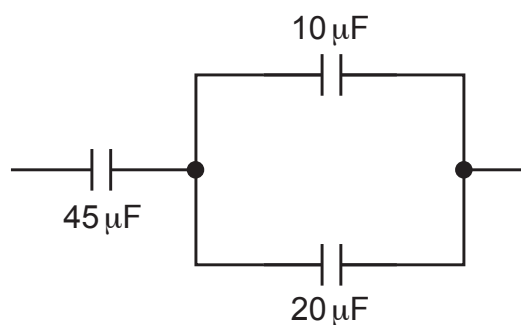


Fig. 4.1

Determine the total capacitance, in μF , of the network of three capacitors.

capacitance = μF [2]

- (b) A capacitor of capacitance $45\ \mu\text{F}$ is connected to a variable power supply initially set at $8.0\ \text{V}$. The output of the power supply increases so that the potential difference (p.d.) across the capacitor increases to $9.6\ \text{V}$.

Calculate the increase in energy ΔE stored in the capacitor.

$\Delta E = \dots\dots\dots\ \text{J}$ [2]

- (c) A sinusoidal a.c. power supply is connected to the input of a bridge rectifier. The output of the rectifier is connected to a load resistor.

- (i) Complete the circuit in Fig. 4.2 by adding a capacitor to smooth the p.d. across the load resistor.

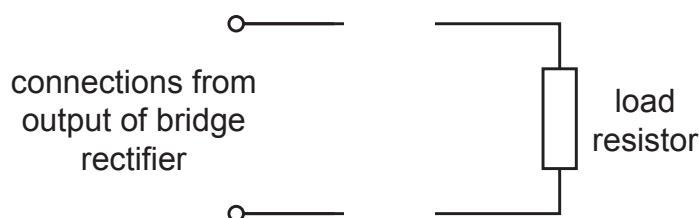


Fig. 4.2

- (ii) The variation with time t of the p.d. V of the smoothed output is shown in Fig. 4.3.

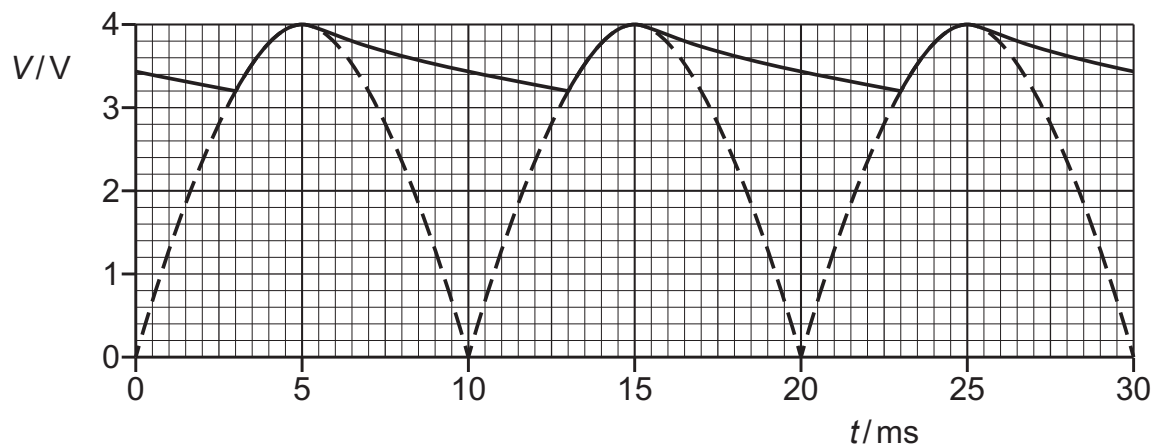


Fig. 4.3

Determine the time constant, in ms, of the smoothing circuit.

time constant = ms [3]

- (d) A sinusoidal a.c. power supply has a maximum power of 16 W.

State the value of the mean power when the output of the power supply is:

- (i) full-wave rectified

mean power = W [1]

- (ii) half-wave rectified.

mean power = W [1]

[Total: 10]

- 5 A capacitor, a battery of electromotive force (e.m.f.) 12V, a resistor R and a two-way switch are connected in the circuit shown in Fig. 5.1.

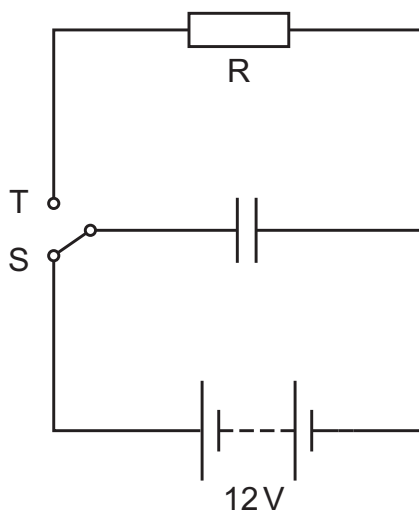


Fig. 5.1

The switch is initially in position S. When the capacitor is fully charged, the switch is moved to position T so that the capacitor discharges. At time t after the switch is moved the charge on the capacitor is Q .

The variation with t of $\ln(Q/\mu\text{C})$ is shown in Fig. 5.2.

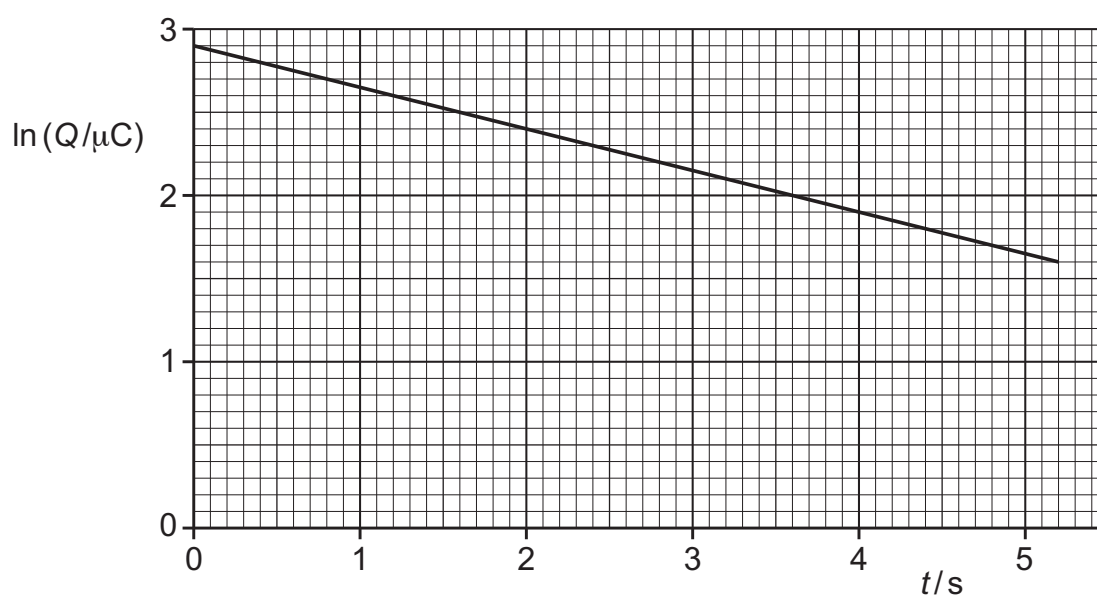


Fig. 5.2

- (a) Show that the capacitance of the capacitor is $1.5\mu\text{F}$.

(b) Determine the resistance of R.

resistance = Ω [3]

(c) Calculate the energy stored in the capacitor at time $t = 0$.

energy = J [2]

(d) A second identical resistor is now connected in parallel with R.

The switch is initially in position S. When the capacitor is fully charged, the switch is moved to position T so that the capacitor discharges. At time t after the switch is moved the charge on the capacitor is Q .

On Fig. 5.2, sketch a line to show the variation of $\ln(Q/\mu\text{C})$ with t between time $t = 0$ and time $t = 5.0$ s. [2]

[Total: 10]