Unit 22 · Capacitors

HARDER PRACTICE QUESTIONS

Full marks 28

Write your answers on separate paper. Show your working. Take $\varepsilon_0 = 8.85 \times 10^{-12}$ F/m.

1 Spot the error [3]

Find the mistake in the working and correct it.

Bipana needed the combined capacitance of a 6 μF and a 12 μF capacitor joined in series. She wrote:
"In series things add, so C = 6 + 12 = **18 μF**."

2 Check the readings [3]

Kushal charged a capacitor to different voltages and measured the charge each time:

V (V)	2	4	6	8	10
Q (μC)	94	188	282	340	470

Find the capacitance. Which reading is wrong, and what should it have been?

3 What if? [4]

A 4.0 μF capacitor is charged to 12 V, disconnected, and then joined across an uncharged 2.0 μF capacitor.

i. Find the common p.d. after they are joined.
ii. Find the energy stored before and after.
iii. Where has the missing energy gone?

4 Design it [3]

Ashish needs a 6 μF capacitor that can take 400 V, but he has only 4 μF capacitors rated at 250 V. Design a combination using as few as possible, and show it works.

5 Estimate it [2]

How large would the plates of a 1 F parallel-plate capacitor with an air gap of 1.0 mm have to be? Compare it with something you know.

6 Predict, then explain [3]

Write your prediction first, then explain it.

A capacitor is charged by a battery and then disconnected. Its plates are then pulled twice as far apart. Predict what happens to its charge, its p.d. and the energy it stores. Then explain where any extra energy comes from.

7 Reading a graph [3]

A graph of the p.d. across a capacitor against the charge on it is a straight line through the origin reaching 25 V at 500 μC.

i. Find the capacitance.
ii. Find the energy stored at 500 μC from the graph.
iii. How much more energy is stored when the charge goes from 500 μC to 1000 μC?

8 Correct the misconceptions [3]

The paragraph has three mistakes. Write each mistake and correct it.

> Riya wrote: “A charged capacitor stores extra electrons, so its total charge is negative. The capacitance of a capacitor rises when the voltage across it is raised. Current flows through the dielectric while the capacitor charges.”

9 Think [2]

A thinner dielectric gives a larger capacitance. Why don't makers make the dielectric as thin as they possibly can?

10 Make your own [2]

Using any capacitors of your choice (no more than four), make a combination with a capacitance of exactly 3 μF. Draw it and show that it works.