# On capacitors

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## Warm-up problems

1. Draw a labelled diagram of a simple capacitor comprising two metal plates, and explain how it works.

2. Give the definition of capacitance, its SI unit, and what it is **usually** measured in (i.e. what unit would you see written on a capacitor and how and why is it different from the standard SI unit?)

## Regular problems

3. What is the charge stored when the voltage across

   (a) a 100 000 µF capacitor is 10 V,

   (b) a 50 µF capacitor is 9 V?

4. Two parallel metal plates are set up opposite each other. One plate is charged and the other plate is earthed. What happens to the capacitance and the potential if

   (a) the plates are brought closer together but the overlapping area is kept the same?

   (b) the plates are kept the same distance apart but the area of overlap of the plates is increased?

   (c) the plates have a piece of wax inserted between them?

5. What is the capacitance of a capacitor which stores 12 µC of charge when connected to a 12 V battery?

6. Work out the voltage across the plates of a 10 µF capacitor when it has a charge of 50 µC.

## Extension problems

7. (from *Advanced questions on Everyday physics*, Susan Williams) Read the following passage and answer the questions that follow

   > Early experimenters with electrostatic machines regarded working with electricity as an interesting activity which generated showy demonstrations but which would never have any real use! They did discover, however, that they could achieve much bigger sparks if they incorporated a long rod of iron into

their design. Somehow it seemed to allow them to build up more charge before a spark developed. This idea of storing charge was developed by Pieter van Musschenbroek, who stored charge in a hand held bottle of water containing a brass wire. This ideas was later developed into the *Leyden jar*, which comprise a glass jar with an inner and outer coating of metal foil.

(a) What was happening when the experimenters used an iron rod? Discuss.

(b) The *Leyden jar* was one of the earliest forms of capacitor. Explain how it worked in terms of what you know about capacitors.

(c) How do you think the design and use of the Leyden jars was improved to give bigger sparks?

(d) Imagine you have six Leyden jars. To get the maximum possible charge stored. do you connect them in series or parallel? Justify your answer.