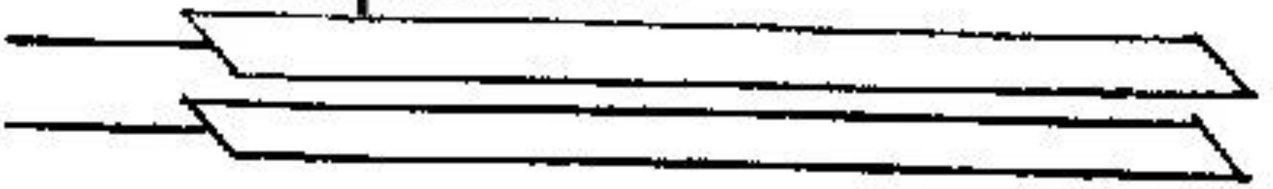
Transmission Line

Capacitor



Spot the difference

Advanced Level Physics

Third edition with SI units

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chapter thirty-one

Capacitors

A capacitor (or 'condenser'), is a device for storing electricity. The earliest capacitor was invented—almost accidentally—by van Musschenbroek of Leyden, in about 1746, and became known as a Leyden jar. A present-day form of it is shown in Fig. 31.1 (i). J is a glass jar, FF are tin-foil coatings over the lower parts of its walls, and T is a knob connected to the inner coating. Modern forms of capacitor are shown at (ii) and (iv) in the figure. Essentially, all capacitors consist of two metal plates separated by an insulator. The insulator is called the dielectric; in some capacitors it is oil or air. Fig. 31.1 (iii) shows the conventional symbol for a capacitor.

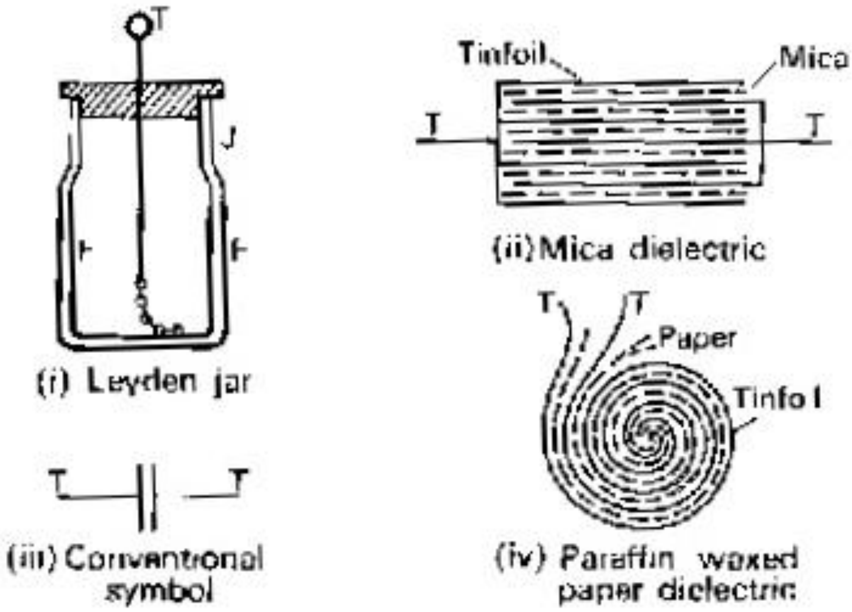


FIG. 31.1. Types of capacitor.

Charging a Capacitor

To study the action of a capacitor we need a paper one of about 4 microfarad capacitance (see later), a couple of high-tension batteries D and a high impedance voltmeter V such as a valve voltmeter reading to about 300 volts. We also need a two-way key (K in Fig. 31.2) and a poor conductor (R). The latter is a short stick of powdered and compressed carbon; it is called a radio resistor, and should have a resistance of about 5 megohms (p. 790). We connect the batteries in series, and measure their total voltage, V_0, with the voltmeter (Fig. 31.2 (i)). We then connect up all the apparatus as shown in Fig. 31.2 (ii). If we close

Is (iv) a "Type of Transmission Line"? February 2013.

Another book. Added 28 february 2017. Ivor Catt.

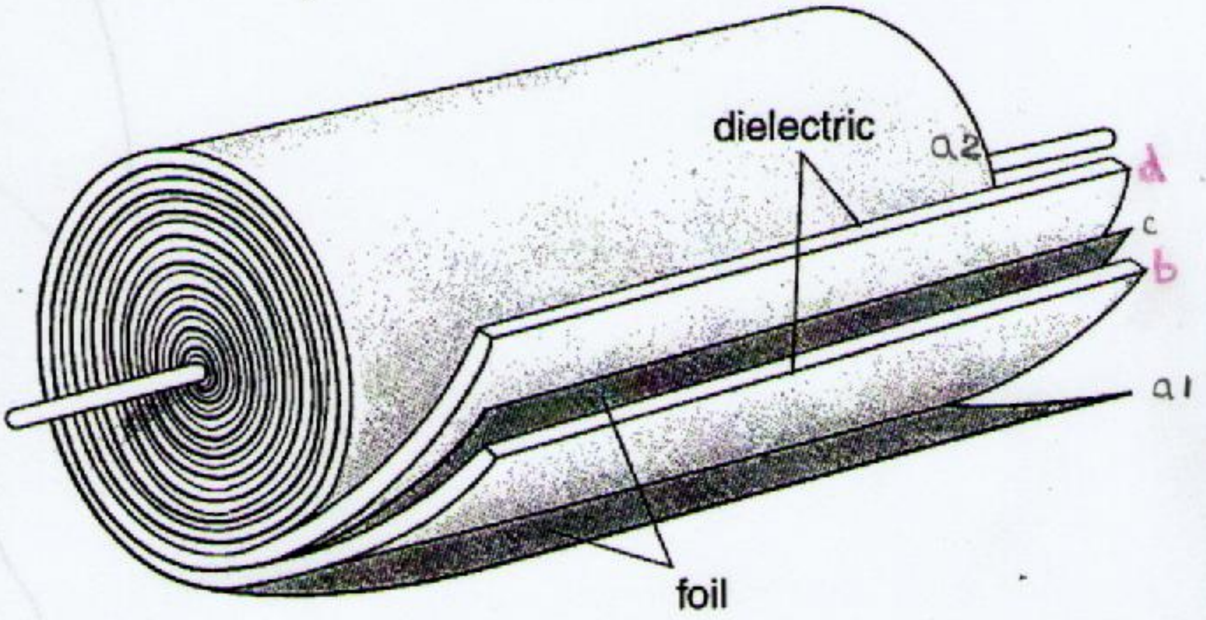
“Advanced Physics through diagrams” – Stephen Pople

For A Level Physics students (17 years old).

Oxford University Press. 2001.

a2 should be black

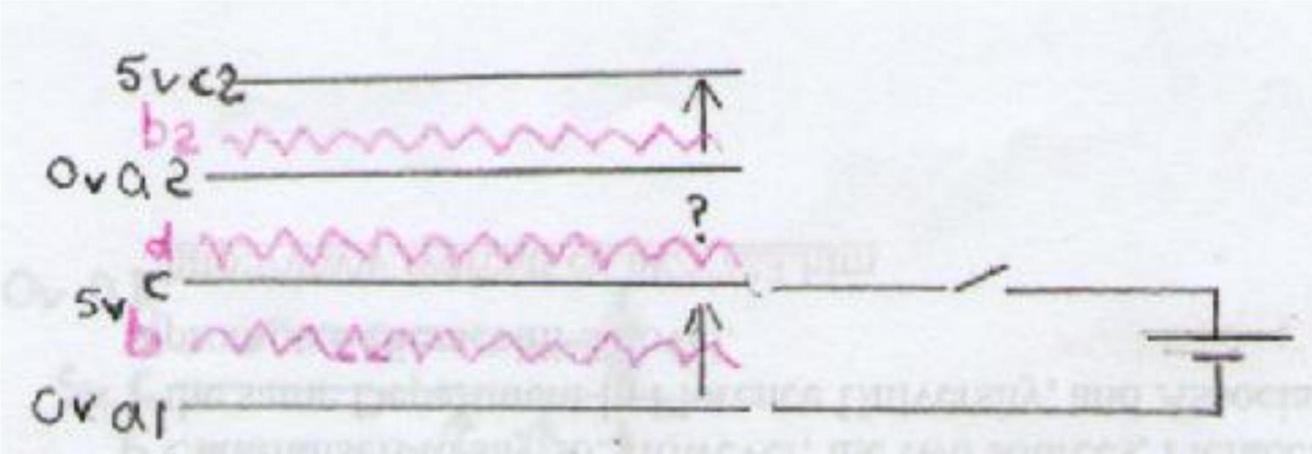
Practical capacitors



Equation (3) shows that, for a high *C*, a capacitor needs a high *A*, high ε_r, and low *d*. In practice, this is achieved by rolling up two long strips of foil with a thin dielectric between them.

In ***electrolytic capacitors***, the dielectric is formed by the chemical action of a current. This gives a very thin dielectric, and a very high capacitance. But the capacitor must always be used with the same plate positive, or the chemical action is reversed.

Capacitors have a ***maximum working voltage*** above which the dielectric breaks down and starts to conduct.



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There are two transmission lines. Energy is introduced into the bottom one a1/c, amplitude 5v and proceeds in this transmission line. It comes back round in the a2/c transmission line. No energy is introduced in the upper, second transmission line c/a2. There is a voltage difference between them, but no electric field, and no ExH or perhaps (½)CV^2 energy. In the case of high frequency input, not from a battery, this is easily explained by skin effect. The energy introduced means electricity is in/on the top surface of a1 and the bottom surface of c. The top surface of c, like the bottom surface of a2, is at 0v.

To summarise. For a high frequency input, the bottom surface of c is alternating voltage, but its top surface is at 0v.

But what about DC from a battery? The bottom surface of c stays at 5v, and the top surface stays at 0v. There is a steady 5v drop from bottom to top of the thin metal .

12 March 2017. Solution, below.

At the centre, the lower dielectric must be wrapped round to become the upper dielectric, or the metal conductors a, c would be shorted together at the centre. Thus, energy entering the capacitor between a and c only gets into the upper dielectric, between c and a, after it has travelled to the centre of the capacitor and back. Both dielectric sheets end up with energy within them. Because a short at the centre must be avoided, there is no possibility that only half the capacitance comes into play.