

Digital Coulombmeter

Description

The Digital Coulombmeter operates in the same way as a gold leaf electroscope or an electrometer d.c. amplifier set in the charge measuring mode.

The coulombmeter uses a high impedance voltmeter to measure the potential difference across a known capacitance in the meter. As the quantity of charge is proportional to the capacitance and the voltage, then an accurate measurement of charge can be made.

Battery

A 9V battery of the 6LR61 (PP3) type is required to operate the instrument. Access to the battery compartment is obtained by removal of the back panel of the case. When fitting the battery, care should be taken to ensure correct polarity.

Operation

In electrostatics experiments, the capacitance of charged objects is generally low and when they are connected to the coulombmeter, almost all the charge is transferred. The high input capacitance of the coulombmeter ($4.7\mu\text{F}$) is much greater than that of a conventional electrometer d.c. amplifier set in the charge measuring mode and as such enables accurate measurements of charge to be made from external capacitances of up to approximately $0.22\mu\text{F}$.

Simple electrostatics experiments

1. Insert the charge plate supplied into the red socket of the coulombmeter and connect the black socket to a good earthing point (e.g. a metal water tap or water pipe). Connect a lead with 4mm plugs to the black socket. The free end of the lead can then be used to easily short-circuit the coulombmeter sockets to zero the reading.

2. Charge a polythene rod by rubbing and hold it approximately 50mm from the charge plate. The coulombmeter will indicate a negative charge. Remove the rod and the meter reading will fall to zero. If the rod is well charged and brought close to the charge plate, small sparks may be heard and charge will be transferred to the charge plate leaving a permanent reading on the meter when the rod is removed.

3. The experiment can be repeated with an acetate rod in which case a positive charge will be transferred to the coulombmeter. The quantitative results obtained using the coulombmeter enable the charging effectiveness of different materials and methods to be investigated.

Charging the Coulombmeter by induction

1. Hold a charged rod near to the charge plate. This will induce a charge separation at the charge plate and hence at the plates of the internal capacitor.

2. With the charged rod still in position, use the flying lead to short circuit the coulombmeter sockets and zero the meter. Remove the short circuit and the meter reading will remain zero.

3. Remove the rod. Most of the charge on the charge plate will transfer onto one plate of the internal capacitor since the capacitance of the charge plate is much lower than that of the coulombmeter. A charge will be attracted from earth so that the coulombmeter indicates a charge equal and opposite to the initial charge on the rod.

Determination of unknown capacitances

1. The charge on capacitors having capacitances up to approximately $0.22\mu\text{F}$ can be measured using the coulombmeter.

2. Charge the capacitor from a dry cell or suitable d.c. source. Wait for a few seconds to ensure the capacitor is fully charged.

3. Discharge the capacitor into the coulombmeter by connecting it directly to the red and black sockets.

4. The unknown capacitance can then be calculated by dividing the charge transferred by the charging voltage.

Further Information

For further information regarding use of the Digital Coulombmeter, including descriptions of experiments and demonstrations that can be performed, visit our website at <http://www.ipcel.co.uk>