CAPACITANCE

$$C = \frac{Q}{\Delta V}$$

$$\text{capacitance} = \frac{\text{magnitude of charge on each plate}}{\text{potential difference}}$$

The SI unit for capacitance is the *farad,* F, which is equivalent to a coulomb per volt (C/V). In practice, most typical capacitors have capacitances ranging from microfarads ($1\ \mu F = 1 \times 10^{-6}$ F) to picofarads ($1\ pF = 1 \times 10^{-12}$ F).

Did you know?

The farad is named after Michael Faraday (1791–1867), a prominent nineteenth-century English chemist and physicist. Faraday made many contributions to our understanding of electromagnetic phenomena.

Capacitance depends on the size and shape of the capacitor

The capacitance of a parallel-plate capacitor with no material between its plates is given by the following expression:

CAPACITANCE FOR A PARALLEL-PLATE CAPACITOR IN A VACUUM

$$C = \varepsilon_0 \frac{A}{d}$$

$$\text{capacitance} = \text{permittivity of a vacuum} \times \frac{\text{area of one of the plates}}{\text{distance between the plates}}$$

SCILINKS.
www.scilinks.org
Topic: Michael Faraday
Code: HF60955

In this expression, the Greek letter ε (epsilon) represents a constant called the *permittivity* of the medium. When it is followed by a subscripted zero, it refers to a vacuum. It has a magnitude of $8.85 \times 10^{-12}\ C^2/N{\bullet}m^2$.

We can combine the two equations for capacitance to find an expression for the charge stored on a parallel-plate capacitor.

$$Q = \frac{\varepsilon_0 A}{d} \Delta V$$

This equation tells us that for a given potential difference, ΔV, the charge on a plate is proportional to the area of the plates and inversely proportional to the separation of the plates.

Suppose an isolated conducting sphere has a radius R and a charge Q. The potential difference between the surface of the sphere and infinity is the same as it would be for an equal point charge at the center of the sphere.

$$\Delta V = k_C \frac{Q}{R}$$

Substituting this expression into the definition of capacitance results in the following expression:

$$C_{sphere} = \frac{Q}{\Delta V} = \frac{R}{k_C}$$