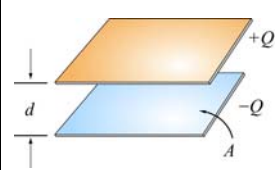
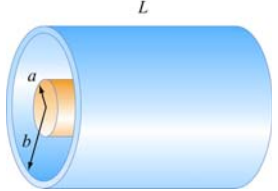
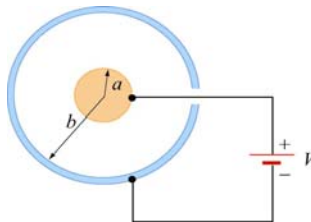
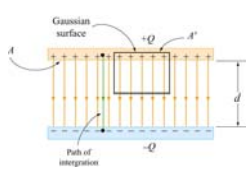
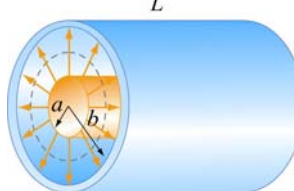
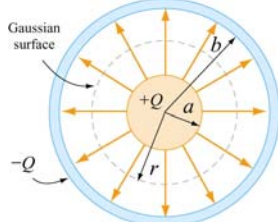


(3) Compute the electric potential difference ΔV .

(4) Calculate the capacitance C using $C = Q/|\Delta V|$.

In the Table below, we illustrate how the above steps are used to calculate the capacitance of a parallel-plate capacitor, cylindrical capacitor and a spherical capacitor.

Capacitors	Parallel-plate	Cylindrical	Spherical
Figure			
(1) Identify the direction of the electric field using symmetry			
(2) Calculate electric field everywhere	$\oiint_S \vec{E} \cdot d\vec{A} = EA = \frac{Q}{\epsilon_0}$ $E = \frac{Q}{A\epsilon_0} = \frac{\sigma}{\epsilon_0}$	$\oiint_S \vec{E} \cdot d\vec{A} = E(2\pi r l) = \frac{Q}{\epsilon_0}$ $E = \frac{\lambda}{2\pi\epsilon_0 r}$	$\oiint_S \vec{E} \cdot d\vec{A} = E_r(4\pi r^2) = \frac{Q}{\epsilon_0}$ $E_r = \frac{1}{4\pi\epsilon_0} \frac{Q}{r^2}$
(3) Compute the electric potential difference ΔV	$\Delta V = V_- - V_+ = -\int_+^- \vec{E} \cdot d\vec{s}$ $= -Ed$	$\Delta V = V_b - V_a = -\int_a^b E_r dr$ $= -\frac{\lambda}{2\pi\epsilon_0} \ln\left(\frac{b}{a}\right)$	$\Delta V = V_b - V_a = -\int_a^b E_r dr$ $= -\frac{Q}{4\pi\epsilon_0} \left(\frac{b-a}{ab}\right)$
(4) Calculate C using $C = Q/ \Delta V $	$C = \frac{\epsilon_0 A}{d}$	$C = \frac{2\pi\epsilon_0 l}{\ln(b/a)}$	$C = 4\pi\epsilon_0 \left(\frac{ab}{b-a}\right)$