

Image charges

1. For the first image charge problem that we did in class, of a charge located near a metal plate, from the electric field at the plate calculate the surface charge density, and by direct integration find the total charge on the surface of the plate.
2. A conductor has a spherical cavity of radius R inside it. Inside this sphere there is a charge $+Q$ located at a distance d from its centre, where $d < R$. Find the potential inside the cavity, and the charge density on its walls.
3. A charge $+Q$ at the origin is located between two metal plates which occupy the planes $z=+a$ and $z=-a$.

Complex functions

4. For each of the following analytic functions find the equipotentials and electric field lines, and describe the physical situation(s) that relate to it.
 - a. $f(z) = z = u(x,y) + iv(x,y)$
 - b. $f(z) = \ln(z) = \ln(re^{i\phi}) = u(r,\phi) + iv(r,\phi)$