# Sheet 2

Due date: 7 March 2014

**Exercise 1** [*Point charge in a conducting sphere*]:

(i) Consider a point charge $q$ at position $\mathbf{a}$ inside a conducting grounded ($\phi = 0$) sphere of radius $R$ ($|\mathbf{a}| < R$), and compute the electric potential $\phi$ and the electric field inside the sphere. Deduce the induced charge density on the sphere, and show that the total charge on the sphere equals $-q$. What does Gauss's law imply for the electric field outside the sphere? Finally, compute the force on the point charge.

(ii) Repeat the analysis from (i) for the case that the sphere is uncharged and insulated. In particular, show that the induced charge on the sphere is zero.

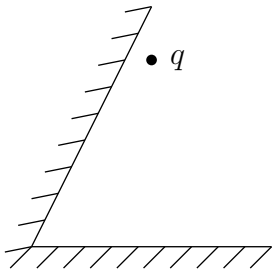
(iii) How does the result from (ii) differ in the case where the sphere is charged (with total charge $Q$)?

**Hints**:

(i) In order to find the electric potential inside the sphere, it is convenient to introduce a mirror charge $q'$ at position $\mathbf{a}'$.

(ii) In order to solve part (ii) of the exercise it is convenient to determine first the electric field outside the sphere, and then, in a second step, the electric potential according to the new boundary conditions.

**Exercise 2** [*Mirror charges*]: Consider a point charge $q$ at an arbitrary position between two grounded conducting metal plates enclosing an angle of 60°.




(i) Compute the electric potential in between the metal plates using the method of mirror charges.

(ii) Compute the force $\mathbf{F}$ on the point charge.