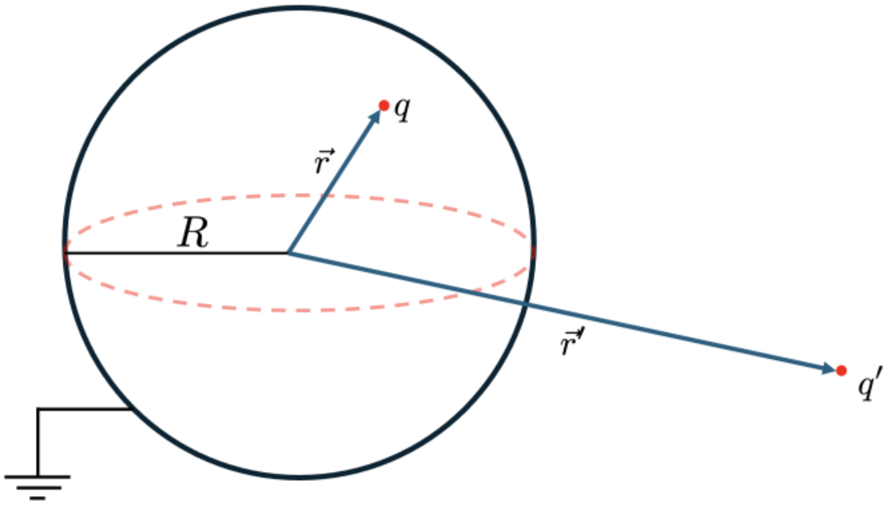
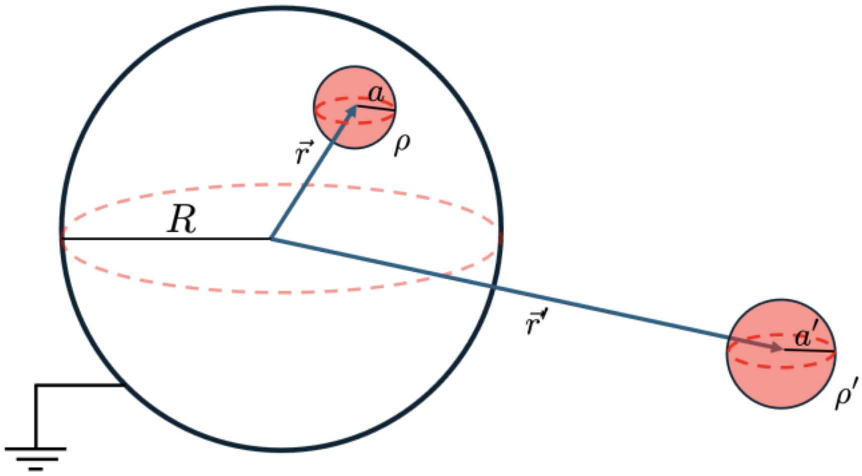
Q2: Thinking outside the conducting sphere

Consider a conducting sphere that is grounded (i.e., has zero electric potential) that has a radius R. There are two charged point-like particles, one inside the sphere at a location $\vec{r}$ ($|\vec{r}| < R$), of charge q, and one outside the sphere, at a location $\vec{r}'$ ($|\vec{r}'| > R$), of charge q', as in the figure below.



a)	Find the electric force that acts on the particle of charge q and on the particle of charge q', respectively.	**3.5 p**

Consider a similar setup as in point **a)** by replacing the point-like particles with two dielectric spheres of finite radius:



One sphere, of radius a, has a homogenous charge density ρ, is centered at $\vec{r}$ and lies fully within the conducting grounded sphere ($|\vec{r}| + a < R$). The other sphere, of radius a', with a homogenous charge density ρ', is centered at $\vec{r}'$ and lies fully outside the conducting grounded sphere ($|\vec{r}'| + a > R$).

b)	Find the electric force that acts on the sphere with charge density ρ and on the sphere with charge density ρ', respectively.	**3.5 p**

The spheres have masses m (for the sphere with charge density ρ) and m' (for the sphere with charge density ρ').

c)	Starting at rest in the configuration in point **b)** (with initial locations $\vec{r}_0$ and $\vec{r}_0{}'$ for the centers of the spheres), find the relationship between the velocity of each sphere and its position. Calculate their speeds when they touch the conducting sphere. Do not consider the spheres movement after they touch the conducting sphere. Furthermore, consider that the masses of the spheres are sufficiently large so that their velocities and accelerations are sufficiently small in order to neglect the induction of any magnetic fields.	**3.0 p**

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