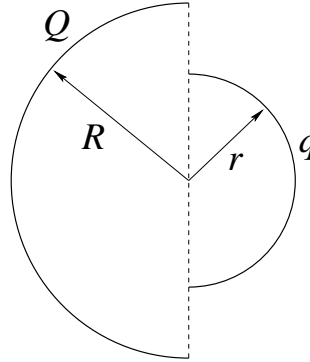


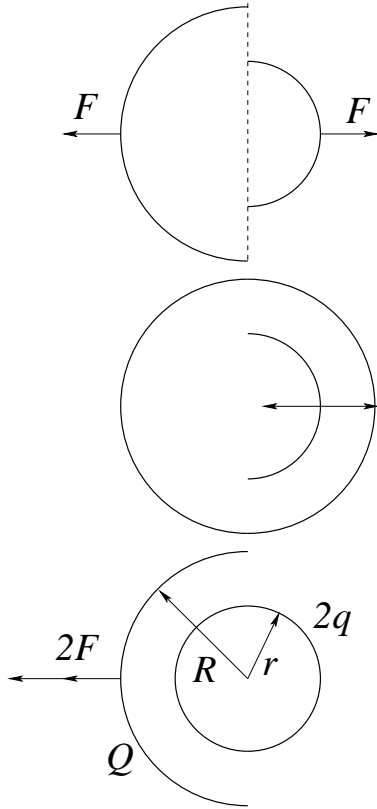
Problem of the Week

Semi-Sphere Coulomb

Find the force with which one uniformly charged hollow semi-sphere acts on another semi-sphere. The semi-spheres have charges Q , q and radii R , r . The centers of the semi-spheres coincide.



We need to find force F , and to have definite directions assume that the charges on the semi-spheres are of the same sign.



Let's complete large semi-sphere to a full sphere with charge $2Q$. Since there is no electric field inside uniformly charged spherical shell, there is no force acting on small semi-sphere, and we deduce that the force from added large semi-sphere cancels the force from initial semi-sphere.

Now let's complete the small semi-sphere to a full sphere of charge $2q$ and radius r . From what we just found, we can say that the resulting force from two small semi-spheres will be the double the force we are looking for.

This force is easy to calculate, because we now know the field everywhere on the large semi-sphere, that has charge density $\sigma = Q/2\pi R^2$,

$$2F = \iint \sigma dS E_z = 2\pi R^2 \int_0^{\pi/2} \sin \theta d\theta \sigma \frac{2q \cos \theta}{R^2}$$

$$F = \frac{qQ}{2R^2}$$

- independent of the small semi-sphere radius!