

## Exercise 16

Two surfaces are described in spherical coordinates by the two equations  $\rho = f(\theta, \phi)$  and  $\rho = -2f(\theta, \phi)$ , where  $f(\theta, \phi)$  is a function of two variables. How is the second surface obtained geometrically from the first?

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### Solution

The factor of 2 makes the points on the second surface twice the distance from the origin as the respective points on the first surface. Including the minus sign reflects every point on the second surface about the origin, that is,

$$\rho = -f(\theta, \phi) \quad \Rightarrow \quad \rho = f(\pi + \theta, \pi - \phi).$$