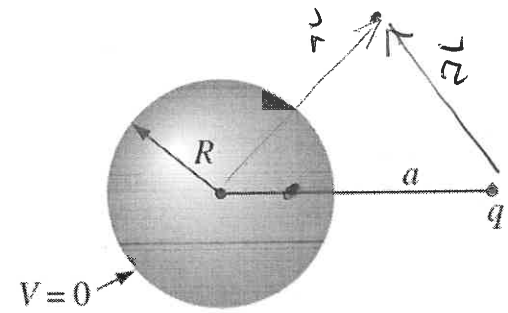
Example 3.2. A point charge q is situated a distance a from the center of a grounded conducting sphere of radius R (Fig. 3.12). Find the potential outside the sphere.



$V = 0$ ⓐ $r = R$

$V = 0$ ⓐ $r \to \infty$

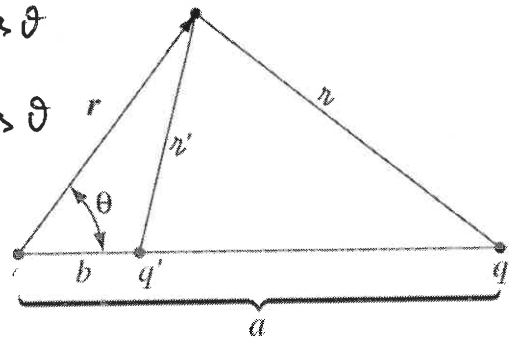
$q' = -\frac{R}{a} q$ at $b = \frac{R^2}{a}$

$$V(\vec{r}) = \frac{1}{4\pi\varepsilon_0}\left(\frac{q}{r} + \frac{q'}{r'}\right)$$

law of cosines

$$r^2 = r^2 + a^2 - 2ra\cos\theta$$

$$r'^2 = r^2 + b^2 - 2rb\cos\theta$$



$$\frac{q'}{r'} = \frac{-\frac{R}{a} q}{\left[r^2 + \left(\frac{R^2}{a}\right)^2 - 2r\left(\frac{R^2}{a}\right)\cos\theta\right]^{\frac{1}{2}}}$$

$$= \frac{-q}{\left[\left(\frac{ar}{R}\right)^2 + R^2 - 2ra\cos\theta\right]^{\frac{1}{2}}}$$

when $r = R$ $V(\vec{r}) = 0$

$r \to \infty$ $V(\vec{r}) \to 0$.

$$V(\vec{r}) = \frac{q}{4\pi\varepsilon_0}\left\{\frac{1}{(r^2 + a^2 - 2ra\cos\theta)^{\frac{1}{2}}} - \frac{1}{\left[\left(\frac{ar}{R}\right)^2 + R^2 - 2ra\cos\theta\right]^{\frac{1}{2}}}\right\}$$ ✓