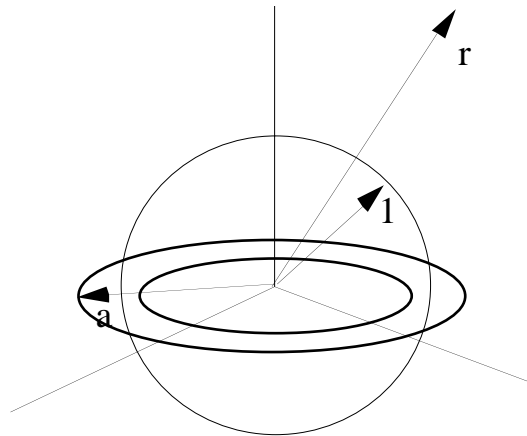


HW3

A homogeneously charged ring of radius a with total charge q is placed symmetrically around the equator of a grounded conducting sphere. Use the method of images to calculate an approximate result for the potential at the position \mathbf{r} , for $r > 1.5 a$.



Hint: Use the symmetry of the problem. Let the ring and its image ring be in the xy -plane, put the x -axis so that the field point \mathbf{r} lies in the xz -plane. The potential will then only depend on x and z and more general on ρ and z in cylindrical coordinates.

You will end up with an integral of the type

$$I(b) = \int_0^{2\pi} d\varphi \frac{1}{\sqrt{b^2 - \cos(\varphi)}}$$

This has no closed form. Make a series expansion for large b and find that by keeping 3 terms:

$$I(b) \approx \pi \left(\frac{2}{b} + \frac{3}{8b^5} \right)$$

The approximation becomes better the larger the value of b . For b having the value 1.5 the error is less than half a percent.

To check your result calculate the potential along the z -axis where you should find the exact result for $z \geq 1$.