1 Potential Due to a Ring of Charge–Limiting Cases

(10 pts) The potential due to a ring of charge is given by:

$$V(s,\phi,z) = \frac{1}{4\pi\epsilon_0}\frac{Q}{2\pi}\int_0^{2\pi}\frac{d\phi'}{\sqrt{s^2+R^2-2sR\cos(\phi-\phi')+z^2}}$$

Expand this potential in a power series to fourth order, in the plane of the ring, for $s < R$. Make sure to integrate. Warning: Make sure you keep all of the terms up to fourth order and none of the terms of higher order. Figuring out which terms to keep is tricky and is the most important lesson from this homework problem.

2 Potential from a Cone

(8, 2 pts)

A conical surface (an empty ice-cream cone) carries a uniform charge density σ. The height of the cone is H, and the radius of the top is R.

(a) Find the potential at point $\vec{r}$ (in the center of the opening of the cone), letting the potential at infinity be zero.

(b) Evaluate your integral in the special case that $H = R$. You may use a computer algebra system.