PHYS 512 F22

Assignment 2

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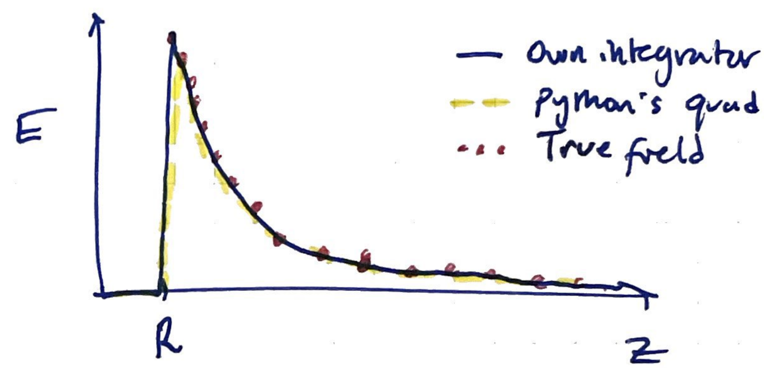
From Griffiths 2.7, we have our desired expression for the electric field a distance Z away:

$$E(z) = \frac{R^2\sigma}{2\varepsilon_0}\int_0^\pi \frac{(z-R\cos\theta)\sin\theta}{(R^2+z^2-2Rz\cos\theta)^{3/2}}\,d\theta$$

shell radius

For our own integrator, we have to skip Z = R to avoid blow up
Python's quad function doesn't care!

We get something like:



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a) We have to rescale our x-range to $(-1, 1)$
Consider the linear rescaling:

$$x \rightarrow ax + b$$

where the limits of our interval for x $(\frac{1}{2}, 1)$ are mapped to $(-1, 1)$; So we need

$$\begin{cases} \frac{1}{2}a + b = -1 \\ a + b = 1 \end{cases} \Rightarrow \begin{cases} a = 4 \\ b = -3 \end{cases}$$

b) We would like to express the log in base e of x as a function of the log in base 2 of x, as expressed from its mantissa/exponent decomposition:

$$x = M \cdot 2^{exp}$$

From log rules, we know $\ln(x) = \frac{\log_2(x)}{\log_2(e)}$

where we can take a numerical approx. of $\log_2(e)$ with 10^{-16} precision

$$\Rightarrow \ln(x) = \frac{\log_2(M \cdot 2^{exp})}{1.442..4}$$

$$\boxed{\ln(x) = \frac{\log_2(M) + exp}{1.442....4}}$$