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Problem Set 2

1 Problem 1

The electric field from a ring gives:

$$E = \frac{\lambda rz}{2\varepsilon(r^2+z^2)^{3/2}} \tag{1}$$

Converting to spherical coordinates, and putting into integral

$$E = \int_0^{\pi} \frac{\lambda R^2 \sin\theta(a - R\cos\theta}{2\varepsilon(R^2\sin^2\theta + (a - R\cos\theta)^2)^{3/2}} \tag{2}$$

$$\tag{3}$$

Let $u = -\cos\theta$ and $du = \sin\theta d\theta$

$$E = \int_{-1}^{1} \frac{(a-Ru)\lambda}{2\varepsilon(R^2+a^2-2Rau)^{3/2}} du \tag{4}$$

Plugging this into out integrator in the code, there is a singularity when using the legendary integration method at $z = R$. However, the quad method does not care and do not blow out at infinity.

2 Problem 2

Straightforward, see code.

3 Problem 3

We can perform the *mylog*2 function by using the change of basis.

$$\ln x = \frac{\log_2(x)}{\log_2(e)} \tag{5}$$

By using the *frexp* function, $x = ma_x \times 2 \times \exp exp_x$. Hence equation (5) can be written as:

$$\ln x = \frac{\log_2(ma_x) \times 2^{exp_x}}{\log_2(ma_e) \times 2^{exp_e}} = \frac{\log_2(ma_x) + exp_x}{\log_2(ma_e) + exp_e} \tag{6}$$

Which now we could use our function $\log_2$ from the first part of our code to evaluate $\log_2 ma$.