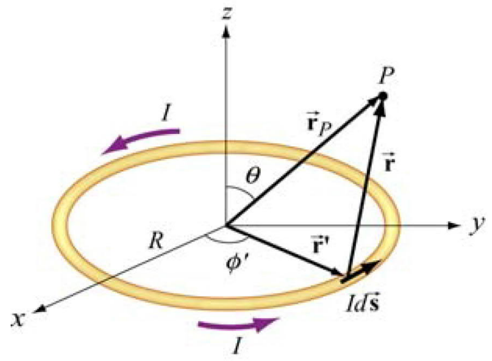
Exercise 1

Consider the current loop in the figure and derive an equation for the magnetic flux density ***B*** on the z-axis as function of loop current *I*, the *z*-coordinate, and the radius of the loop *R*. Use of the Biot-Savart law.

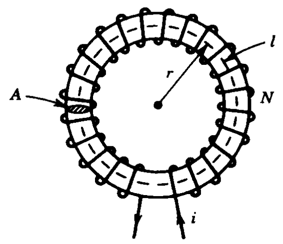
$$d\vec{\boldsymbol{B}} = \frac{\mu_0}{4\pi}\frac{Id\vec{\mathbf{s}} \times \vec{\boldsymbol{e}}_r}{r^2}$$

Plot the magnitude of the derived magnetic flux density as a function of the ratio *z*/*R* for a given current *I* and radius *R* (if you wish you can plot the magnitude normalized to the one at *z*=0)



Exercise 2

Consider the toroid measurement system in the figure. The primary coil has N_1=500 turns and the secondary coil has N_2=100 turns. The average radius of the toroid is r=100 mm and its cross section area is A=10x10 mm^2.



Measurements have been carried out by feeding the primary coil with a current i=1*sin(2*pi*t) A. The measured induced voltage in the secondary coil was u=0.1*cos(2*pi*t-0.2) V. Compute the magnetic field strength *H* along the average perimeter of the toroidal and the average magnetic flux density *B* through it. Plot *B* as a function of *H*.

Compute the hysteresis power losses in the toroid core. As the frequency is very low you can ignore the eddy current losses.

What do you think of the material in the toroid core (linear/nonlinear)