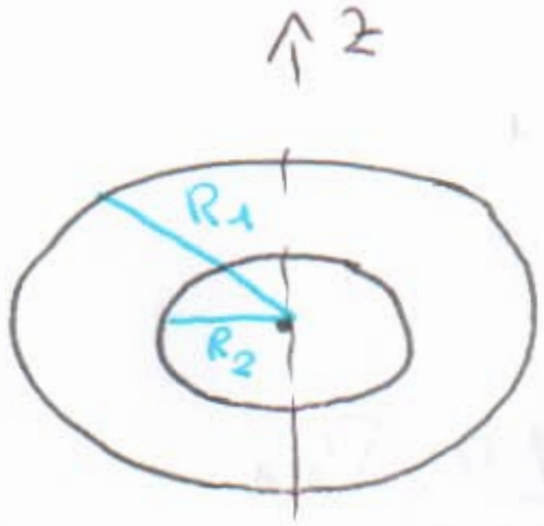
7) (Purcell 7.20)



$R_1 >> R_2$

- Run current in the large loop: the magnetic field on its axis is:

$$\vec{B}_2 = \frac{2\pi I}{C} \frac{R_1^2}{(R_1^2 + z^2)^{3/2}} \hat{z} \qquad (1)$$

(review the derivation we did in class)

Since $R_1 >> R_2$ the magnetic field due to the large loop at the location of the small loop is

$$\vec{B}_2 \simeq \frac{2\pi I}{C R_1} \hat{z} \qquad (2)$$

(1) with $z = 0$

The flux through the small loop is:

$$\Phi_{21} = \pi R_2^2 B_2$$

If we perturb the radius ($R_1 \to R_1 + \Delta R_1$)

$$\Delta\Phi_{21} = \Phi_{21}^{NEW} - \Phi_{21} \simeq \pi R_2^2 \frac{\partial B_2}{\partial R_1} \Delta R_1 = -\frac{2\pi^2}{C} \frac{R_2^2}{R_1^2} I \Delta R_1$$

- Now run the current in the small loop: what is the flux through the large one?