Answer to Question #75180, Physics / Electric Circuits

Two coils p and q lie in the same plane and are concentric, coil p has $10\ T$ of $r = 5.0\ cm$ and carries a current of $1.0\ A$, coil q has $20\ T$ of $r = 8.0\ cm$ and the current in it is adjusted in the magnitude and direction so that the resultant field at the common center is zero. Draw the diagram to show the relative directions of the two coils and find the magnitude of the coil q.

Solution.

If we have just one coil p, magnetic field in its centre:

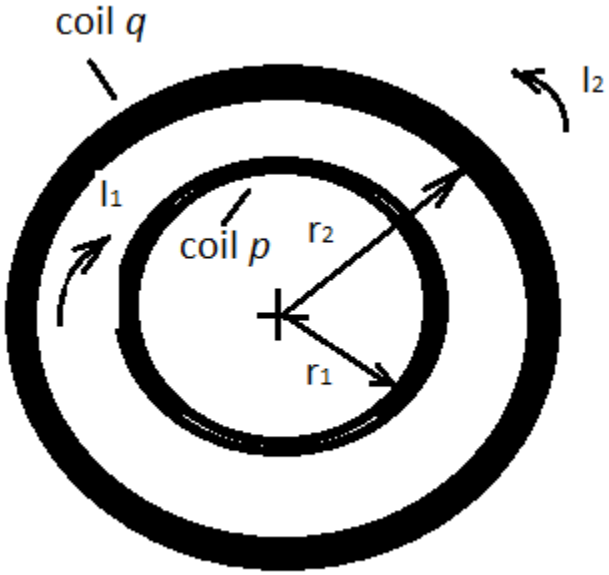
$$B_1 = \frac{\mu_0}{4\pi}\frac{2\pi I_1 n_1}{r_1} = \frac{10^{-7}\cdot 2\cdot 3.14\cdot 1\cdot 10}{0.05} = 1.256\cdot 10^{-4}\ T$$

In our case, magnetic field in the centre of just one coil q:

$$B_2 = -B_1$$

So, the current in the coil q:

$$I_2 = \frac{4\pi B_2 r_2}{2\pi n_2} = \frac{1.256\cdot 10^{-4}\cdot 0.08}{2\cdot 3.14\cdot 20\cdot 10^{-7}} = 0.8\ A$$



The currents I_1 and I_2 in the coils have opposite directions.

The magnetic field in the coil p is directed from us, in the coil q - to us.