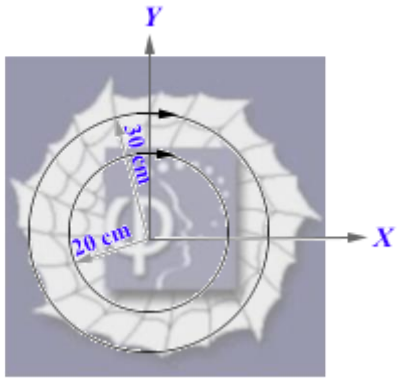
453.

Problem 34.59 (RHK)

Two concentric circular loops, radii 20.0 *and* 30.0 cm, *in the xy plane each carry a clockwise current of* 7.0 A, *as shown in the figure. We have to find* (a) *the net magnetic moment of this system; and repeat the calculation if the current in the outer loop is reversed.*



Solution:

The magnitude of the magnetic dipole moment of a planar current loop, current i, enclosing area A is

$\mu = iA,$

and the direction of $\vec{\mu}$ is perpendicular to the plane of the loop pointing toward the direction of the thumb when fingers turn in the direction of the current loop.

Therefore, in case (a) the magnetic dipole moments of the both currents will have the direction $-\hat{k}$ and will add algebraically. We have

$$\vec{\mu} = \left(-\pi(0.2)^2 \times 7\hat{k} - \pi\left(0.3^2\right) \times 7\hat{k}\right) \text{ J T}^{-1}$$

$$= -2.88\ \hat{k} \text{ J T}^{-1}.$$

(b)

If the current in loop of radius 30.0 cm flows in the counter-clockwise direction, the direction of the magnetic dipole moment will be $\hat{k}$. The vector sum of the magnetic dipole moments will be

$$\vec{\mu} = \left(-\pi(0.2)^2 \times 7\hat{k} + \pi(0.3)^2 \times 7\hat{k}\right) \text{ J T}^{-1}$$

$$= 1.099\ \hat{k} \text{ J T}^{-1}.$$