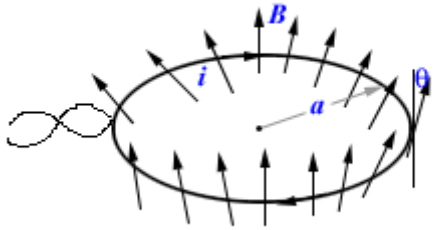
450.

Problem 34.53 (RHK)

In the figure a wire ring of radius a at right angles to the general direction of a radially symmetric diverging magnetic field has been shown. The magnetic field at the ring is everywhere of the same magnitude B, and its direction is everywhere at an angle θ with a normal to the plane of the ring. The twisted wire leads have no effect on the problem. We have to find the magnitude and the direction of the force the field exerts on the ring if the ring carries a current i as shown in the figure.



Solution:

Let us assume that the wire ring lies in the *xy*-plane. Therefore, the vertical direction to the plane is along the z-axis. The magnetic field at each infinitesimal length segment of the loop can be resolved into a component in the z-direction and the other in the *xy*-plane. As the field

is radially divergent the component of the field in the *xy*-plane at each point on the circumference of the loop will have the same magnitude $B\sin\theta$ and it will be radially normal to the circumference at that location. The contributions to the force on the current carrying circular loop due to z-components of the magnetic field at opposite length pairs on the circumference will cancel each other. Therefore, the force on the loop will be due to the components of the magnetic field in the *xy*-plane and the total magnitude of the force will be $2\pi aiB\sin\theta$. The direction of the net force on the loop will be along the *z*-axis.