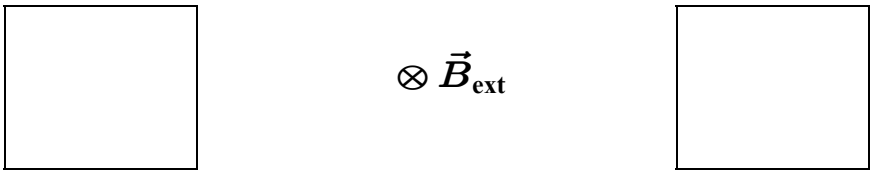
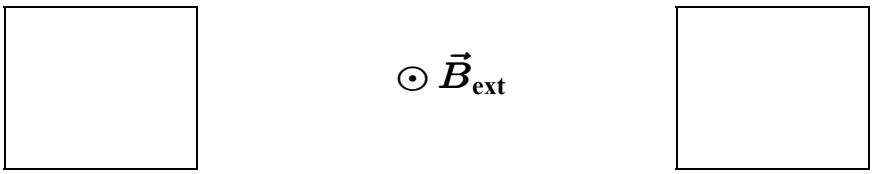
# HOMEWORK for TUESDAY, JULY 12, 2005

**For each of the following situations two circuit loops are shown in a uniform external magnetic field $\vec{B}_{\text{ext}}$. Let the one on the left have a clockwise current and the one on the right have a counterclockwise current. For each loop show the direction of $\vec{B}_{\text{loop}}$. Determine in each case the forces acting on each side of the current and determine if there is a net force or a net torque. If there is a net torque, determine how the loop will rotate, and describe how this is related to the directions of $\vec{B}_{\text{loop}}$ and $\vec{B}_{\text{ext}}$.**

**1.** 

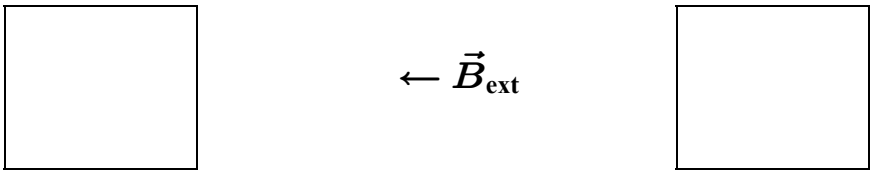

Clockwise current on left: $\vec{B}_{\text{loop}}$ is down ( $\otimes$ ); forces on top, right, bottom, left sides are, respectively, $\uparrow$ , $\rightarrow$ , $\downarrow$ , and $\leftarrow$ (all directed outward). There is no net force and no net torque.

Counterclockwise current on right: $\vec{B}_{\text{loop}}$ is up ( $\odot$ ); forces on top, right, bottom, and left sides are, respectively, $\downarrow$ , $\leftarrow$ , $\uparrow$ , and $\rightarrow$ (all directed inward). There is no net force and no net torque.

**2.** 

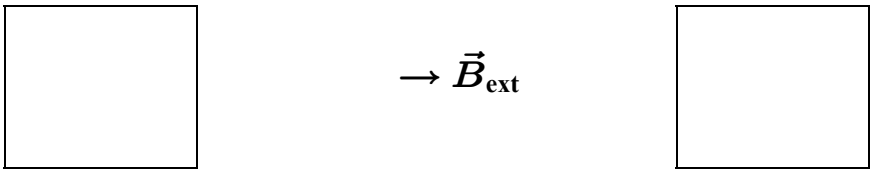

Clockwise current on left: $\vec{B}_{\text{loop}}$ is down ( $\otimes$ ); forces on top, right, bottom, left sides are, respectively, $\downarrow$ , $\leftarrow$ , $\uparrow$ , and $\rightarrow$ (all directed inward). There is no net force and no net torque.

Counterclockwise current on right: $\vec{B}_{\text{loop}}$ is up ( $\odot$ ); forces on top, right, bottom, and left sides are, respectively, $\uparrow$ , $\rightarrow$ , $\downarrow$ , and $\leftarrow$ (all directed outward). There is no net force and no net torque.

**3.** 

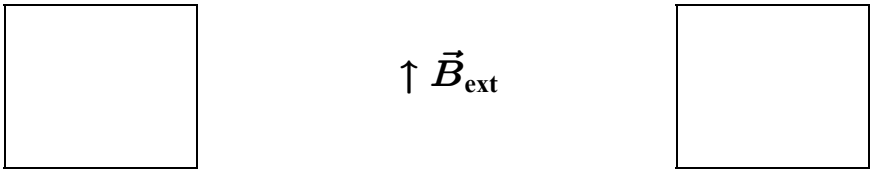

Clockwise current on left: $\vec{B}_{\text{loop}}$ is down ( $\otimes$ ); forces on top and bottom are 0 and those on left and right sides are, respectively, $\odot$ and $\otimes$. There is no net force but there is a net torque causing clockwise rotation as viewed from below the bottom side.

Counterclockwise current on right: $\vec{B}_{\text{loop}}$ is up ( $\odot$ ); forces on top and bottom are 0 and those on left and right sides are, respectively, $\otimes$ and $\odot$. There is no net force but there is a net torque causing counterclockwise rotation as viewed from below the bottom side.

**4.** 

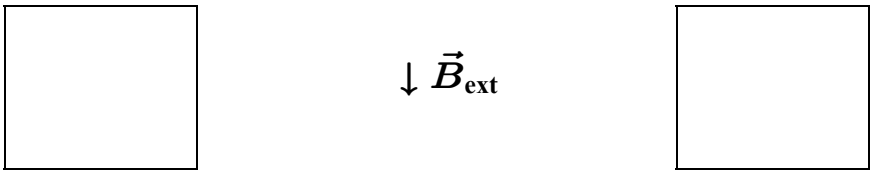

Clockwise current on left: $\vec{B}_{\text{loop}}$ is down ( $\otimes$ ); forces on top and bottom are 0 and those on left and right sides are, respectively, $\otimes$ and $\odot$. There is no net force but there is a net torque causing counterclockwise rotation as viewed from below the bottom side.

Counterclockwise current on right: $\vec{B}_{\text{loop}}$ is up ( $\odot$ ); forces on top and bottom are 0 and those on left and right sides are, respectively, $\odot$ and $\otimes$. There is no net force but there is a net torque causing clockwise rotation as viewed from below the bottom side.

**5.** 

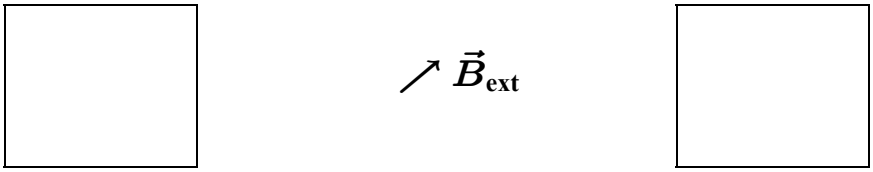

Clockwise current on left: $\vec{B}_{\text{loop}}$ is down ( $\otimes$ ); forces on left and right sides are 0 and those on the top and bottom sides are, respectively, $\odot$ and $\otimes$. There is no net force but there is a net torque causing clockwise rotation as viewed from the left of the left side.

Counterclockwise current on right: $\vec{B}_{\text{loop}}$ is up ( $\odot$ ); forces on left and right sides are 0 and those on the top and bottom sides are, respectively, $\otimes$ and $\odot$. There is no net force but there is a net torque causing counterclockwise rotation as viewed from the left of the left side.

**6.** 

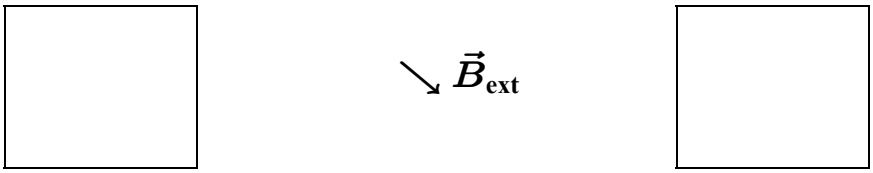

Clockwise current on left: $\vec{B}_{\text{loop}}$ is down ( $\otimes$ ); forces on left and right sides are 0 and those on the top and bottom sides are, respectively, $\otimes$ and $\odot$. There is no net force but there is a net torque causing counterclockwise rotation as viewed from the left of the left side.

Counterclockwise current on right: $\vec{B}_{\text{loop}}$ is up ( $\odot$ ); forces on left and right sides are 0 and those on the top and bottom sides are, respectively, $\odot$ and $\otimes$. There is no net force but there is a net torque causing clockwise rotation as viewed from the left of the left side.

**7.** 


Clockwise current on left: $\vec{B}_{\text{loop}}$ is down ( $\otimes$ ); forces on top, right, bottom, left sides are, respectively, $\odot$, $\odot$, $\otimes$, and $\otimes$. There is no net force but there is a net torque causing counterclockwise rotation as viewed from below and to the right of the lower right corner.

Counterclockwise current on right: $\vec{B}_{\text{loop}}$ is up ( $\odot$ ); forces on top, right, bottom, left sides are, respectively, $\otimes$, $\otimes$, $\odot$, and $\odot$. There is no net force but there is a net torque causing clockwise rotation as viewed from below and to the right of the lower right corner.

**8.** 


Clockwise current on left: $\vec{B}_{\text{loop}}$ is down ( $\otimes$ ); forces on top, right, bottom, left sides are, respectively, $\otimes$, $\odot$, $\odot$, and $\otimes$. There is no net force but there is a net torque causing counterclockwise rotation as viewed from below and to the left of the lower left corner.

Counterclockwise current on right: $\vec{B}_{\text{loop}}$ is up ( $\odot$ ); forces on top, right, bottom, left sides are, respectively, $\odot$, $\otimes$, $\otimes$, and $\odot$. There is no net force but there is a net torque causing clockwise rotation as viewed from below and to the left of the lower left corner.

In cases $3-8$, the rotation in every case is so as to align $\vec{B}_{\text{loop}}$ with $\vec{B}_{\text{ext}}$ through the smallest posssible angle.