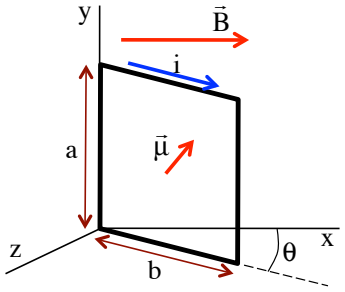
Problem 29.47



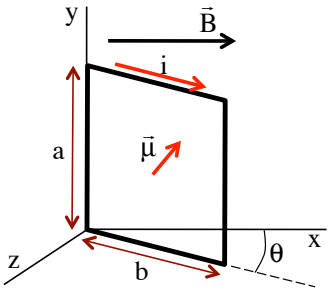
The rectangular coil has 100 winds. The sides a = .4 meters and b = .3 meters. The angle is 30 degrees and the B-fld is .8 Teslas. If the current is i = 1.2 amps:

a.) What's the torque's magnitude?

Note: The angle between the magnetic moment, a vector perpendicular to the face of the coil, and the B-fld vector along the x-axis is 60 degrees.

$$\begin{aligned}
\left|\vec{\Gamma}\right| &= \left|\vec{\mu}x\vec{B}\right| \\
&= \mu B \sin\theta \\
&= (N\ i\ A) B \sin\theta \\
&= (N\ i\ (ab)) B \sin\theta \\
&= (100)(1.2\ \text{A})[(.4\ \text{m})(.3\ \text{m})](.8\ \text{T})\sin 60^{\circ} \\
&= 9.98\ \text{N}\bullet\text{m}
\end{aligned}$$

b.) What's the direction of the torque vector?



In general, loops rotate so as to align their magnetic moment with the external B-field. In this case, that means the torque should rotate the loop about the y-axis in a clockwise direction (as viewed from above along the +y side of the axes). This is the $-\hat{j}$ direction (according to the standards for a right-handed coordinate system).

Checking to see if this makes sense as far as the cross product goes, the vectors are shown to the right. Using the right hand rule, cross the magnetic moment into the B-fld vector and sure enough, we get a vector in the –y direction.