1. **Problem 1**

A rectangular loop (dimensions \(a, b\)), with mass \(M\), and resistance \(R\), enters a uniform magnetic field \(B\). a) Which direction does the current flow? b) Show that the terminal velocity \(v_T\) of the loop can be expressed as:

\[
v_T = \frac{MgR}{B^2a^2}
\]

where \(a\) is the width of the loop.

a) The current is clockwise due to Lenz's law.

b) Since \(Mg = F_b\); and \(F_b = IaB\)

the induced current is:

\[
I = \frac{E}{R} = \frac{Ba v_T}{R}
\]

therefore

\[
F_b = (\frac{Ba v_T}{R})aB = Mg
\]

Solving for \(v_T\):

\[
v_T = \frac{MgR}{B^2a^2}
\]
2. **Problem 2**

A current loop lies in the $x-y$ plane. The magnetic moment $\mu$ points in the $+z$ direction.

a) If you look down on the loop, which way is the current flowing? (Choose only one):

1. Clockwise

○ 3. Counterclockwise

b) A uniform $B$ field points in the $+y$ direction. Which way is the torque $\tau$ on the loop? What is the formula describing this?

\[ \vec{\tau} = \vec{\mu} \times \vec{B} \]

a) The current $I$ is counterclockwise, since $\vec{\mu}$ points to the $+z$ direction.

b) Since \[ \vec{\tau} = \vec{\mu} \times \vec{B} \] the torque $\vec{\tau}$ points to the negative $x$-direction.