Problem 1
Two particles, 1 and 2, are accelerated from rest by a uniform electric field over a distance of 20 cm. They then enter a region with a uniform B field that is orientated perpendicularly to the velocity of the particles. Particle 1 has twice the mass of particle 2 and 1/3 the charge. If particle 1 has a radius of gyration in the magnetic field of $1.1 \times 10^{-3}$ cm, what is the radius of gyration of particle 2 (in cm)?

\[ \text{Problem 2} \]
A bar magnet is held above the center of a wire loop in a horizontal plane, as shown in the figure below. The south end of the magnet is toward the loop. The magnet is then dropped. Find the direction of the current through the resistor (a) while the magnet is falling toward the loop and (b) after the magnet has passed through the loop and moves away from it.

a) To oppose the approach of the north end of the magnet, the magnetic field along the axis of the loop should be directed downward. Thus, the current must be clockwise when viewed from above the loop.

b) To oppose the departure of the north end of the magnet, the magnetic field should be directed upward along the axis of the loop, so the current must be counterclockwise when viewed from above the loop.
Problem 3
A car travels northward at 75 km/hr along a straight road in a region where the earth's magnetic field has a vertical component of 0.50 \times 10^{-4} \text{T}. Find the induced emf between the left and right side if they are separated by 1.7 m.

\[ V = 75 \text{ km/hr} \]
\[ B = 0.5 \times 10^{-4} \text{T} \]
\[ l = 1.7 \text{ m} \]

To think of the car as a charged conducting bar moving with velocity \( v \) and length \( l \) through a uniform \( B \)-field, the charges will experience a magnetic force \( F_{mag} = q(v \times B) \).

The force moves the charges to the opposite ends of the conductor, creating an induced emf.

\[ E = B \cdot A = BAc \cos \theta \]
\[ \theta = 0 \]
\[ A = vl \]
\[ E = -\Delta(\frac{V}{A}) = -B \frac{\Delta l}{\Delta t} = -Bl \frac{\Delta l}{\Delta t} \]

\[ \Rightarrow |E| = \left| \left( 0.5 \times 10^{-4} \text{T} \right) \left( 1.7 \text{ m} \right) \left( \frac{1 \text{ hr}}{3600 \text{ sec}} \right) \left( \frac{1 \text{ km}}{1 \text{ km}} \right) \right| \]

\[ \left| E \right| = 1.77 \times 10^{-5} \text{ V} \]

Problem 4
What is the direction of the current induced in the resistor when the current in the long, straight wire in the figure below decreases rapidly to zero?

To oppose the decreasing flux, directed into the page, through the area enclosed by the loop, the induced current in the loop must be clockwise or left to right through the resistor.