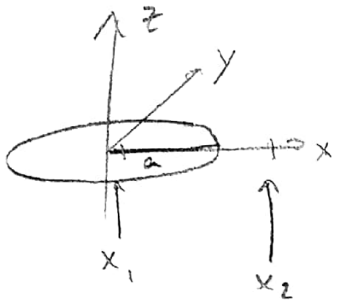
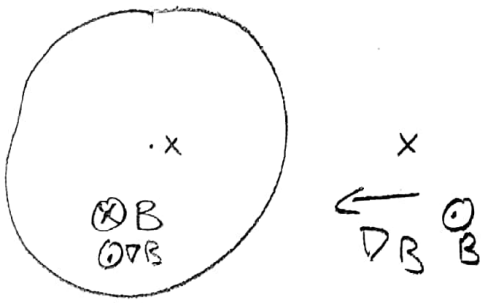
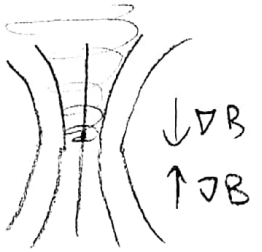
2015 II: Q4 Quickie



Current loops produce dipole field.



For the particle starting at $r = 0.1a$, we can assume that the B-field is uniformish in r. But ∇B points towards center of dipole. So the particle will experience a mirror force away from $z = 0$ and drift outwards while conserving μ. This particle will eventually be lost.



For the particle starting at $r = 1.5a$, it will experience all the same drifts as a particle in Earth's dipole field. This particle will (1) conserve μ by changing ρ as B changes in magnitude, (2) bounce back and forth in z along B due to the mirror force and (3) rotate around the z-axis due to the $\nabla B \times B$ drift. All three motions have associated adiabatic invariants.