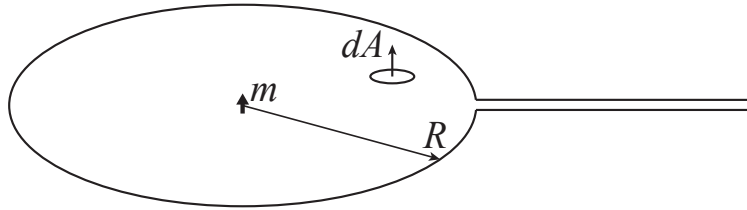2. A particle with magnetic moment m is located at the center of a circular loop of wire with a radius R. The magnetic moment is pointing up, perpendicular to the plane of the loop.

(a) Calculate the flux of the magnetic field generated by the magnetic moment through the wire loop. Take the positive direction of an area element of the loop to point up.

The circular wire loop is now connected to a constant current source which maintains a constant current I flowing around the loop in the counter-clockwise direction when viewed from above.

(b) Calculate the mechanical work that needs to be done on the magnetic moment to rotate it by 180 degrees, turning it from pointing up to pointing down.

(c) Calculate the additional electrical energy supplied by the current source while the magnetic moment is being rotated. Comment on the conservation of energy.