An off-centered hole of radius *a* is bored parallel to the axis of a long metallic cylinder of radius *b (b>a)*. With the exception of the bored hole the cylinder is assumed to be full. The two axes are at distance *d* apart as shown in **Fig. 1** below. Uniform current *I* with current density ***J*** flows in the cylinder out of the plane of the paper and perpendicular to the paper as shown in **Fig. 1**. Answer the following questions:

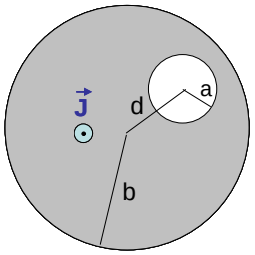

Fig. 1

a. What are the magnitude and direction of magnetic field ***B*** at the center of the hole?
b. Now assume that the current through the long metallic cylinder is generated by the circuit shown in **Fig. 2**, where ***S*** represents a switch, ***C*** a large capacitor, ***V*** a battery, and ***R*** the total resistance of the circuit. A square conducting loop of side L is placed at distance *r* from the center of the metallic cylinder and in the plane formed by the axes of the two cylinders, of radius a and b. Assume also that the conducting loop has mass ***m*** and resistance $\boldsymbol{R_L}$ and is located on a frictionless horizontal plane. Now let us assume that we suddenly open the circuit by disconnecting switch ***S*** from the circuit. For this problem, ignore the displacement current, and assume that all the wires and the circuit elements are far from the metallic cylinder and the loop. Using only the first principles, show on the figure the direction of the current in the loop and the acceleration ***a*** exerted on the loop immediately after the switch is opened. Briefly explain your reasoning.
c. Determine the acceleration of the loop immediately after the switch is opened.

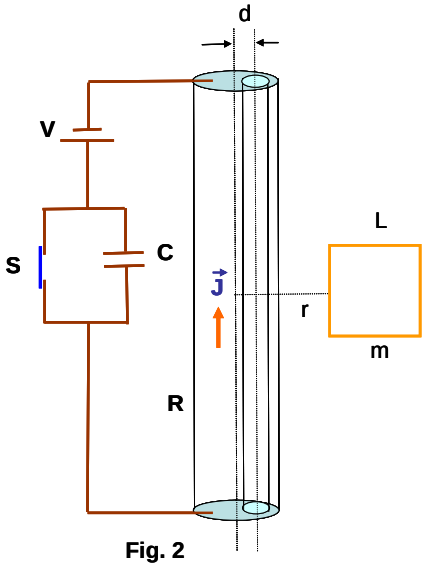

Fig. 2