A conducting rod of mass \( M \) is free to slide without friction on two long parallel conducting rails separated by a distance \( D \). The rails are connected through a switch to a battery of emf \( E \) and a coil of inductance \( L \). The rod completes the circuit. There is negligible electrical resistance. A uniform magnetic field \( B \) is normal to the plane of the paper, as shown.

(a) Assuming the switch to be closed, show that the speed \( v \) of the rod as a function of time \( t \) satisfies a differential equation of the form

\[
d^2v/dt^2 + av + b = 0
\]

Find expressions for \( a \) and \( b \) in terms of the quantities \( E, D, L, B, M \), and fundamental constants.

(b) Now suppose the switch, which is initially open, is closed at \( t = 0 \) and that \( I(0) = v(0) = 0 \). Sketch the potential drop across both the inductor and the rod as a function of time. Be sure to include both a voltage and time scale.

(c) Find \( I(t) \) for \( t > 0 \).