Magnetic Induction: Application (13)

A rod of length ℓ, mass m, and negligible resistance slides without friction down a pair of parallel conducting rails, which are connected at the top of the incline by a resistor with resistance R. A uniform vertical magnetic field $\vec{B}$ exists throughout the region.

(a) Identify the forces acting on the rod when it slides down with velocity v.
(b) Determine the velocity for which all forces acting on the rod are in balance.

Determine the direction of the induced current from

(c) the magnetic force acting on the charge carriers in the rod,
(d) from the change in magnetic flux through the conducting loop,
(e) from Lenz's law.