

31. (a) Eq. 30-8 leads to

$$\mathcal{E} = BLv = (1.2 \text{ T})(0.10 \text{ m})(5.0 \text{ m/s}) = 0.60 \text{ V} .$$

(b) By Lenz's law, the induced emf is clockwise. In the rod itself, we would say the emf is directed up the page.

(c) By Ohm's law, the induced current is $i = 0.60 \text{ V}/0.40 \Omega = 1.5 \text{ A}$.

(d) The direction is clockwise.

(e) Eq. 27-22 leads to $P = i^2 R = 0.90 \text{ W}$.

(f) From Eq. 29-2, we find that the force on the rod associated with the uniform magnetic field is directed rightward and has magnitude

$$F = iLB = (1.5 \text{ A})(0.10 \text{ m})(1.2 \text{ T}) = 0.18 \text{ N} .$$

To keep the rod moving at constant velocity, therefore, a leftward force (due to some external agent) having that same magnitude must be continuously supplied to the rod.

(g) Using Eq. 7-48, we find the power associated with the force being exerted by the external agent: $P = Fv = (0.18 \text{ N})(5.0 \text{ m/s}) = 0.90 \text{ W}$, which is the same as our result from part (e).