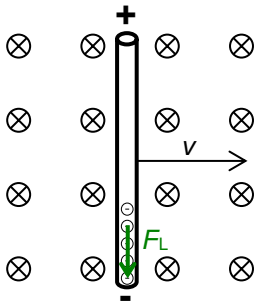
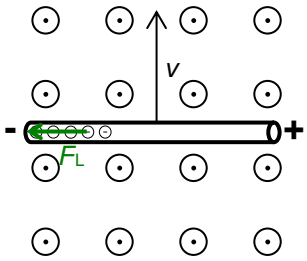
1. a)



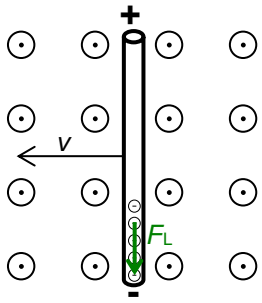
voltage is induced

b)



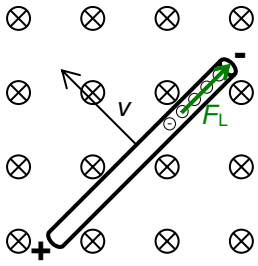
voltage is induced

c)



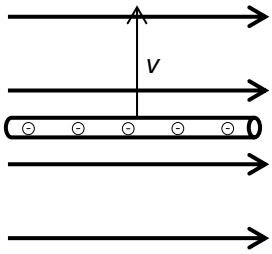
voltage is induced

d)



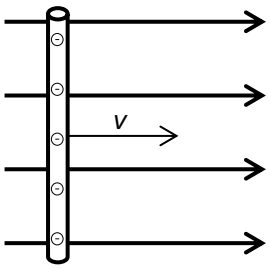
voltage is induced

e)



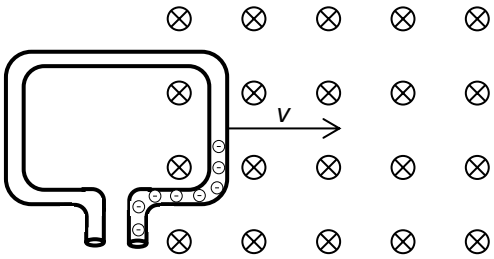
no voltage is induced. The magnetic force points out of the paper, and the electrons are displaced to the upper part of the rod (and not to the left or right side of the rod).

f)



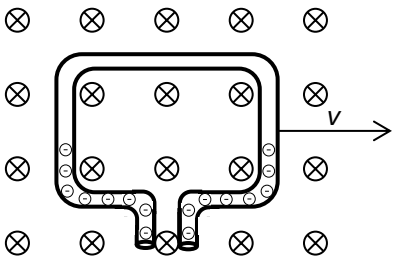
no voltage is induced. The rod is moving parallel to the magnetic field lines, and therefore there is no magnetic force.

2. a)



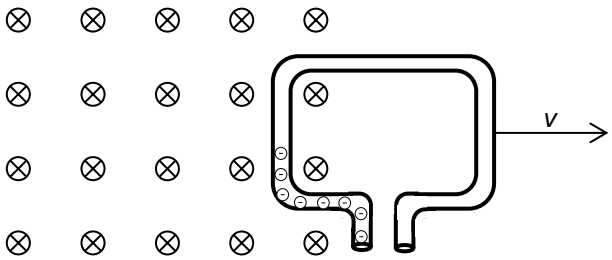
The magnetic force is acting downwards, but only in the part of the loop of wire that is moving in the magnetic field. The electrons are displaced only on the right side and a voltage is induced.

b)



The whole loop of wire is moving in the magnetic field. The electrons experience a downward force on both side and they are displaced on both sides. No voltage is induced.

c)



The magnetic force is acting downwards, but only in the part of the loop of wire that is moving in the magnetic field. The electrons are displaced only on the left side and a voltage is induced.

3. $U_{ind} = B \cdot v \cdot d = 0.430 \cdot 10^{-4}\ \text{T} \cdot 40.0\ \frac{\text{m}}{\text{s}} \cdot 1.435\ \text{m} = 2.47 \cdot 10^{-3}\ \text{V} = \underline{2.47\ \text{mV}}$

4. $v = \frac{U_{ind}}{B \cdot d} = \frac{0.50\ \text{V}}{0.430 \cdot 10^{-4}\ \text{T} \cdot 30.0\ \text{m}} = 387.6\ \frac{\text{m}}{\text{s}} = \underline{\underline{1'395\ \frac{\text{km}}{\text{h}}}}$

5. a) While the rod is moving to the right, a downward magnetic force is acting on the electrons in the rod. The circuit is closed, and the electron continue moving through the rod, the rails and the lamp (clockwise).
   A second magnetic force is acting on the electrons that are moving downwards in the rod. This force acts in the opposite direction to the direction of motion of the rod. The rod is slowed down.

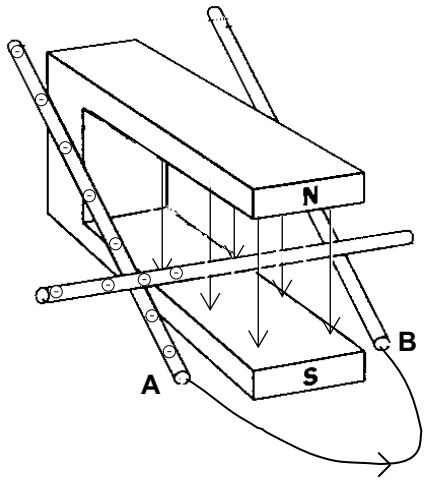
   b) If the switch is open, the electrons in the rod are displaced, but no flow of electrons is induced. They are not moving downwards in the rod, and there is no "second" magnetic force acting which could slow the movement of the rod down. It continues at constant velocity.

   c) The lamp is lit only in a) and only as long as the rod is moving.

6. a) and b) see picture

   c) They are passing through the wire in the direction of the arrow

   d) The electrons moving in the wire from right to left experience a magnetic force which acts in the opposite direction to the direction of motion of the rod.



7. a) $U_{ind} = B \cdot v \cdot d = 0.10 \cdot \text{T} \cdot 5.0\ \frac{\text{m}}{\text{s}} \cdot 0.20\ \text{m} = \underline{0.10\ \text{mV}}$

   b) $I = \frac{U}{R} = \frac{0.10\ \text{V}}{0.15\ \Omega} = \underline{\underline{0.67\ \text{A}}}$

   c) $P = U \cdot I = 0.10\ \text{V} \cdot 0.67\ \text{A} = 0.067\ \text{W} = \underline{67\ \text{mW}}$

   d) $W = P \cdot t = 0.067\ \text{W} \cdot 10\ \text{s} = \underline{0.67\ \text{J}}$

   e) Mechanical energy is converted to electrical energy. The amount of energy is the same: $\underline{0.67\ \text{J}}$