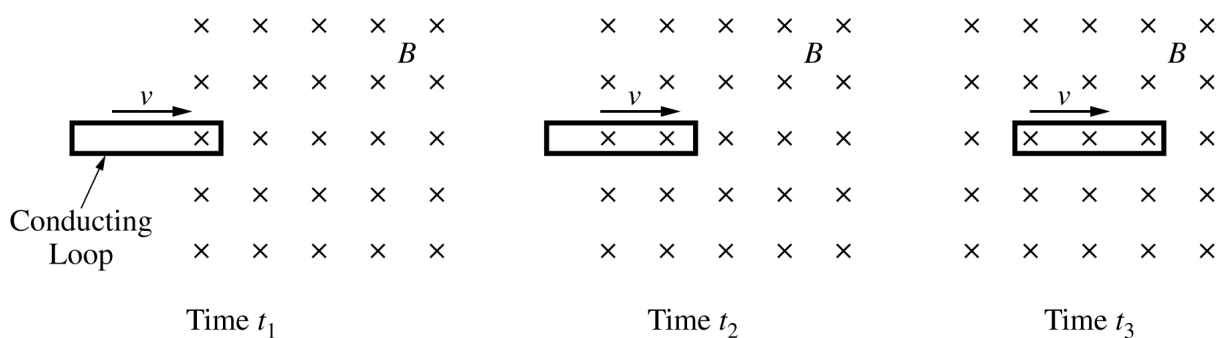


PHYSICS 2**Section II****Time—1 hour and 30 minutes****4 Questions**

Directions: Questions 1 and 4 are short free-response questions that require about 20 minutes each to answer and are worth 10 points each. Questions 2 and 3 are long free-response questions that require about 25 minutes each to answer and are worth 12 points each. Show your work for each part in the space provided after that part.

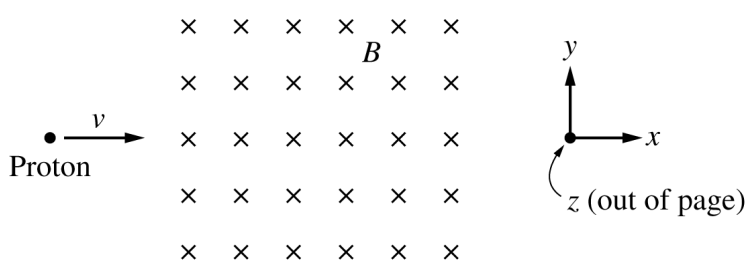


1. (10 points, suggested time 20 minutes)

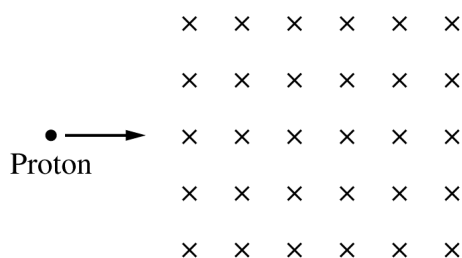
The figures above show a rectangular conducting loop at three instants in time. The loop moves at a constant speed v into and through a region of constant, uniform magnetic field B directed into the page. The magnetic field is zero outside the region.

- (a) In a coherent paragraph-length response, compare the magnitude and direction of the current at times t_1 , t_2 , and t_3 . Include an explanation of why there is or is not a current and the direction of the current if one is present. Use fundamental physics concepts and principles in your explanation.

- (b) The loop is removed. A proton traveling to the right in the plane of the page, as shown below, then enters the region of magnetic field with a speed $v = 3.0 \times 10^5$ m/s. The magnitude of the field is 0.030 T. The effects of gravity are negligible.



- i. Calculate the magnitude of the force on the proton as it enters the field.
- ii. On the figure below, sketch a possible path of the proton as it travels through the magnetic field. Clearly label the path P1.



- iii. A second proton now enters the magnetic field at the same point and from the same direction but at a greater speed than the first proton. On the figure above, draw the path of the second proton as it travels through the field. Clearly label the path P2.
- iv. Next an electric field is applied in the same region as the magnetic field, such that there is no net force on the first proton as it enters the region. Calculate the magnitude and indicate the direction of the electric field relative to the coordinate system shown in part (b).