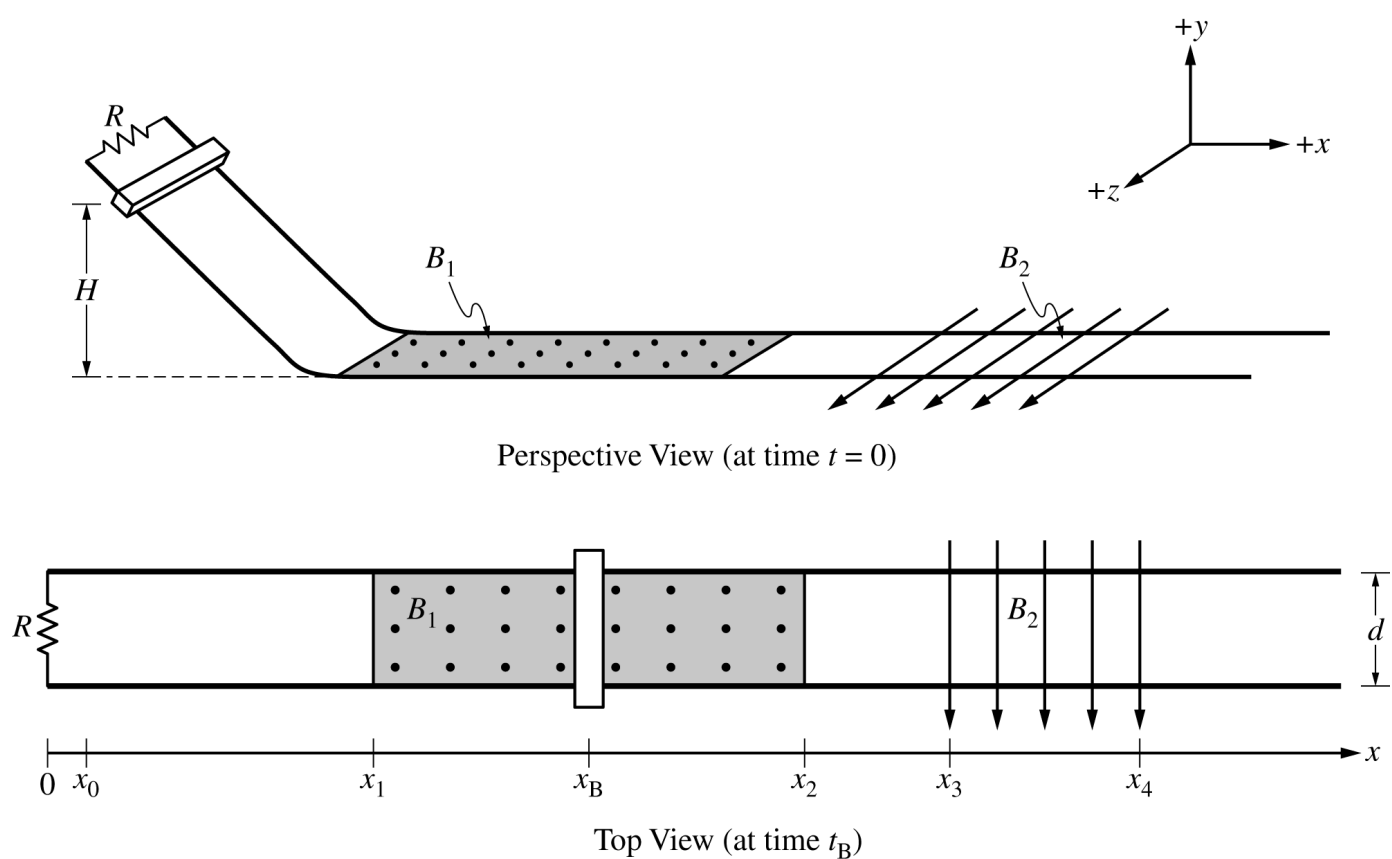




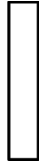
Two parallel conducting rails are separated by distance $d = 0.30$ m. A resistor of resistance $R = 0.20\ \Omega$ connects the rails. A conducting bar is placed on a sloped section of the rails at height H above the horizontal section of the rails. Frictional forces and the resistances of the bar and rails are negligible.

- At time $t = 0$, the bar is released from rest from position x_0 and slides down the sloped section of the rails, as shown in the Perspective View.
- At time t_1 , the bar reaches position x_1 and smoothly transitions to the horizontal section of the rails and enters a uniform magnetic field of magnitude $B_1 = 0.40$ T that is directed in the $+y$ -direction.
- At time t_2 , the bar reaches position x_2 and enters a region with no magnetic field.
- At time t_3 , the bar reaches position x_3 and enters a uniform magnetic field of magnitude $B_2 = 0.60$ T that is directed in the $+z$ -direction.
- At time t_4 , the bar reaches position x_4 and enters a region with no magnetic field.

The bar is at position x_B (shown in Top View) at time t_B such that $t_1 < t_B < t_2$.

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- (a) On the following diagram of the bar, as observed from the Top View, draw an arrow indicating the direction of the net force F_{net} exerted on the bar at time t_B . If the net force is zero, write $F_{\text{net}} = 0$.

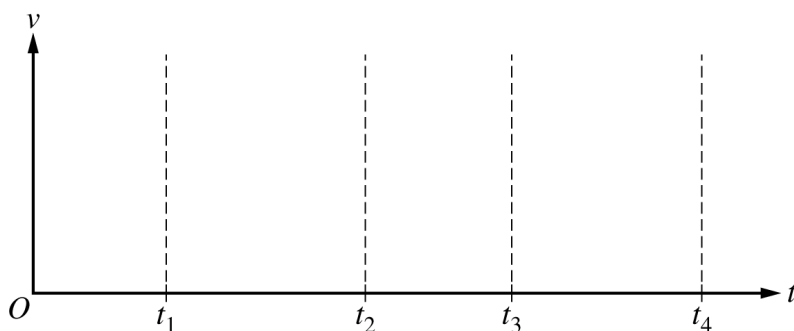


- (b) At time t_B , the speed of the bar is $v = 2.5$ m/s.

i. Calculate the magnitude of the current in the bar at time t_B .

ii. Calculate the magnitude of the net force F_{net} exerted on the bar at time t_B .

- (c) On the following axes, sketch a graph of the speed v of the bar as a function of time t between $t = 0$ and t_4 .



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Continue your response to QUESTION 2 on this page.

- (d) The original scenario is repeated but with a new bar that has the same mass but with a nonnegligible resistance $R = 0.20\ \Omega$. The new bar is released from rest and smoothly transitions to the horizontal section of the rails and enters the first uniform magnetic field.

i. Determine the total resistance of the closed circuit.

ii. In the original scenario, the magnitude of the acceleration of the bar immediately after the bar enters the first uniform magnetic field is a_{original} . In the new scenario, the magnitude of the acceleration of the bar immediately after the bar enters the first uniform magnetic field is a_{new} . Is a_{new} greater than, less than, or equal to a_{original} ? Justify your answer.

- (e) Describe a modification to H , B_1 , or d that will result in a larger induced current in the new bar immediately after the bar enters the first uniform magnetic field. Justify your answer.

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