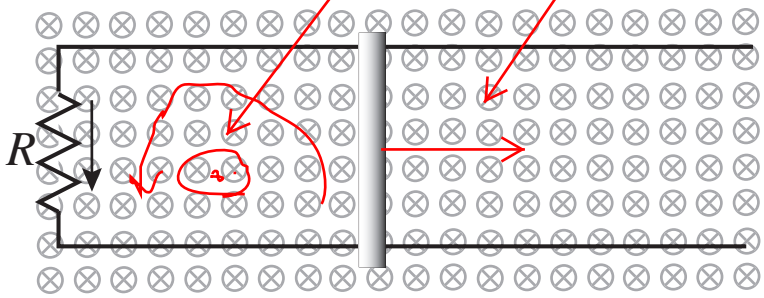
Physics 102 (F16)

from Lenz current makes this B, so this are should be expanding

Name: _____ **Section:** _____ **Score:** _____/20

1. On the horizontal plane is a pair of parallel metal rails 2.5 m apart whose left ends are connected to a resistor of resistance $R = 2\ \Omega$ as depicted in the figure. Sliding frictionlessly on the rails is a conducting bar. The resistances of the rails and the bar are negligible. A uniform magnetic field of a certain intensity B into the page is applied as illustrated in the figure.



(a) When you pull the bar with force 1.2 N horizontally, you realize a motion of the metal bar with a constant speed and simultaneously observe a current 12 A flowing in the direction of the arrow through the resistor. Find the intensity of the magnetic field B. [5]

We should try the force and the power balance: F = ILB, power balance: vF = I^2 R. Obviously, the force relation is enough.

B = F/IL = 1.2/12x2.5 = 0.04 T.

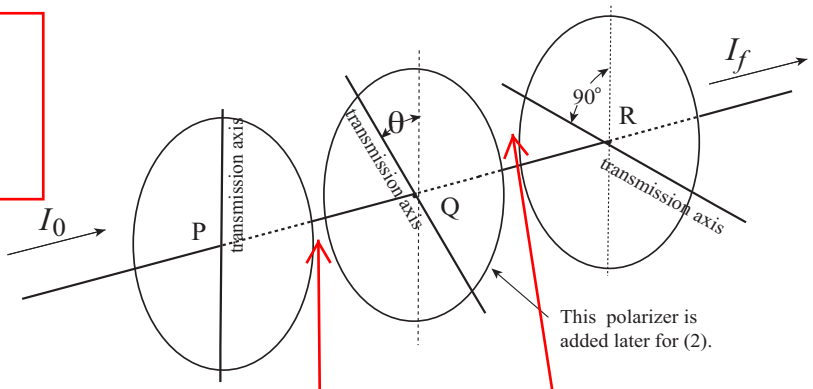
(b) Determine the velocity (magnitude and direction!) of the bar. [5]

You could use the power balance. Or motional emf, since you know B now:
LvB = RI

power: v = I^2R/F = 12^2x2/1.2 = 240 m/s.
motional emf: v = RI/LB = 2 x 12/2.5x0.04 = 240 m/s, of course.

2. Unpolarized light of intensity I_0 is incident on a linear polarizer at P from left as depicted in the figure.

I0 -> I0/2 (unpolarized case)
Malus tells us
I = I0 cos^2theta



(1) Initially, there is no polarizer placed at Q, and the second polarizer is at R which is orthogonal to the one at P. What is the intensity I_Q of the light at Q and the intensity I_f beyond R? [5]

Q is i0/2. Its plane of polarization is parallel to the transmission axis of P,

(2) Now, we insert the third linear polarizer at Q that makes angle $\theta = 30°$ with the **first** one at P. Find the intensity I_f in terms of I_0. [5]

30 deg 60 deg

If = (I0/2) (cos 30 cos 60)^2 = (3/32)I0 = 0.09375 I0