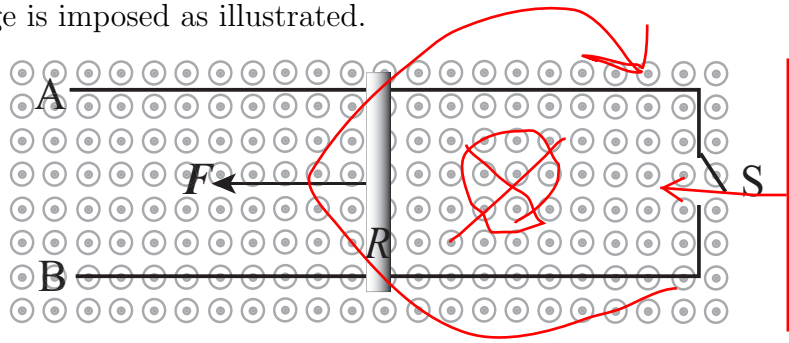
Physics 102 (F16) Q8B

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

1. On the horizontal plane is a pair of parallel metal rails 3 m apart which are connected at the right end to switch S as shown in the figure. A conducting bar with resistance $R = 10$ Ω between the rails is mounted on the rails as illustrated. A uniform magnetic field $B = 1.2$ T out of this page is imposed as illustrated.



If S is closed, the area here increases -> upward magnetic flux increases -> Lenz tells us that the circuit hates this and make the magnetic flux in the opposite direction

(a1) Initially, the switch is **closed**, and the metal bar is horizontally pulled by a force of $F = 10$ N as shown in the figure. What is the speed v of the bar when it moves at a constant velocity? [Hint: determine the currentusing the force balance. Then, use the power balance.] [5]

power balance Fv = I^2R = V^2/R
force balance F = ILB

What do we know? L =3, B = 1.2, R = 10, F = 10,

We want v = I^2R/F = (F/LB)^2R/F = FR/(LB)^2 = 10x10/3.6^2 = 7.7 m/s

emf = LvB -> Fv = (LvB)^2/R is wiser to get the above formula.

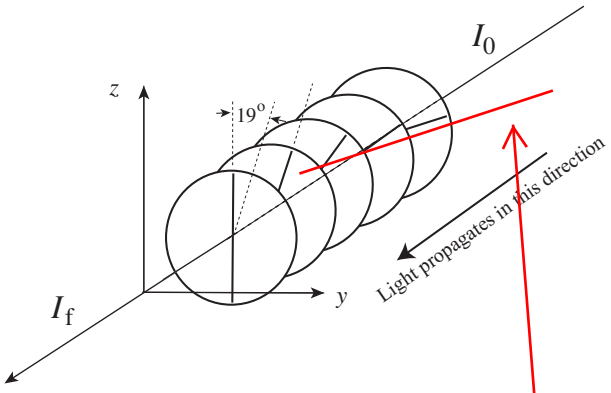
(a2) Does the current flow upward or downward through the metal bar in the figure. Draw the arrow in the figure indicating the positive current direction. [2]

(b) Now, we open the switch. What force do you need to keep the speed obtained in (a)? [3]

No dissipation 0, of course!

2. Unpolarized light of intensity I_0 is incident on a series of 5 linear polarizers, each with its transmission axis tilted by the same angle 21° relative to the preceding polarizer as illustrate below.

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



(1) What is the direction of the electric field of the light coming out from these polarizer bank? Describe it or indicate it in the figure. [5]

Its polarization plane is parallel to the last transmission axis.

(2) What is the intensity I_f of the outgoing light in terms of I_0, the intensity of the incident **unpolarized** light? [5]

Behind the first polarizer I0 -> I0/2, because the incident light is unpolarized.
After this the light is linearly polarized.
(I0/2) (cos^2 19)^8 = 0.319 I0.