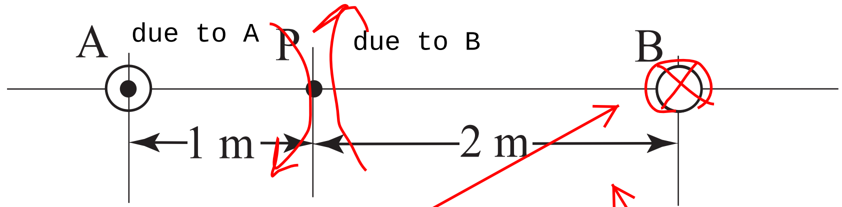
Physics 102 (F16) Q7B

Name: ____________ **Section:** ________ **Score:** ________/20

1. Two straight thin wires are perpendicular to the page as illustrated in the figure. Wire A carries a current I of 3.5 A as illustrated.



(1) The magnetic field at P happens to be zero. What is the current through wire B? Its magnitude and direction must be answered with justification. [5]

Ampere's law, RHscrew rule
B = mu0 I/(2Pi r)

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B due to B
RH screw rule tells us
current B must be into the page
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Magnitude: B = mu0 I/(2pi r)
rA = 1 m, rB = 2 m.
Therefore, IA/rA = IB/rB is required.  ->  IB = IA(rB/rA) = 3.5(2/1) = 7 A.
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(2) Now wire A is rotated 90 degrees around the line AB in the figure and the whole wire A is in this page (still perpendicular to the line connecting A and B). All the currents maintain their magnitudes as in (1). What is the force acting on wire A per 1 m? [5]

F = ILB sin phi

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B and I are perpendicular, so F = 0.
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2. On the xy plane is a closed square loop of wire enclosing an area $A = 5.0 \times 10^{-4}$ m^2. The wire carries an unknown but permanent current of I as shown in the figure.

(1) A uniform magnetic field $\boldsymbol{B}$ of magnitude 11 T making an angle $\theta = 25°$ with the positive z-axis, as illustrated, twists the loop with a torque of 21×10^{-3} N·m. What is the current I? [5]

tau = NIAB sin phi

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I = tau/BA sin phi
  = 21x10^{-3}/11 x 5x10^{-4}x sin 25
  = 21x10^{-3}/2.32x10^{-3}
 = 9.05 A
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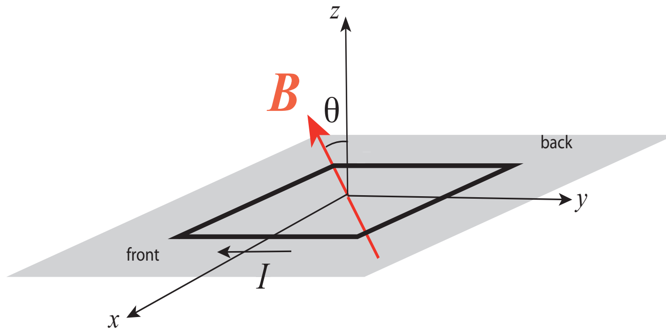

(2) After turning off the magnetic field, a bar magnet parallel to the y-axis is placed on the y-axis as illustrated below while the loop with the same current as in (1) is fixed. Then, the loop is gently released so that it can freely rotate around the origin. What happens to the loop shortly after it is released? [e.g., it starts to rotate around $\cdots$ as shown by the arrow (that you draw) in the figure.] [5]