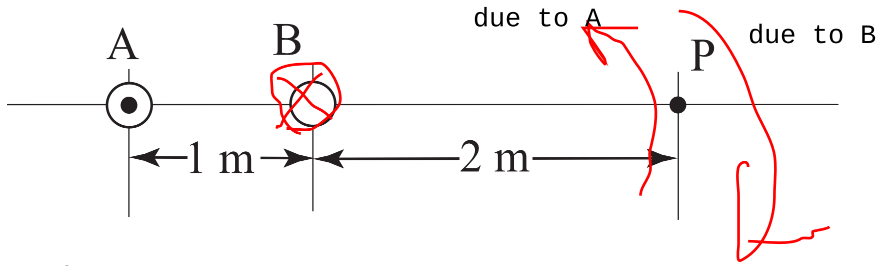
Physics 102 (F16)

Name: ____________________ **Section:** __________ **Score:** __________/20

1. Two straight thin wires A and B are perpendicular to the page as illustrated in the figure. Wire A carries a current of 3.6 A in the directions as indicated in the figure.



(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)

B due to B
RH screw rule tells us
current B must be into the page

Magnitude: B = mu0 I/(2pi r)
rA = 3 m, rB = 2 m.
Therefore, IA/rA = IB/rB is required. -> IB = IA(rB/rA) = 3.6(2/3) = 2.4 A.

(2) Now the current through wire A is modified and the force acting on wire A is 3 mN per 1 m. What is the force acting on wire B per 1 m? (5)

F = ILB sin phi

But this is the problem of the action-reaction principle.

The same.

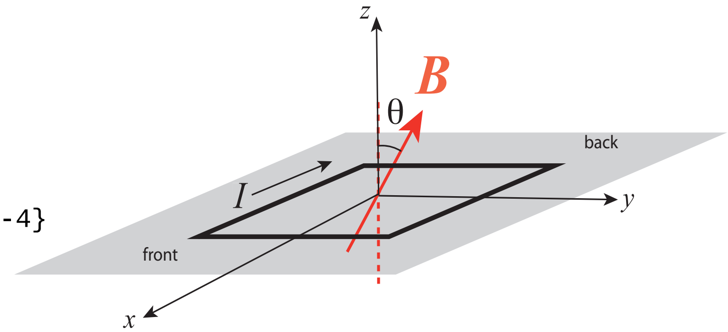
2. On the xy plane is a closed square loop of wire enclosing an area $A = 4.1 \times 10^{-4}$ m^2. The wire carries a permanent current of $I = 121$ A as shown in the figure.

(1) A uniform magnetic field $\boldsymbol{B}$ with magnitude 1.3 T makes a certain angle θ with the positive z-axis as illustrated twists the loop with a torque of 4×10^{-2} N·m. What is the angle θ? [5]

tau = NIAB sin phi

```
sin theta = tau/IBA
  = 4x10^{-2}/121 x 1.3 x 4.1x10^{-4}
  = 4x10^{-2}/0.0645 = 0.62

Therefore, theta = 38.3 deg.
```



(2) After turning off the magnetic field, a bar magnet parallel to the x-axis is placed on the x-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]