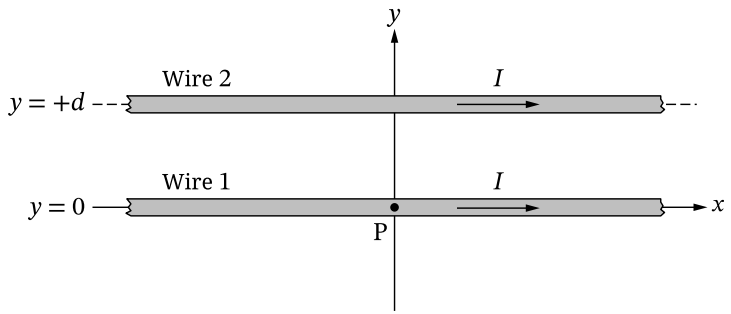
Question 1: Version J

1. Very long Wire 1 carries current I in the $+x$-direction along the line $y = 0$. Very long Wire 2 carries current I in the $+x$-direction along the line $y = +d$. Point P is located along Wire 1 at the origin, as shown in Figure 1. The diameters of the wires are small compared to the distance between the wires. Both wires are in the xy-plane.

Figure 1

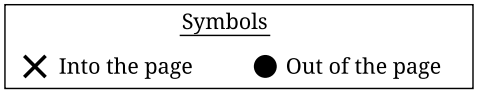


Note: Figure not drawn to scale.

A.

i. Complete the following tasks in figures 2 and 3. Use either arrows or the symbols shown in the box above the figures for your response.

- **Indicate** the direction of the magnetic field from Wire 2 at Point P in Figure 2.
- **Indicate** the direction of the magnetic force that is exerted on Wire 1 by Wire 2 in Figure 3.



Magnetic Field from Wire 2 at Point P

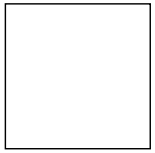


Figure 2

Magnetic Force on Wire 1 by Wire 2

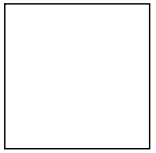


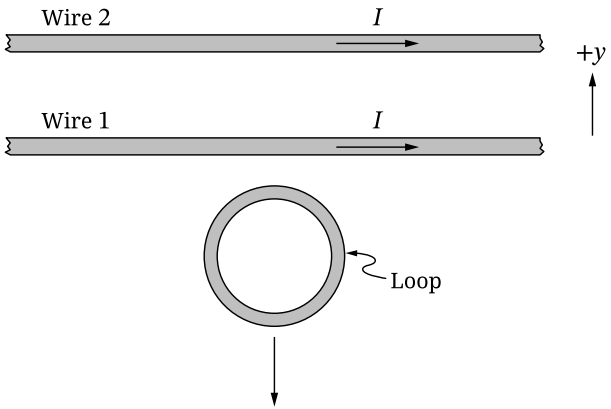
Figure 3

ii. Very long Wire 3 carrying current $2I$ in the $+x$-direction is placed in the xy-plane along the line $y = y_3$. The net magnetic force exerted on Wire 1 by the currents in wires 2 and 3 is zero.

Derive an expression for y_3 in terms of d. Begin your derivation by writing a fundamental physics principle or an equation from the reference information.

B. Wire 3 is moved very far away from wires 1 and 2. A circular conducting loop in the *xy*-plane is initially held at rest below Wire 1. The loop is then moved at a constant speed in the $-y$-direction, as shown in Figure 4.

Figure 4



Note: Figure not drawn to scale.

Indicate whether there is a clockwise induced current in the loop, a counterclockwise induced current in the loop, or no induced current in the loop.

_____ Clockwise

_____ Counterclockwise

_____ There is no induced current in the loop.

Justify your answer.