Given: Two parallel wires with currents $I_A$ and $I_B$ enter into the page, where $I_B = I_A \sin 30^\circ$. The separation between them is $2a$.

$$A (-a, 0) \quad B (+a, 0)$$

$$I_B = I_A \sin 30^\circ$$

The direction of the magnetic field $\vec{B}$ at $P (0, -2a)$ is

A) in quadrant I.
B) in quadrant II.
C) in quadrant III.
D) in quadrant IV.

$I_A = 2I_B$,
since
$\sin 30^\circ = \frac{1}{2}$.

By the RH-rule for a long wire, $\vec{B}$ at point $P$ due to current $I_A$ is tangential to the arc with the center at $A (-a, 0)$ and radius $\overline{AP}$, pointing left-downward; $\vec{B}$ at point $P$ due to current $I_B$ is tangential to the arc with center at $B (+a, 0)$ and radius $\overline{BP}$, pointing left-upward. These two magnetic fields have horizontal components in the negative $x$ direction.

Since $I_A = 2I_B$, the magnitudes of the vertical components are related such that $||\vec{B}_{AP_y}|| = 2 ||\vec{B}_{BP_y}||$. Note: $\vec{B}_{AP_y}$ points downward (in the negative $y$ direction) so the resultant $y$ components is downward.

So the net $\vec{B}$ at $P$ is directed in quadrant III.
Answer C.

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