A ball is thrown and follows the parabolic path shown. Air friction is negligible. Point $Q$ is the highest point on the path. Points $P$ and $R$ are the same height above the ground.

How do the speeds of the ball at the three points compare?

A) $||\vec{v}_Q|| < ||\vec{v}_R|| < ||\vec{v}_P||$

B) $||\vec{v}_P|| < ||\vec{v}_Q|| < ||\vec{v}_R||$

C) $||\vec{v}_R|| < ||\vec{v}_Q|| < ||\vec{v}_P||$

D) $||\vec{v}_Q|| < ||\vec{v}_P|| = ||\vec{v}_R||$

E) $||\vec{v}_P|| = ||\vec{v}_R|| < ||\vec{v}_Q||$

The speed of the ball in the $x$-direction is constant. Because of gravitational acceleration, the speed in the $y$-direction goes to zero at point $Q$. Since points $P$ and $R$ are located at the same point above ground, by symmetry we see that they have the same speed in the $y$-direction (though they do not have the same velocity). The answer is then “$v_Q < v_P = v_R$”.

Answer D.