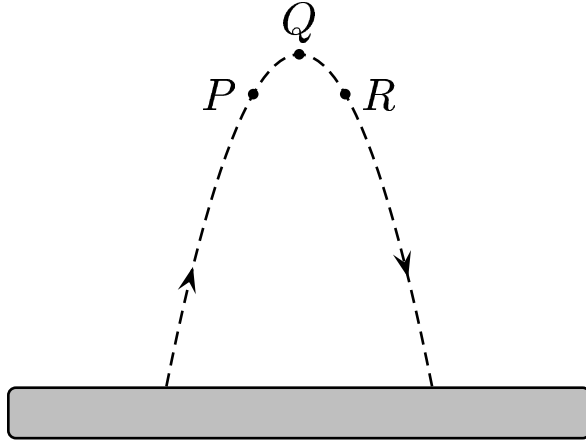


A ball is thrown and follows the parabolic path shown. Air friction is negligible. Point Q is the highest point on the path. Points P and R are the same height above the ground.



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**.

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