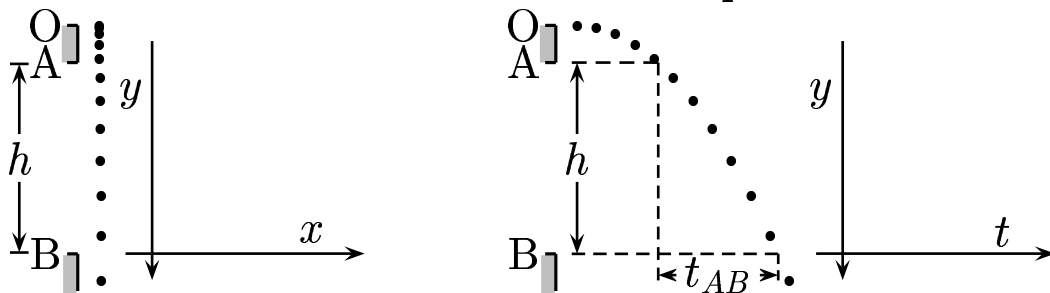


A ball is dropped from rest at O . It passes a window which has a height h , in a time interval t_{AB} . Let down be positive.



Let $\|\vec{v}\| \equiv v$ be the speed of the ball. Identify the correct pair of equations for the speeds v_A and v_B that one may use to solve for v_B , where v_A and v_B are speeds and $\Delta t = t_{AB} = t_B - t_A$.

- A) $v_A - v_B = g t_{AB}$ and $v_A + v_B = \frac{h}{t_{AB}}$
- B) $v_A - v_B = g t_{AB}$ and $\frac{v_A + v_B}{2} = \frac{h}{t_{AB}}$
- C) $v_B - v_A = g t_{AB}$ and $v_A + v_B = \frac{h}{t_{AB}}$
- D) $v_B - v_A = g t_{AB}$ and $\frac{v_A + v_B}{2} = \frac{h}{t_{AB}}$

The definition of acceleration implies that $v_B - v_A = g t_{AB}$. For a constant acceleration, the average speed between A and B is given by

$v_{avg} = \frac{v_A + v_B}{2} = \frac{h}{t_{AB}}$. Multiply the first by one-half and add to the second

$$\begin{aligned} \frac{1}{2} v_B - \frac{1}{2} v_A &= \frac{1}{2} g t_{AB} \\ \frac{1}{2} v_B + \frac{1}{2} v_A &= \frac{h}{t_{AB}} \quad \text{adding, we have} \\ v_B &= \frac{h}{t_{AB}} + \frac{1}{2} g t_{AB}. \end{aligned}$$

Answer **D**.