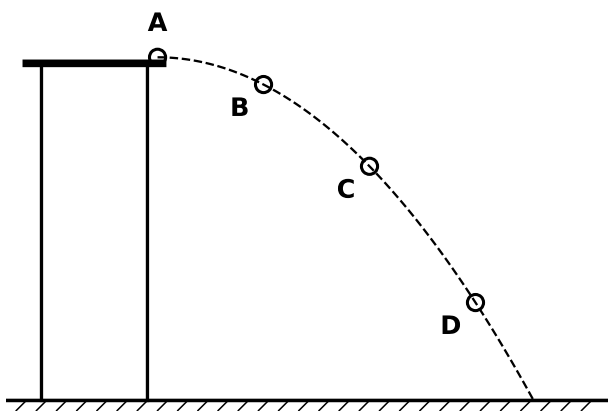


Part A: Concepts

Ignore air resistance in every problem.

1. Ana rolls a marble off a table at the same moment Ben drops an identical marble from the same height. Which marble hits the floor first? Explain using the idea of independent motions.

2. A ball rolls off a table. Its position is shown at four equally spaced moments, A through D.



- a. At each point, draw an arrow for the horizontal velocity v_x and an arrow for the vertical velocity v_y . Make the lengths show how the sizes compare.
- b. Which component stays the same during the fall? Which one changes? Explain why.

Part B: Calculations

Horizontal: $\Delta x = v_x t$. Vertical: $v_{iy} = 0$, $a_y = -9.8 \text{ m/s}^2$, $\Delta y = \frac{1}{2}a_y t^2$. Show your knowns, equation, substitution, and answer with units.

3. A skateboarder rolls off a ledge 0.441 m high at 4.50 m/s.
- How long is she in the air?
 - How far from the base of the ledge does she land?

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4. A stone is thrown horizontally off a cliff 44.1 m above the water. It lands 36.0 m from the base of the cliff.
- How long is the stone in the air?
 - How fast was the stone thrown?
 - What is the stone's vertical velocity just before it hits the water?

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5. A pitcher throws a baseball horizontally at 35.0 m/s toward home plate, 17.5 m away. How far does the ball drop by the time it reaches the plate?

