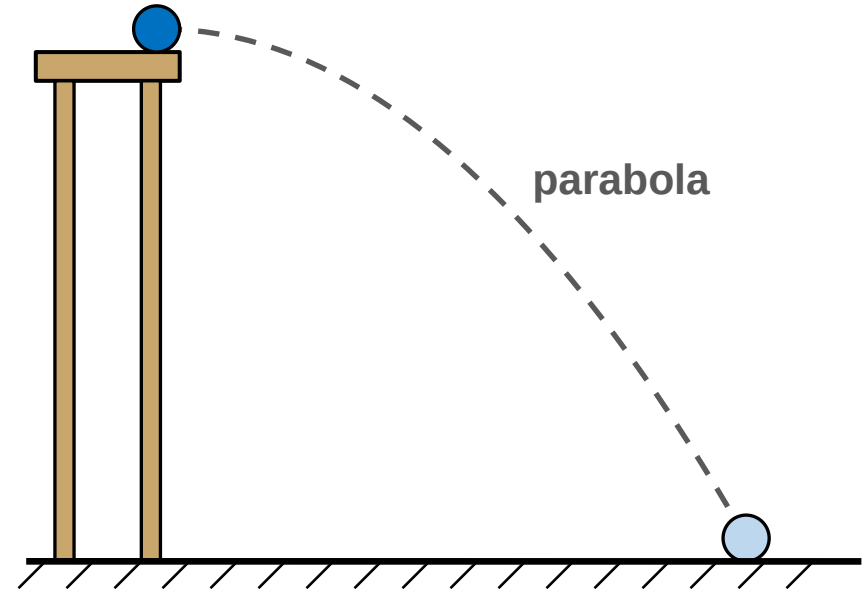


Essential Question

What path does an object take when it's launched sideways?

What Is a Projectile?

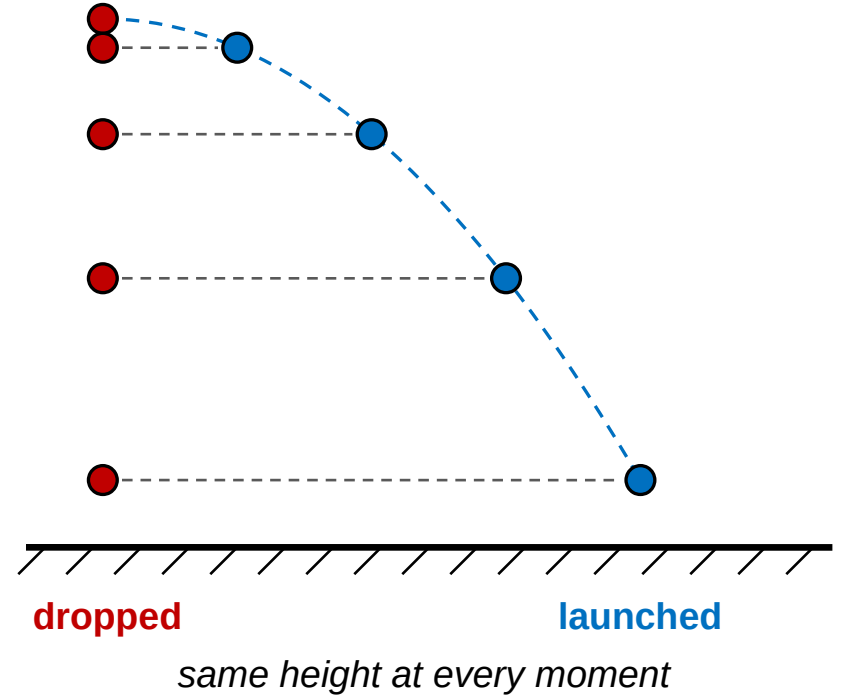
- Any object flying through the air
- Only gravity acts on it
- Its path is a curve: a parabola



gravity bends the path into a parabola

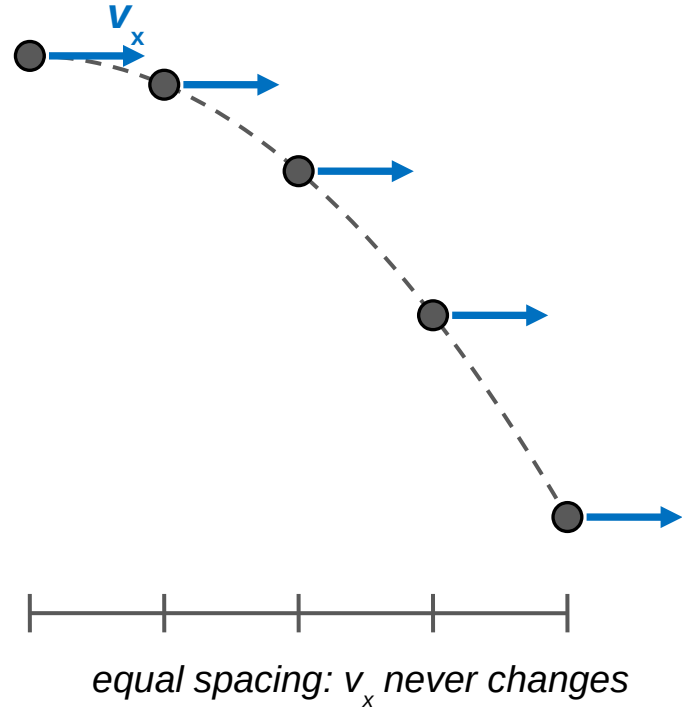
Dropped vs. Launched

- Both start with $v_y = 0$
- Both fall at the same rate
- They hit the ground together



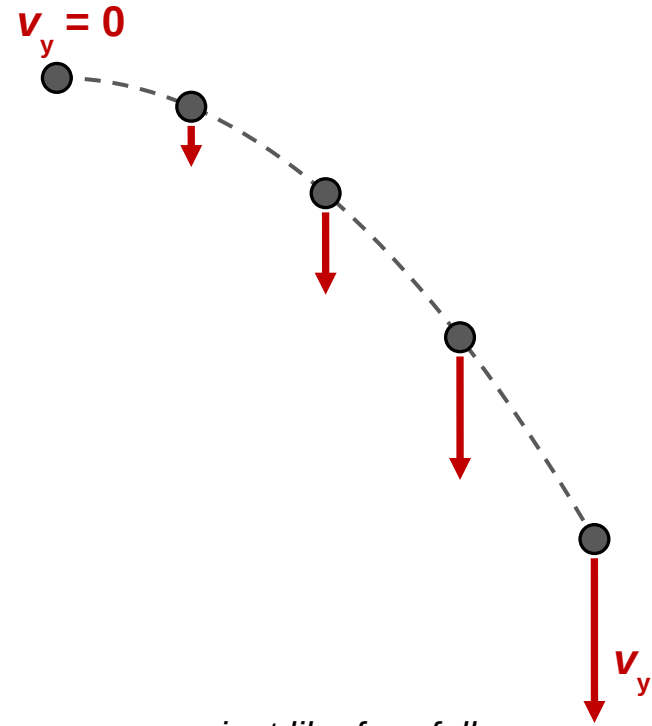
Horizontal Motion

- No horizontal force
- v_x stays constant
- Equal sideways steps



Vertical Motion

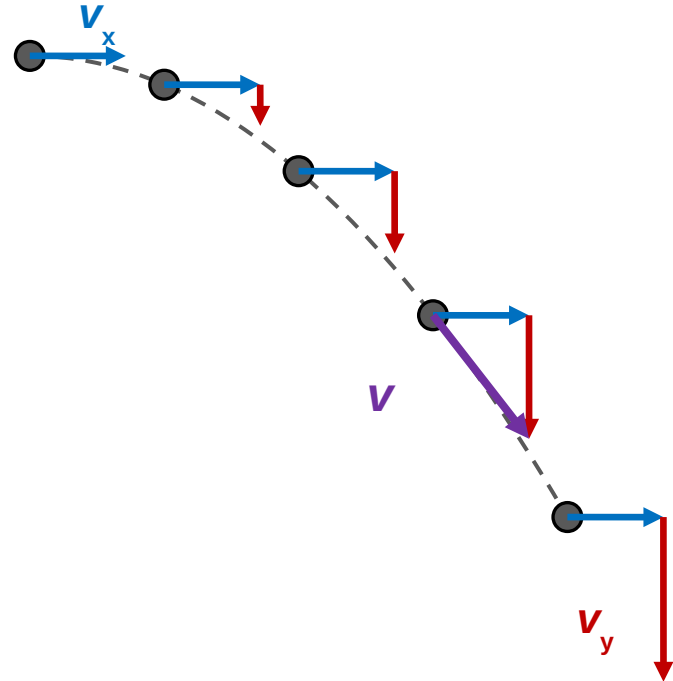
- Gravity pulls straight down
- v_y grows 9.8 m/s each second
- Just like a dropped object



v_y grows, just like free fall

Putting It Together

- The two motions are independent
- v_x : same; v_y : grows
- Total velocity is tangent to the path



v_x stays the same, v_y grows

Solving Horizontal Projectiles

Horizontal

$$v_x = \text{constant}$$

$$a_x = 0$$

$$\Delta x = v_x t$$

Vertical

$$v_{iy} = 0$$

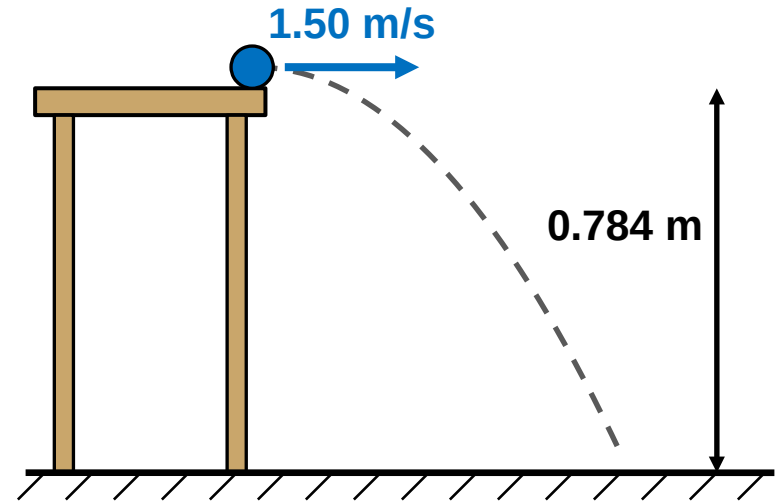
$$a_y = -9.8 \text{ m/s}^2$$

$$\Delta y = \frac{1}{2} a_y t^2$$

same time t for both

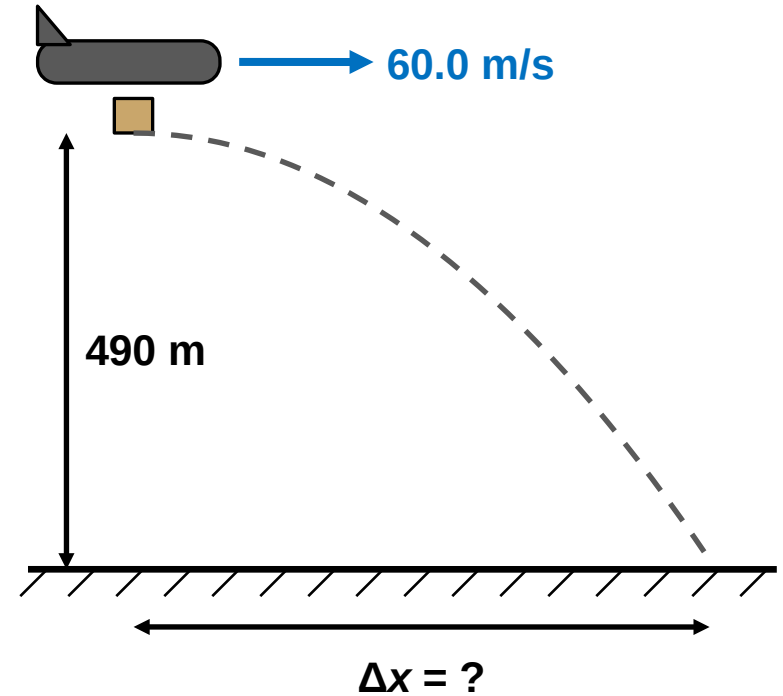
Example: Marble off a Table

A marble rolls off a lab table 0.784 m high at 1.50 m/s. How long is the marble in the air?



Example: Supply Drop

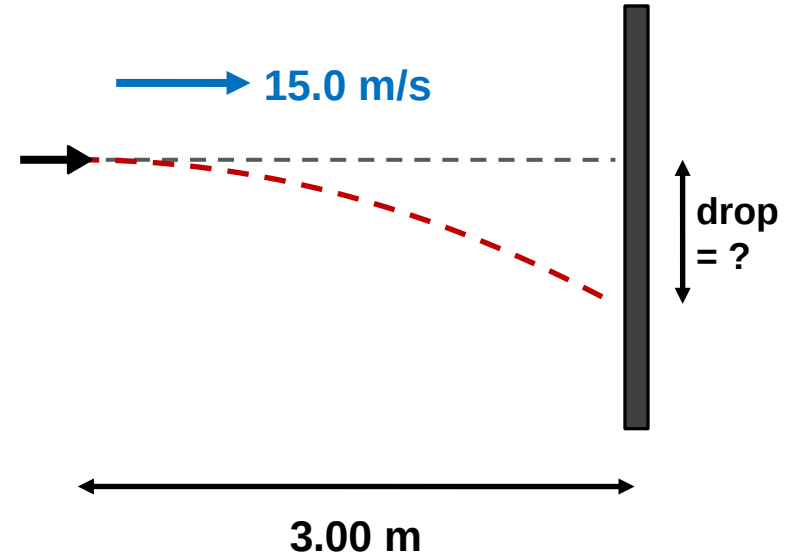
A plane flying horizontally at 60.0 m/s releases a supply package from a height of 490 m . How far does the package travel horizontally before it lands?



Horizontal Projectiles

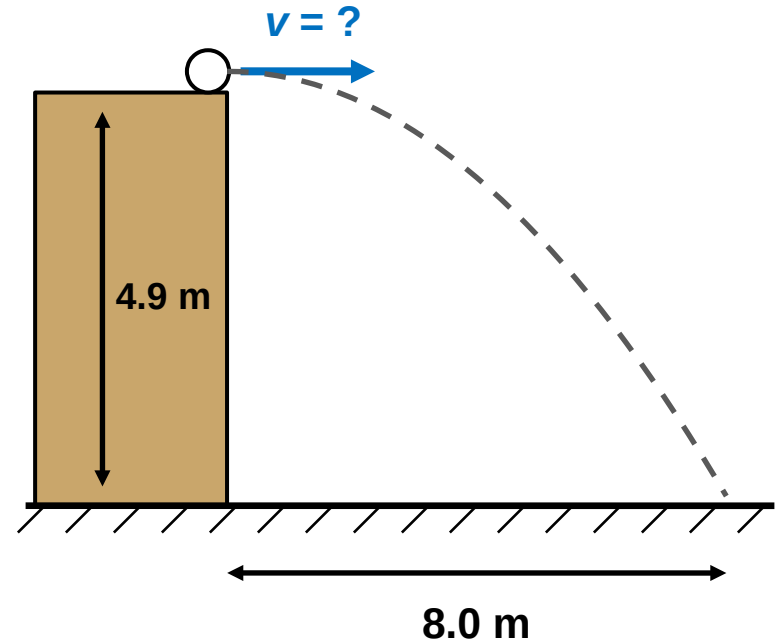
Example: Dart Drop

A dart is thrown horizontally at 15.0 m/s toward a dartboard 3.00 m away. How far does the dart drop by the time it reaches the board?



Example: Launch Speed

A ball is kicked horizontally off a ledge 4.9 m high. It lands 8.0 m from the base of the ledge. How fast was it kicked?



Big Ideas

- Horizontal and vertical motions are independent
- Horizontal: v_x constant, $\Delta x = v_x t$
- Vertical: free fall, $\Delta y = \frac{1}{2}a_y t^2$
- Time links the two motions