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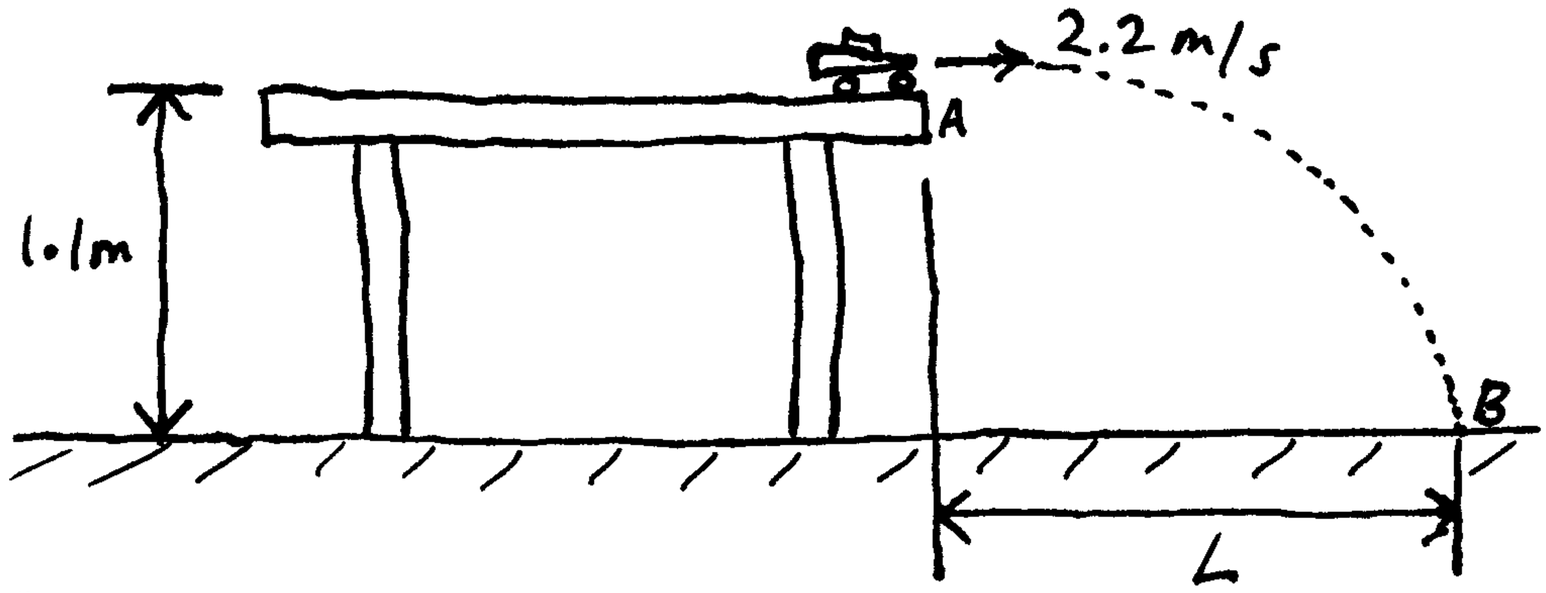
Feb. 1, 2020

This is a problem involving projectile motion.

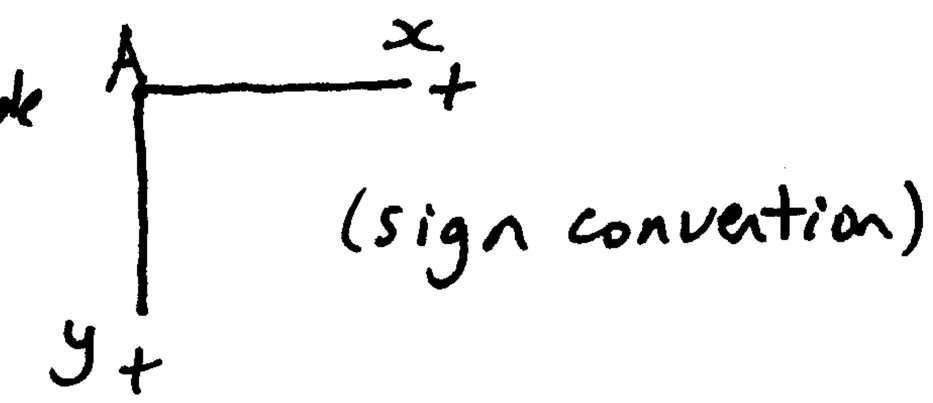


A remote controlled toy car is driven off the edge of a table, at point A, at a speed of 2.2 m/s. It lands at point B. If the table is 1.1 m high, what is the horizontal distance, L, between point A and point B?

Solution:

Assumptions:
- Ignore air resistance → negligible
- Treat car as a particle

Set up an xy coordinate frame with origin at point A, as shown.



The equation for horizontal motion is:

$$d_x = v_0 t \qquad (1)$$

$d_x = ?$ (horizontal displacement when car lands at point B)

$v_0 = 2.2\,m/s$ (initial car speed) $= v_{ox}$ (magnitude of horizontal velocity)

$t = ?$ (time it takes the car to fall to the floor)

The equation for vertical motion is:

$$d_y = v_{oy}t + \frac{1}{2}gt^2 \quad (2)$$

$v_{oy} = 0$ (vertical velocity is 0)

$d_y = 1.1\,m$ (vertical displacement when car lands at point B)

$g = 9.8\,m/s^2$

Simplify (2): $1.1 = \frac{1}{2}gt^2$

From equation (1), $t = \frac{d_x}{v_0} = \frac{d_x}{2.2}$

Substitute this into equation (2):

$$1.1 = \frac{1}{2}g\left(\frac{d_x}{2.2}\right)^2$$

Solve:

$$d_x = 1.04\,m = L \text{ (answer)}$$