De Anza College

Introduction to Mechanics
Relative Motion and Projectiles

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De Anza College

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Last time

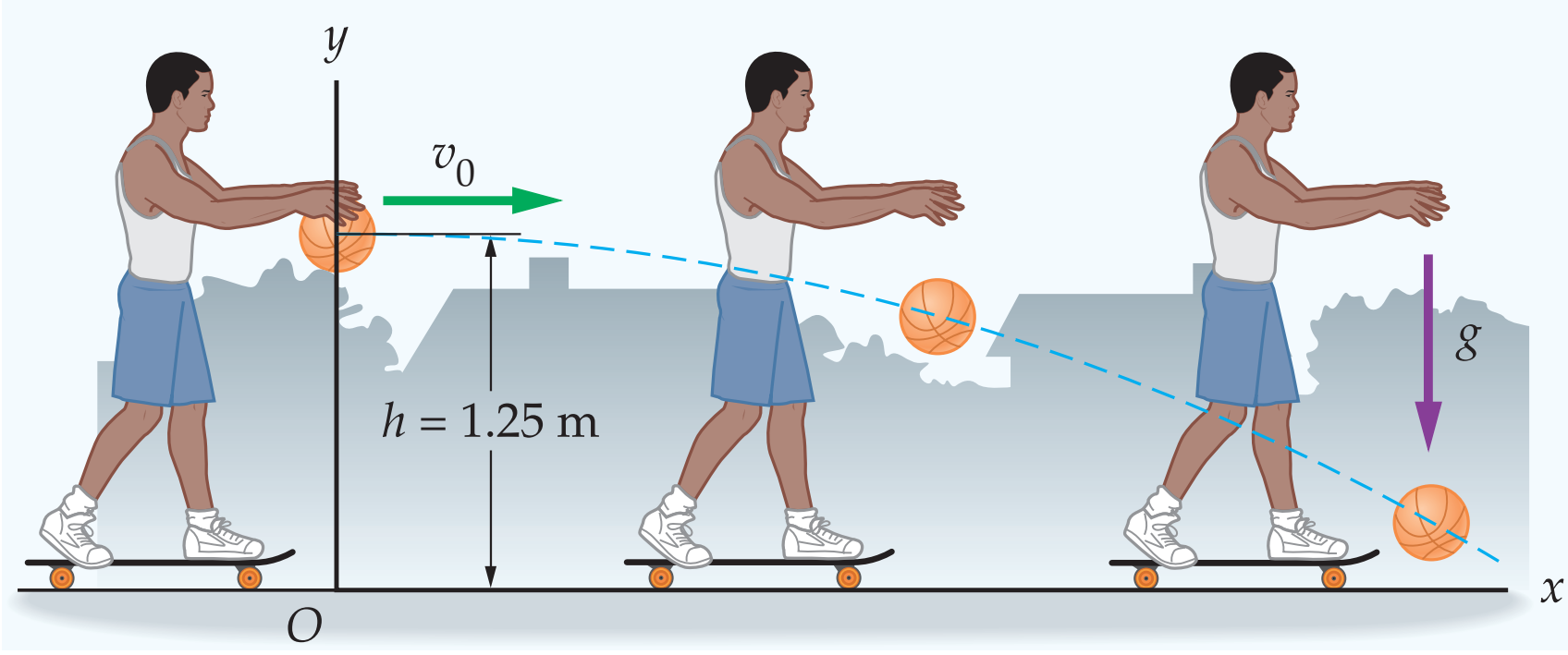
- trajectory equation
- another projectile example

Overview

- relative motion and projectiles

Relative Motion And Projectile Motion

Observer on the skateboard sees the ball fall straight down.



Another observer on the sidewalk sees the ball as a horizontally launched projectile.

Relative Motion And Projectile Motion

#73, page 108

To decide who pays for lunch, a passenger on a moving train tosses a coin straight upward with an initial speed of 4.38 m/s and catches it again when it returns to its initial level. From the point of view of the passenger, then, the coin's initial velocity is $(4.38\ \text{m/s})\,\hat{\mathbf{y}}$. The train's velocity relative to the ground is $(12.1\ \text{m/s})\,\hat{\mathbf{x}}$.

(a) What is the minimum speed of the coin relative to the ground during its flight? At what point in the coin's flight does this minimum speed occur? Explain.

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12.1 m/s, At the top of its path, where the y-component of velocity is zero.

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(b) Find the initial speed and direction of the coin as seen by an observer on the ground.

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(b) Find the initial speed and direction of the coin as seen by an observer on the ground.

$$v_0 = \sqrt{v_{0x}^2 + v_{0,y}^2} \qquad \theta = \tan^{-1}\left(\frac{v_{0y}}{v_{0x}}\right)$$

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$$v_0 = \sqrt{v_{0x}^2 + v_{0,y}^2} \qquad \theta = \tan^{-1}\left(\frac{v_{0y}}{v_{0x}}\right)$$

$\mathbf{v}_0 = 12.9$ m/s, at 19.9° above the horizontal

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(c) Use the expression for $h = y_{\text{max}}$ to calculate the maximum height of the coin, as seen by an observer on the ground.

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$$h = \frac{v_{0y}^2}{2g}$$

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$$h = \frac{v_{0y}^2}{2g}$$

$h = 0.978\ \text{m}$

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(d) Calculate the maximum height of the coin from the point of view of the passenger, who sees only one-dimensional motion.

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$h = 0.978$ m

Summary

- relative motion and projectiles

Test 2 Monday, Feb 24.

Homework

Walker Physics:

- prev: Ch 4, onward from page 100. Con. Ques: 7, 9; Problems: 1, 40 & 41, 43, 71, 77, 87, 67 (projectile in disguise)
- Read ahead in Ch 5.