Physics 211

Sections 1 & 70
Dr. Geoffrey Lovelace
Fall 2012
Lecture 7 (8/30/12)

Lecture 7 outline

- Announcements
- Survey results
- More projectiles

Announcements

- Thursday at 11:59PM: Homework #3 due
- Tuesday, September 25 (1 week!): Exam #1
  - Bring: #2 pencils, eraser, sci. calculator
  - I provide: scantron form, formula sheet
  - Study advice
    - Examples in text (work, then check)
    - Clicker questions from class
    - Learning path review
    - Homework problems
    - Odd-# problems

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Survey results

- Top likes
  - 40% — real-world examples & live demos
  - 18% — example problems in class
  - 12% — the physics itself
  - 10% — clicker questions & interactivity
- Top dislikes
  - 29% — pace too fast
  - 12% — nothing
  - 10% — board writing hard to read
  - 10% — more clarity / hard to hear me

Lecture 7 outline

- Announcements
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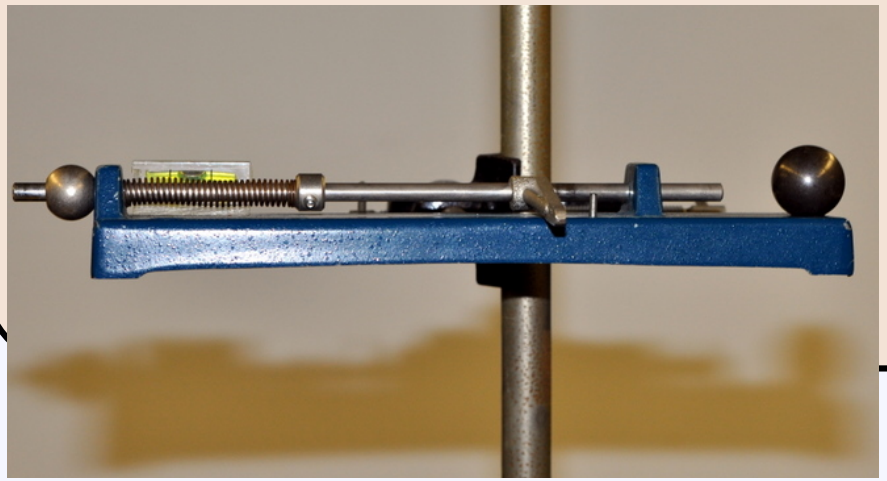
- More projectiles
  - Demo
  - Video: more examples of projectile motion
  - Features of projectile motion
  - Worked example

Clicker question #26

From the *same* height (and at the *same* time), the left ball is dropped and the right ball is fired horizontally. Which one will hit the ground first?



$\mathbf{v}_0^L = \mathbf{0}$

$\mathbf{v}_0^R$ ⟶

A — the left, "dropped" ball

B — the right, "fired" ball

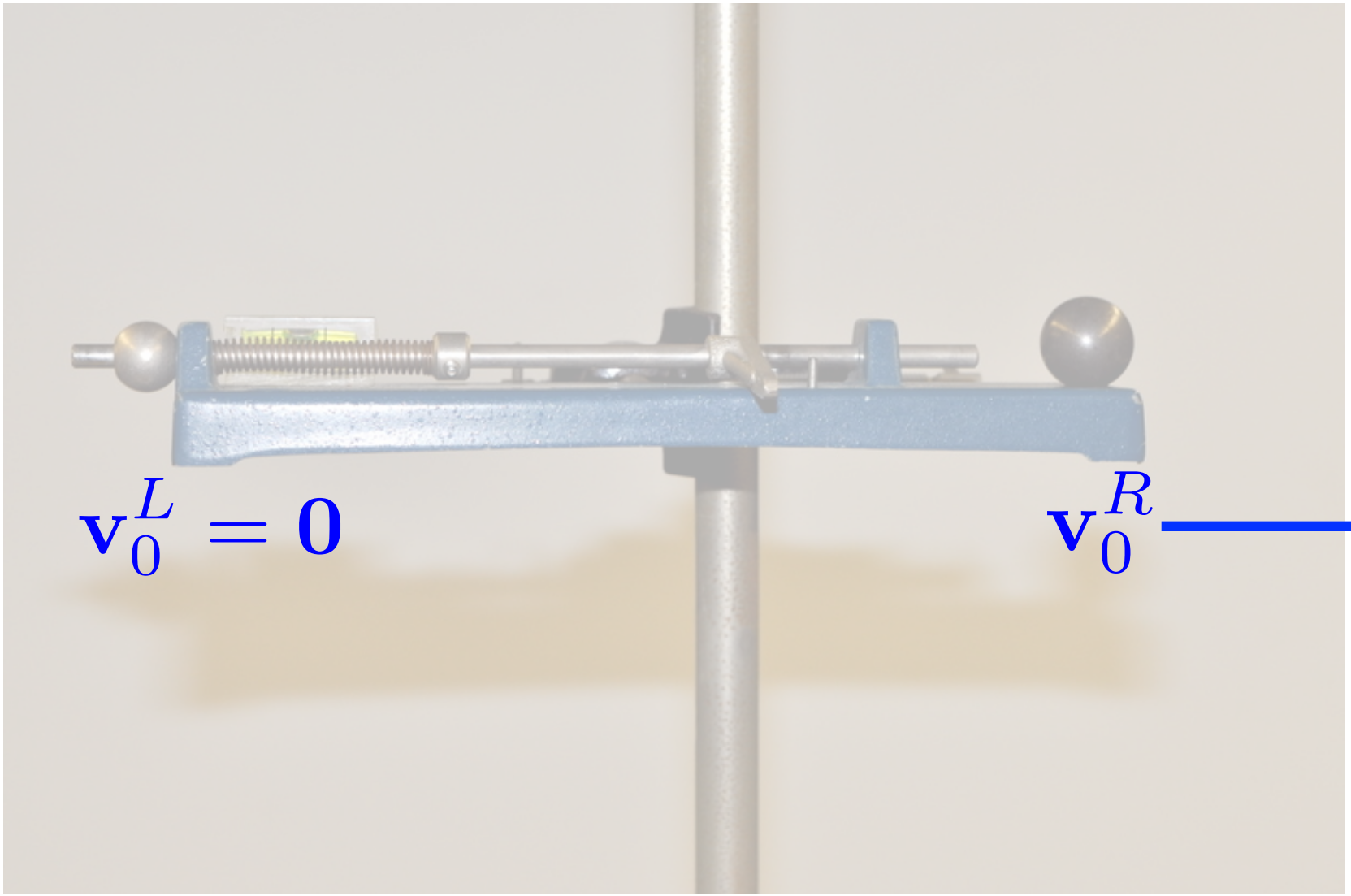
C — they both hit at the same time

D — it depends on how hard the right ball was fired

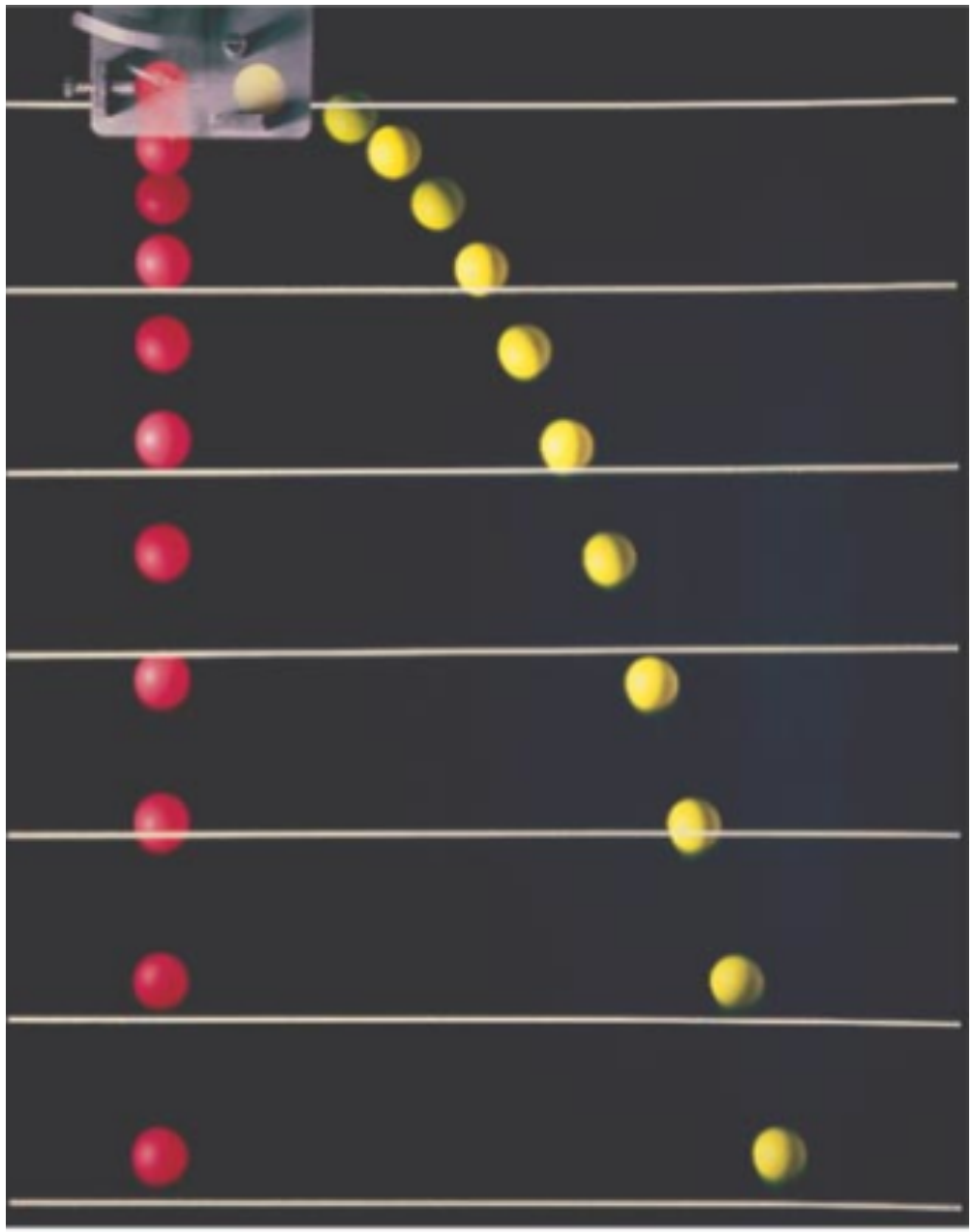
☐ — it depends on the initial height

Demo

http://physics.fullerton.edu/department/lecture-demos/92

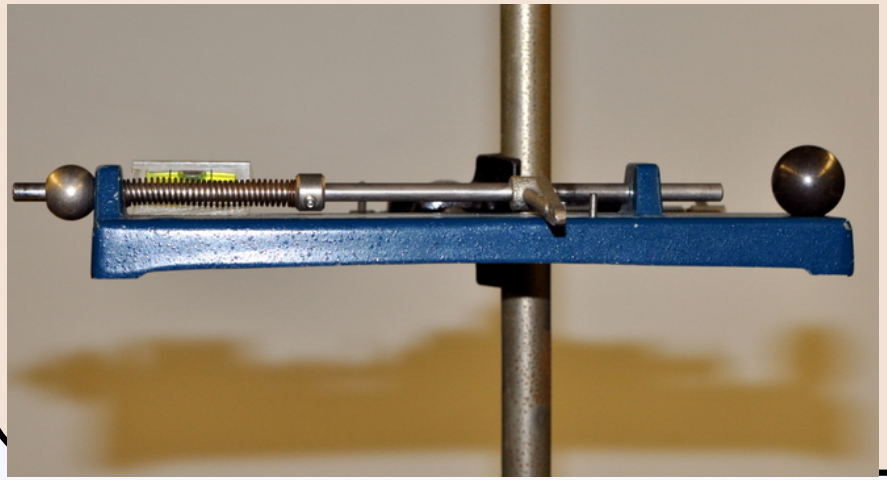


Demo



Clicker question #27

In the previous problem, which ball has the greater velocity magnitude at ground level?



$\mathbf{v}_0^L = \mathbf{0}$

$\mathbf{v}_0^R$ ⟶

A the left, “dropped” ball

B the right, “fired” ball

C neither—they both have the same velocity on impact

D it depends on how hard the right ball was fired

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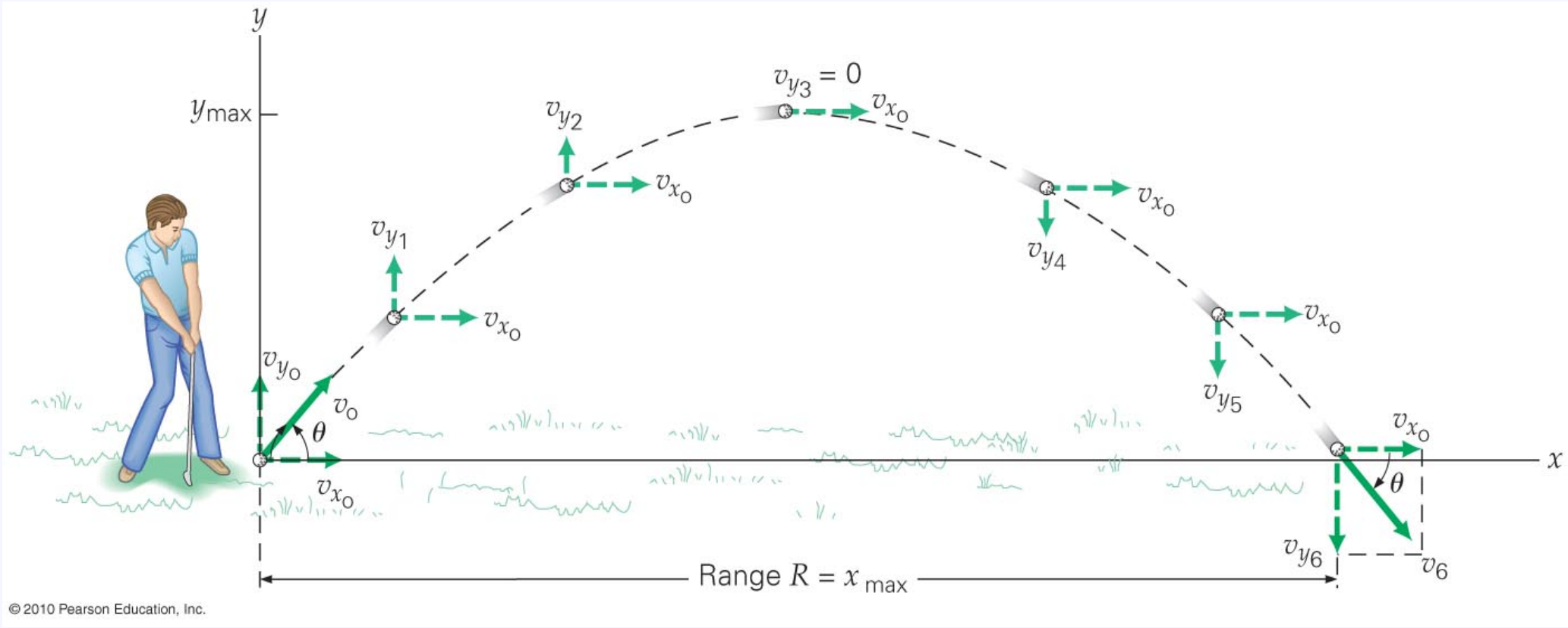
Clicker question #29



Clicker question #28a

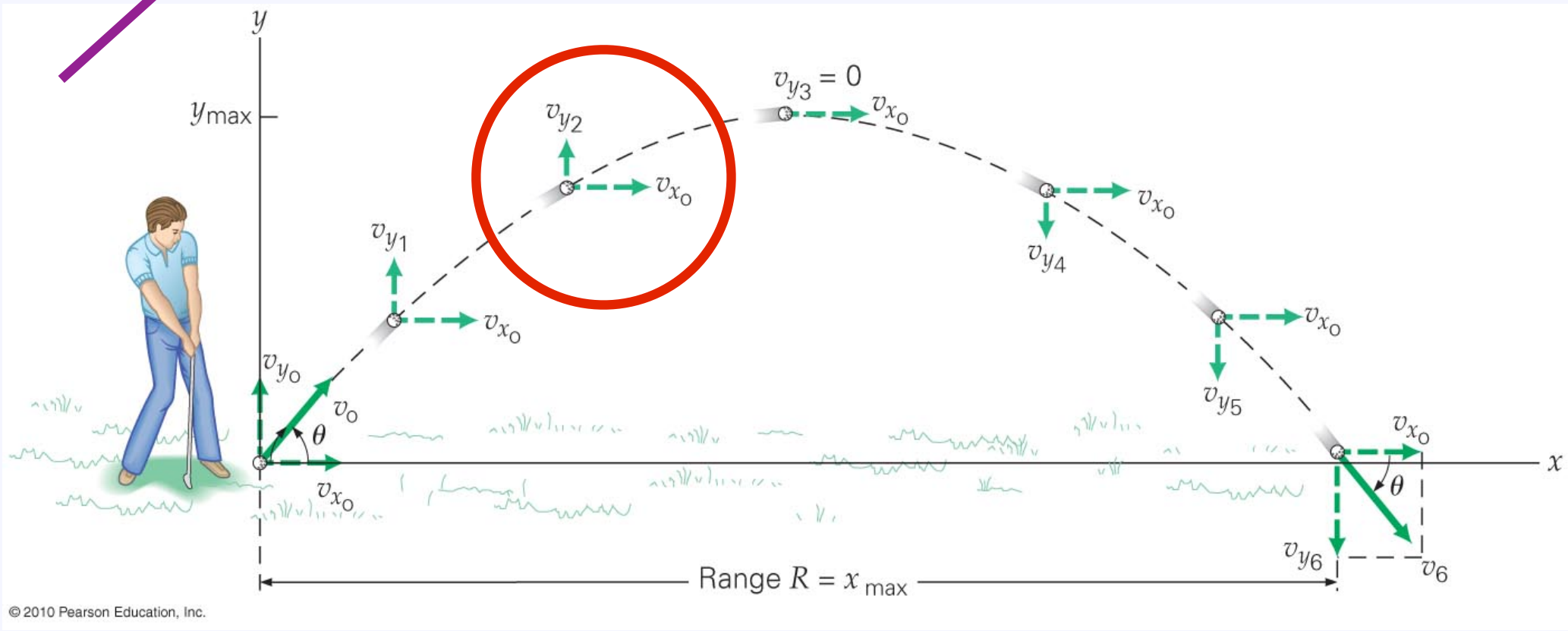
Which is the *position* at the circled time?

A

B

C

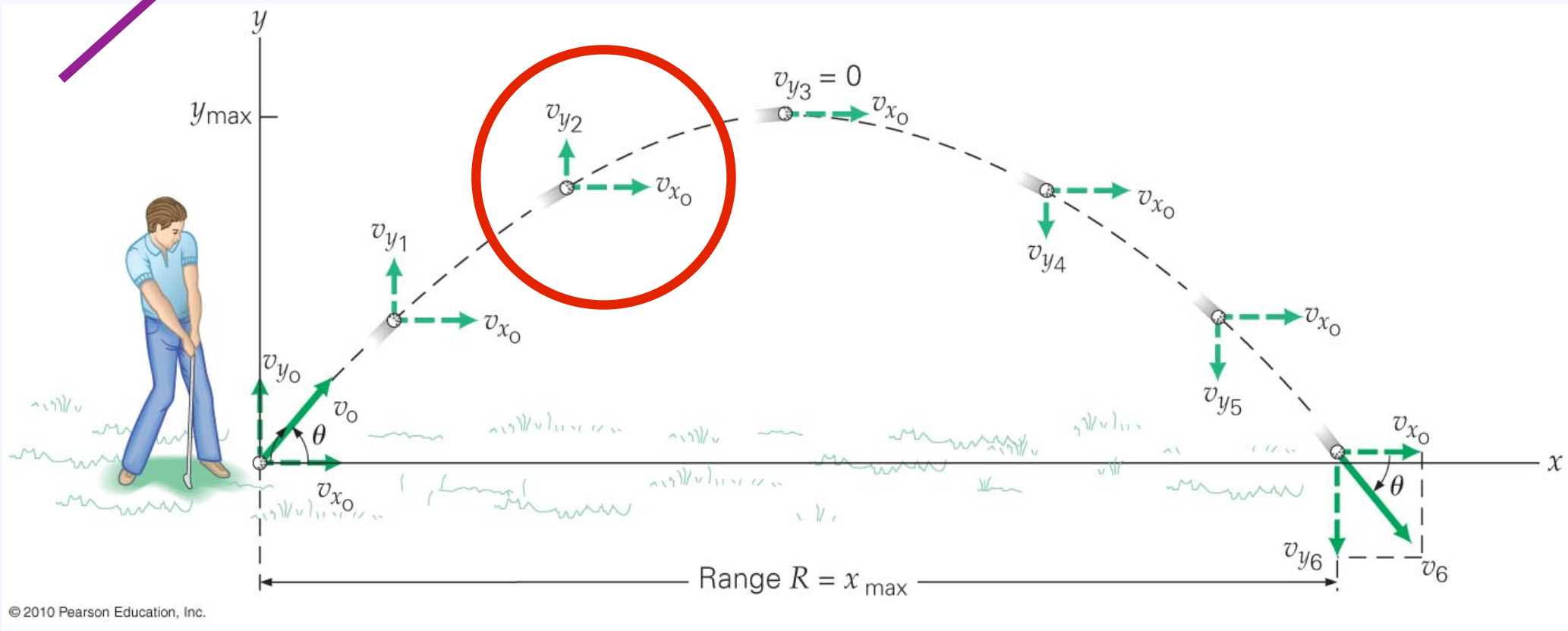
D



Clicker question #28b

Which is the *velocity* at the circled time?

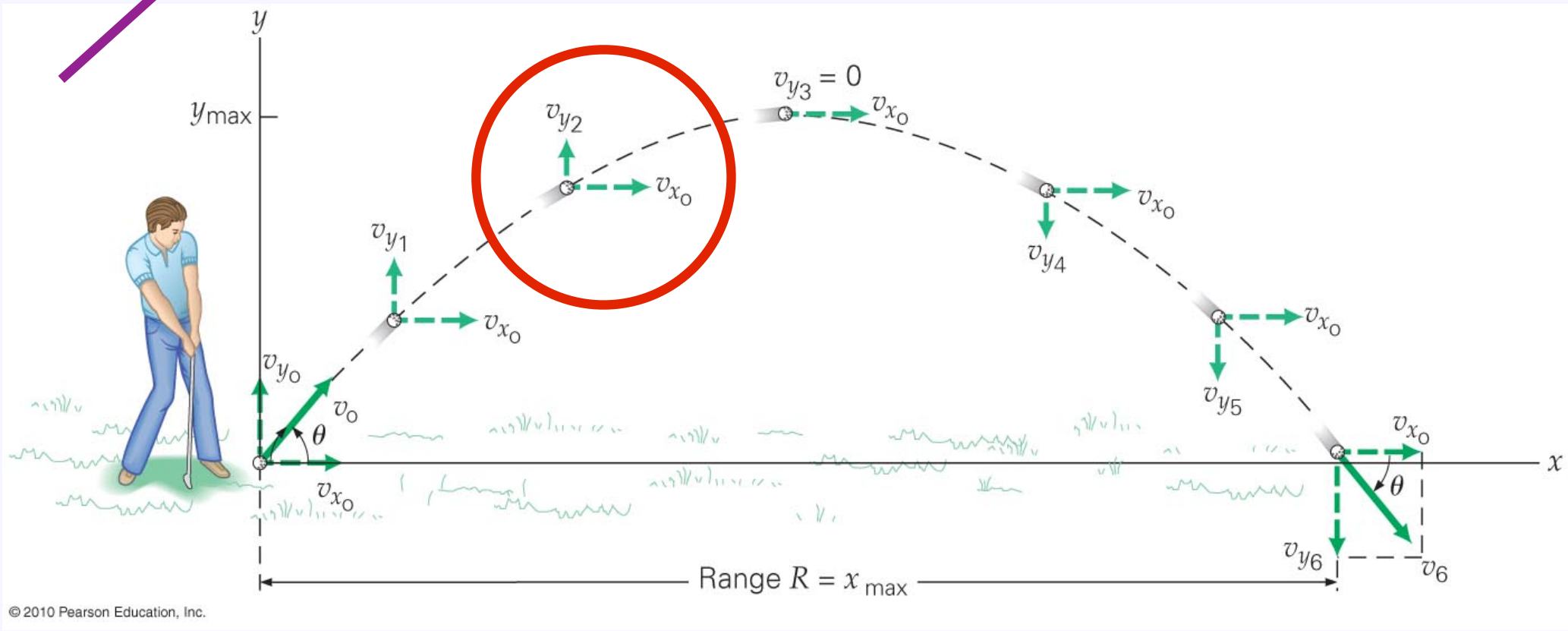
A B C D



Clicker question #28c

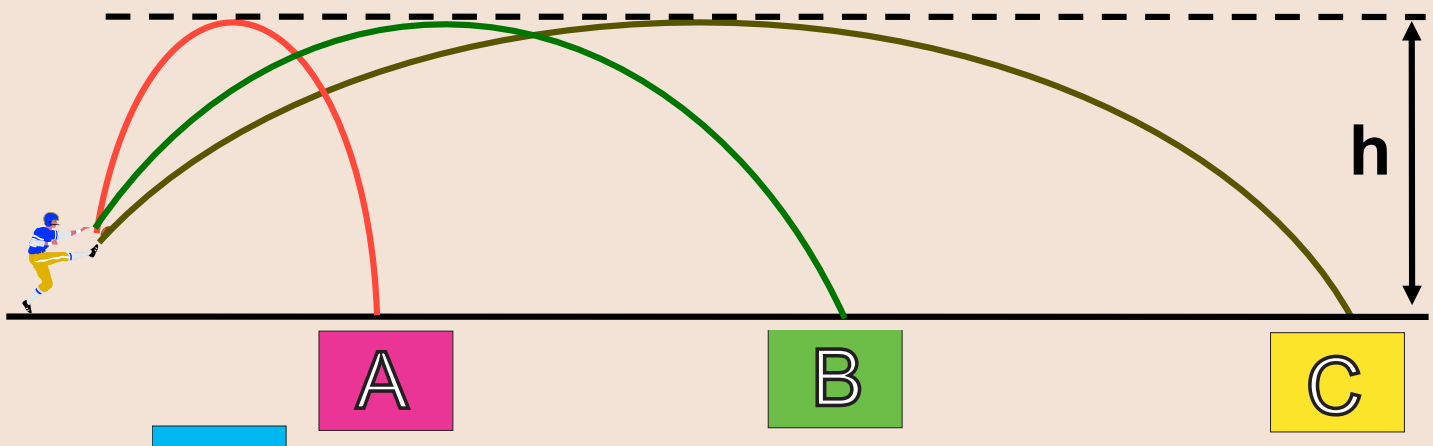
Which is the *acceleration* at the circled time?

A B C D



Clicker question #29

Which of the three punts has the longest hang time?



A

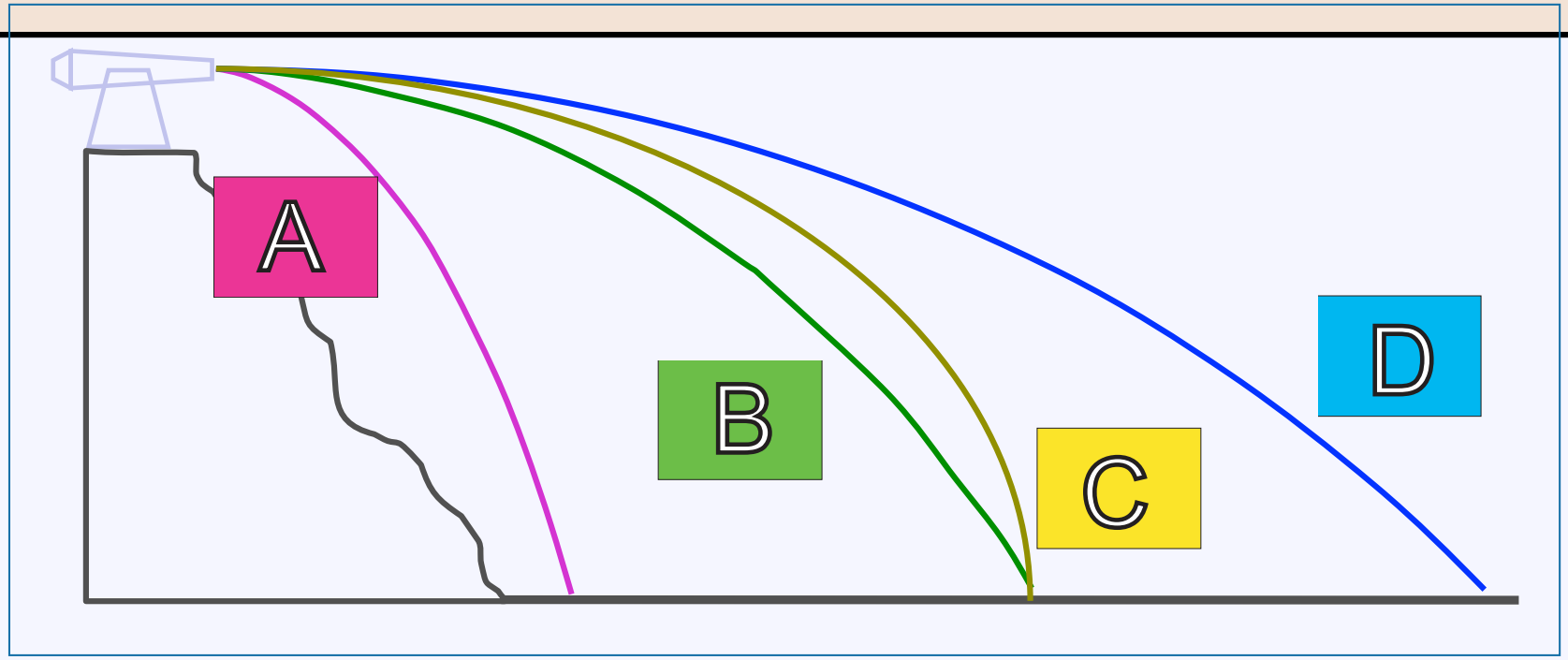
B

C

D all have the same hang time

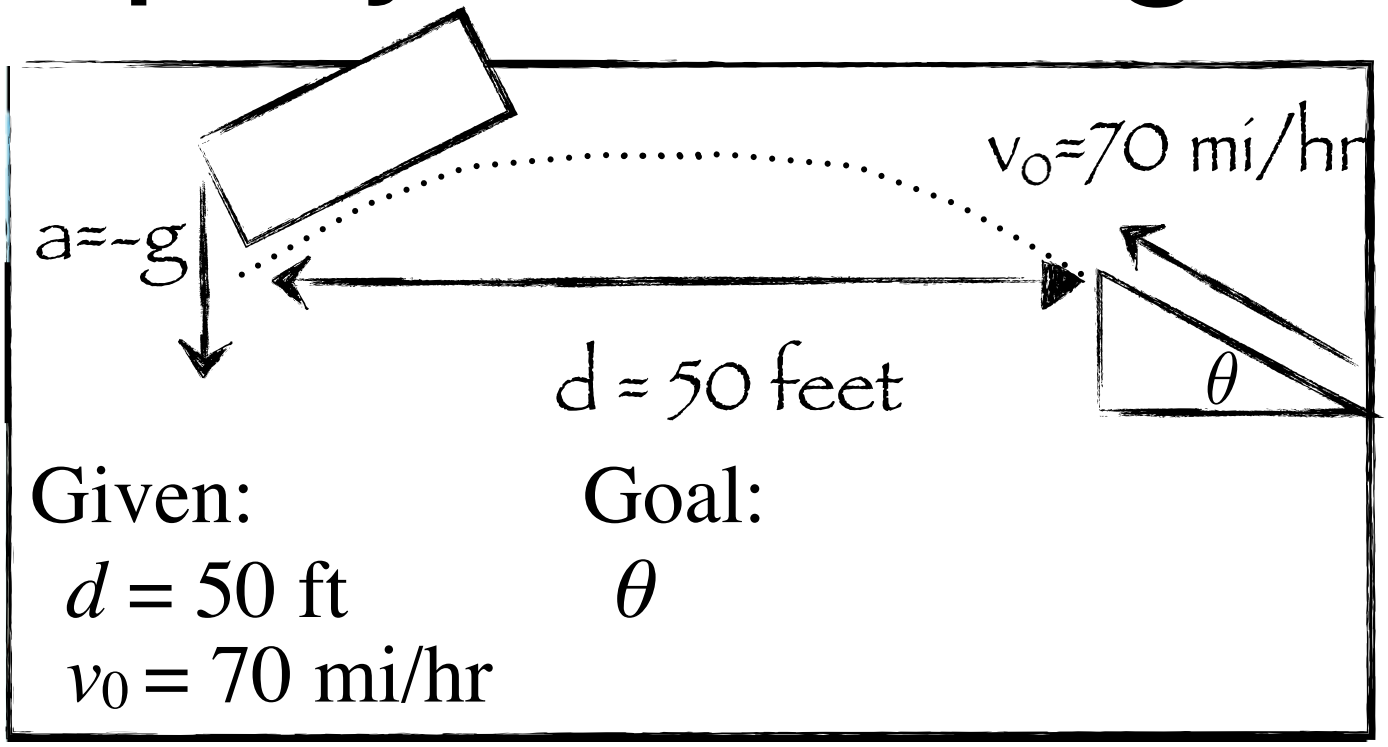
Clicker question #29

For a cannon on Earth, the cannonball would follow path B. Instead, if the same cannon were on the Moon, where g = 1.6 m/s^2, which path would the cannonball take in the same situation?



Example: projectile range

- What is the smallest angle jump so the bus makes it?



1. Read carefully
2. Draw a sketch
3. Given? Goal?
4. Principles & equations?

Clicker question #30

4.Principles
& equations?

A Projectile

$$v_x = v_{0x}$$
$$v_y = v_{0y} - gt$$

B Average velocity

$$\Delta v = \frac{\Delta x}{\Delta t}$$

C Freefall

$$y = y_0 + v_{0y}t - \frac{1}{2}gt^2$$

D Projectile

$$x = x_0 + v_{0x}t$$
$$y = y_0 + v_{0y}t - \frac{1}{2}gt^2$$

1. Read carefully
2. Draw a sketch
3. Given? Goal?
4. Principles & equations?
5. Calculate
   - Choose axes & origin
   - Resolve vector components
   - Solve equations

$$x = x_0 + v_{0x}t \qquad y = y_0 + v_{0y}t - \frac{1}{2}gt^2$$

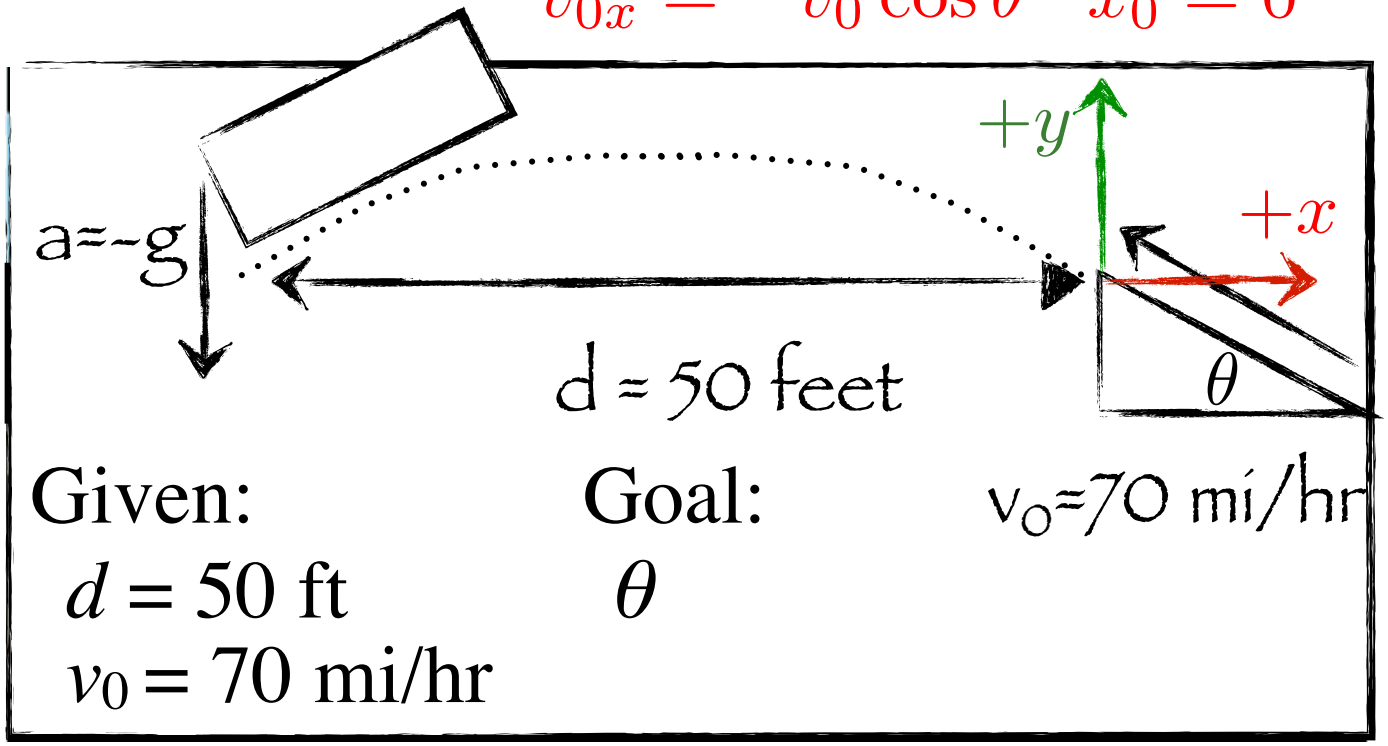
$$-d = -v_0 t\cos\theta \qquad 0 = v_0 t\sin\theta - \frac{1}{2}gt^2$$

$y_0 = 0$

$y = 0$ $\quad v_{0y} = v_0\sin\theta$

$x = -d$

$v_{0x} = -v_0\cos\theta$ $\quad x_0 = 0$



1. Read carefully
2. Draw a sketch
3. Given? Goal?
4. Principles & equations?
5. Calculate

$$x = x_0 + v_{0x}t \qquad y = y_0 + v_{0y}t - \frac{1}{2}gt^2$$

$$-d = -v_0 t\cos\theta \qquad 0 = v_0 t\sin\theta - \frac{1}{2}gt^2$$

$$t = \frac{d}{v_0\cos\theta} \qquad v_0 t\sin\theta = \frac{1}{2}gt^2$$

$$t = \frac{2v_0}{g}\sin\theta$$

$$\frac{d}{v_0\cos\theta} = \frac{2v_0}{g}\sin\theta$$

Note: range [Eq. (3.11) in text]

$$d = \frac{v_0^2}{g}\sin 2\theta$$

$$\boxed{\theta = \frac{1}{2}\sin^{-1}\left(\frac{dg}{v_0^2}\right)}$$

$$\frac{dg}{v_0^2} = 2\sin\theta\cos\theta$$

$$= \sin 2\theta$$

1. Read carefully
2. Draw a sketch
3. Given? Goal?
4. Principles & equations?
5. Calculate
6. Plug in numbers
7. Is answer reasonable?

$$\theta = \frac{1}{2}\sin^{-1}\left(\frac{dg}{v_0^2}\right)$$

$d = 50$ ft

$v_0 = 70$ mi/hr

$g = 32.2\,\frac{\text{ft}}{\text{s}^2}$

$$\theta = \frac{1}{2}\sin^{-1}\left[(50\,\cancel{\text{ft}})\left(32.2\,\frac{\cancel{\text{ft}}}{\cancel{\text{s}^2}}\right)\left(\frac{1}{70}\,\frac{\cancel{\text{hr}}}{\cancel{\text{mi}}}\right)^2\left(\frac{\cancel{\text{mi}}}{5280\,\cancel{\text{ft}}}\right)^2\left(\frac{3600\,\cancel{\text{s}}}{\cancel{\text{hr}}}\right)^2\right]$$

$$\theta = \frac{1}{2}\sin^{-1}[0.15] \qquad \theta = 4.4^\circ$$