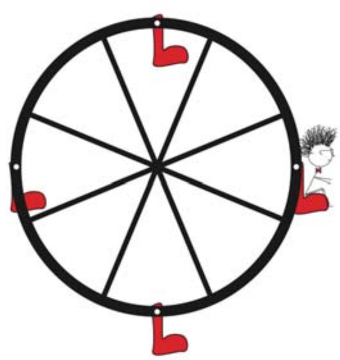
Announcements 25 Feb 09

- **Homework #4**
  - **Written homework due on Friday at beginning of class**
  - **Online homework due on Tue Mar 3 by 8 am**
- **Exam 1**
  - ***Answer keys and scores will be posted by end of the week***
- **Supplemental Instruction sessions next week**
  - ***Wednesday 8:45 – 11:00 pm DuBois 10th floor***
  - ***Tuesday 4:15 – 5:30 pm (usual day and time)***

PRS

A carnival Ferris wheel turns at a steady rate. In the figure below, the passenger is riding the Ferris wheel upwards (counter clockwise). What direction is the acceleration of the passenger?

A. upward
B. downward
C. to the left
D. to the right
E. zero



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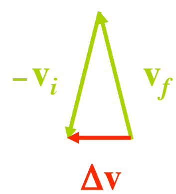
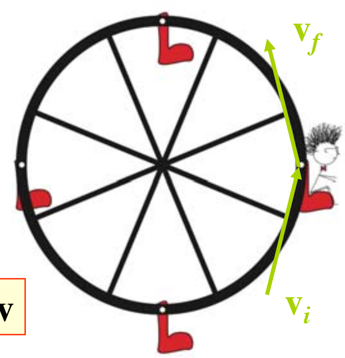
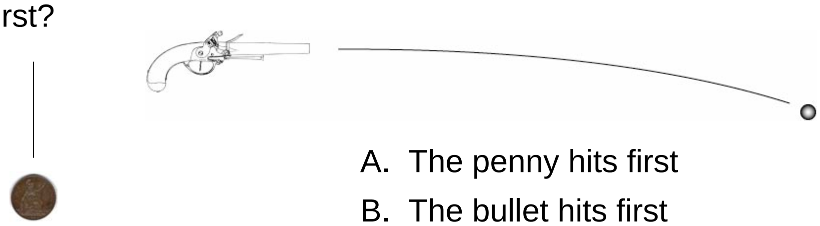


$\boldsymbol{a}$ is in the same direction as $\Delta\mathbf{v}$



PRS

A penny is dropped from rest at the same time that a bullet is fired horizontally from a gun. Both penny and bullet start at the same height. Which hits the ground first?



A. The penny hits first
B. The bullet hits first
C. They hit at the same time
D. Not enough information
E. I have no idea!

DEMO: simultaneous ball drop

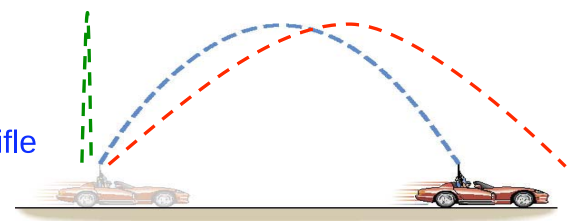
Shoot a Bullet into the Air...

Suppose you are driving a convertible with the top down. The car is moving to the right at constant velocity. You point a rifle straight up into the air and fire it. In the absence of air resistance, where would the bullet land?

A. behind you

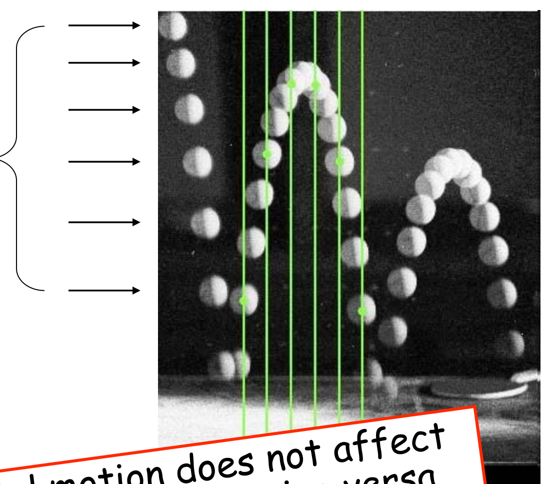
B. ahead of you

C. in the barrel of the rifle



DEMO: Howitzer and bridge

Vertical motion is accelerating



Horizontal motion does not affect vertical motion .... and vice versa.

Horizontal motion is constant velocity

PROJECTILE MOTION

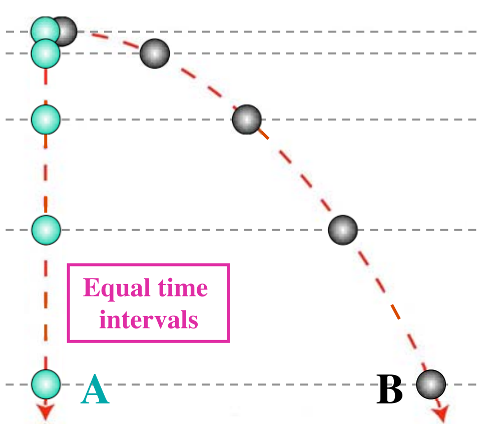
Vertical: $a_y = -g$ Horizontal: $a_x = 0$

$$(v_y)_f = (v_y)_i - g\Delta t$$
$$\Delta y = (v_y)_i \Delta t - \tfrac{1}{2} g \Delta t^2$$
$$(v_y)_f^2 = (v_y)_i^2 - 2g\Delta y$$

equs. 2.8-2.10

$$(v_x)_f = (v_x)_i = v_x$$
$$\Delta x = v_x \, \Delta t$$

The two components are independent, but linked by the common time, t.



How long did ball B take to fall to the ground 2.0 m below?

$$
\left.
\begin{aligned}
a_y &= -g \\
(v_y)_i &= 0 \text{ m/s} \\
\Delta y &= 2.0 \text{ m} \\
\Delta t &= ?
\end{aligned}
\right\}
$$

$$(v_y)_f = (v_y)_i - g\Delta t$$

$$\Delta y = (v_y)_i \Delta t - \tfrac{1}{2} g \Delta t^2$$

$$(v_y)_f^2 = (v_y)_i^2 - 2g\Delta y$$

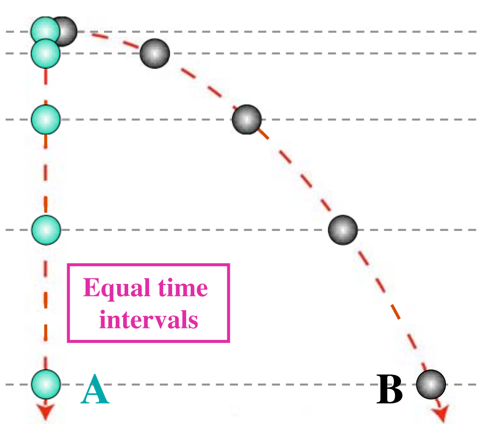
How long did ball B take to fall to the ground 2.0 m below?

$$\Delta y = (v_y)_i \Delta t - \frac{1}{2} g \Delta t^2 = -\frac{1}{2} g \Delta t^2$$

$$-2.0 \text{ m} = -\frac{1}{2}\left(9.8 \text{ m/s}^2\right) \Delta t^2$$

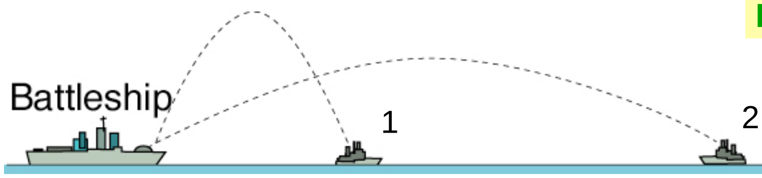
$$\Delta t = \sqrt{4.0 \text{ m} / 9.8 \text{ m/s}^2} = 0.64 \text{ s}$$

The time of flight is generally controlled by the vertical motion.



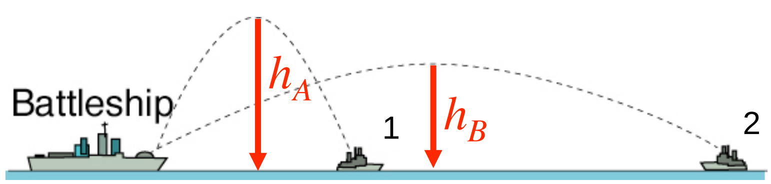
Where does ball B hit the floor?

Suppose $(v_x)_i$ for ball B is 2.5 m/s. How far does it travel horizontally? $\Delta x = v_x \Delta t = 2.5 \text{ m/s} \times 0.64 \text{ s} = 1.6 \text{ m}$



A battleship simultaneously fires two shells toward two enemy ships, one close by (1), and one far away (2). The shells leave the battleship at different angles and travel along the indicated parabolic trajectories. Which enemy ship is hit first?

A. Ship 1
B. Ship 2
C. Both at the same time
D. Insufficient info
E. No idea



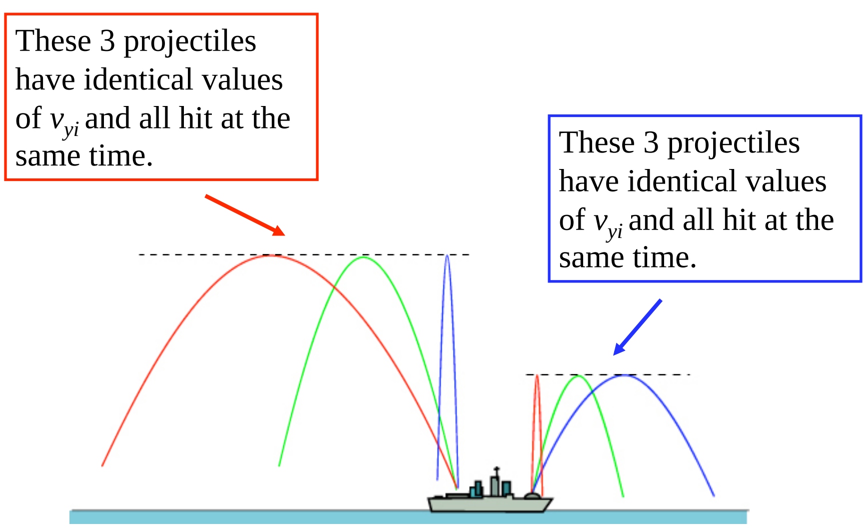
Time aloft = 2 x time to fall from height h

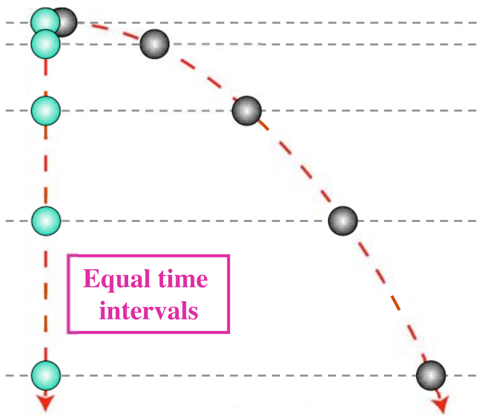
$$\left.\begin{aligned} a_y &= -g \\ v_{y_{top}} &= 0 \\ \Delta y &= -h \\ \Delta t &= ? \end{aligned}\right\} \qquad \begin{aligned} &\Delta y = v_{y_{top}}\Delta t - \tfrac{1}{2} g\Delta t^2 = -\tfrac{1}{2} g\Delta t^2 \\ &\Rightarrow \Delta t_{\text{fall}} = \sqrt{\frac{2h}{g}} \end{aligned}$$

That is, the larger h, the longer the time in the air!

In HOW MANY of the following situations is the object accelerating?

a. a car slowing down at a stop sign
b. a ball being swung in a circle
c. a vibrating string
d. the Moon orbiting the Earth
e. a skydiver falling at terminal speed
f. an astronaut in an orbiting space station
g. a ball rolling down a hill
h. a person driving down a straight section of highway at constant speed with her foot on the accelerator



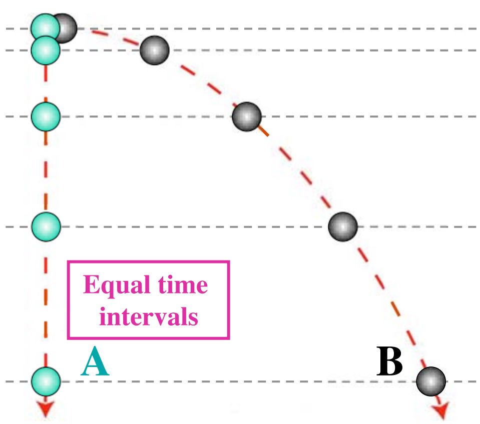


Balls from the same height hit the ground at the **same time.**

Why?

- Same initial v_y (both = 0)
- same acceleration a_y (both = $-g$)

Different v_x is irrelevant!



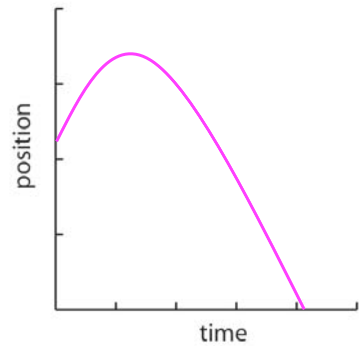
What was v_y for ball B just before it hit?

$$v_{yf} = v_{yi} - g\Delta t$$
$$= -9.8 \text{ m/s}^2 \times 0.64 \text{ s}$$
$$= -6.3 \text{ m/s}$$

What was v_x for ball B just before it hit?

Same as it always has been: 2.5 m/s

Toss a coin straight up and let it fall.



At the top of the trajectory, is the acceleration positive or negative?

At the top of the trajectory, is the velocity positive or negative?