Physics 2A: Lecture 3
Today's Agenda

- Kinematics in 2-D
  - Quick Recap of last lecture
  - Position
  - Velocity
  - Acceleration
- Special case: Constant acceleration in 2-D
  - Constant acceleration equations
  - Examples: Projectile motion

Start Recording!

Clicker Question 0.1:

A car decelerates constantly from an initial velocity to a complete stop. As it does this it covers a total distance D. When the velocity of the car has decreased to half its initial velocity the remaining distance is

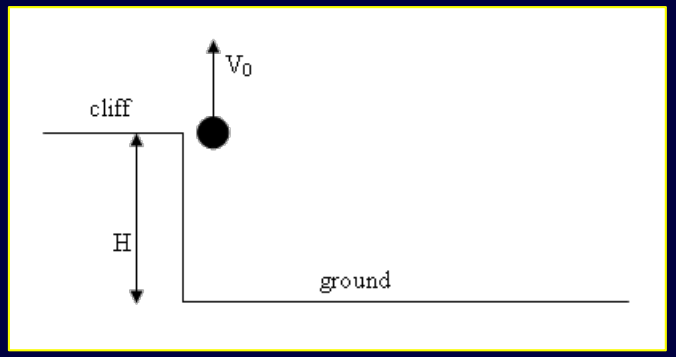
(a) greater than half the total distance D required to stop.
(b) half the total distance D required to stop.
(c) less than half the total distance D required to stop.

Clicker Question 0.2:

At t = 0 a ball is thrown straight upward from the edge of a cliff with initial velocity V_0 = 25 m/s. It lands on the ground at the base of the cliff 7 seconds later.

What is the height *H* of the cliff?

(a) *H* = 46 m
(b) *H* = 53 m
(c) *H* = 65 m
(d) *H* = 76 m
(e) *H* = 82 m



Clicker Question 0.3:

Nicole throws a ball straight up. Chad watches the ball from a window 5.0 m above where Nicole released it. The ball passes Chad on the way up, and it has a speed of 10m/s as it passes him on the way back down.

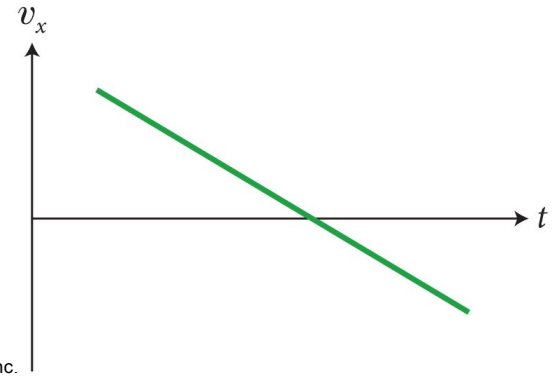
How fast did Nicole throw the ball?

(a) 14 m/s
(b) 22 m/s
(c) 10 m/s
(d) 17 m/s
(e) 26 m/s

Clicker Question 1

Based on the $v(t)$ curve in the figure, which of the following statements is necessarily true for the time interval shown?

A. Acceleration is a constant.
B. The object passes through the position $x = 0$.
C. The object's velocity is never zero.
D. The object is always moving in the same direction.



Clicker Question 2

A ball is thrown downward (not dropped) from the top of a tower. After being released, its downward acceleration will be

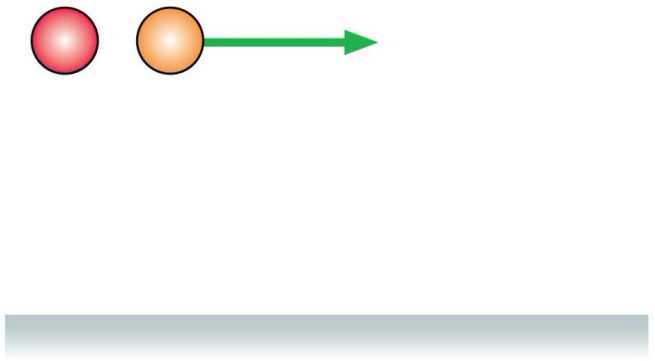
A. greater than g.

B. exactly g.

C. smaller than g.

Clicker Question 3:

A heavy red ball is released from rest 2.0 m above a flat, horizontal surface. At exactly the same instant, a yellow ball with the same mass is fired horizontally at 3.0 m/s. Which ball hits the ground first?



A. The red ball hits first.

B. The yellow ball hits first.

C. They hit at the same time.

Motion in a plane with constant acceleration

2-D model

- We can treat each direction as if the other did not exist. So basically we have 2 1-D cases.

- Demos

Constant acceleration in 2-D

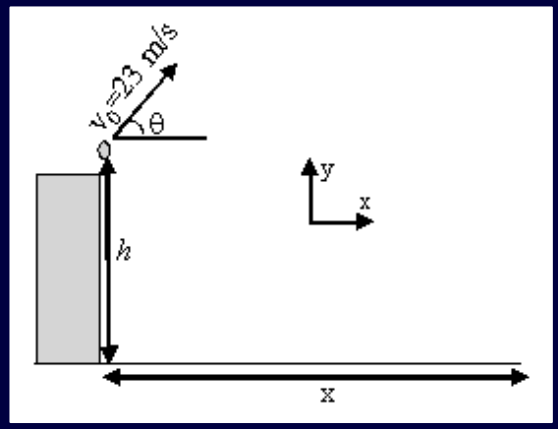
- x-direction
  - $x = x_0 + v_{0x}t + \frac{1}{2} a_x t^2$
  - $v_x = v_{0x} + a_x t$
  - $v_x^2 = v_{0x}^2 + 2a_x(\Delta x)$
- y-direction
  - $y = y_0 + v_{0y}t + \frac{1}{2} a_y t^2$
  - $v_y = v_{0y} + a_y t$
  - $v_y^2 = v_{0y}^2 + 2a_y(\Delta y)$

Clicker Question 4:

A student throws a ball off a cliff. When the ball leaves the student's hand it is traveling with a speed of 23 m/s, and the vertical component of the balls velocity is 18 m/s. The ball hits the ground after 4.2 seconds.

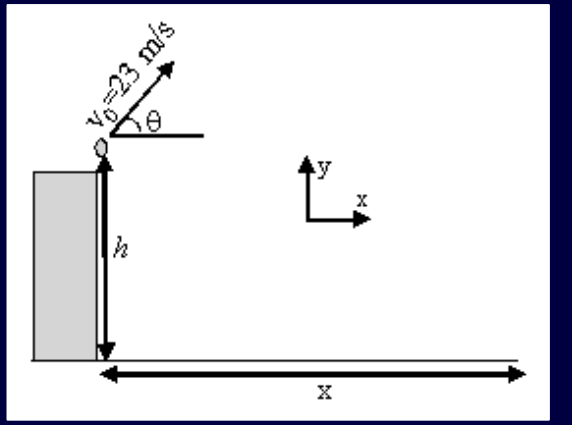
What angle did the student throw the ball?

(a) $\theta = 24°$
(b) $\theta = 37°$
(c) $\theta = 52°$.



A student throws a ball off a cliff. When the ball leaves the student's hand it is traveling with a speed of 23 m/s, and the vertical component of the balls velocity is 18 m/s. The ball hits the ground after 4.2 seconds.

What angle did the student throw the ball?

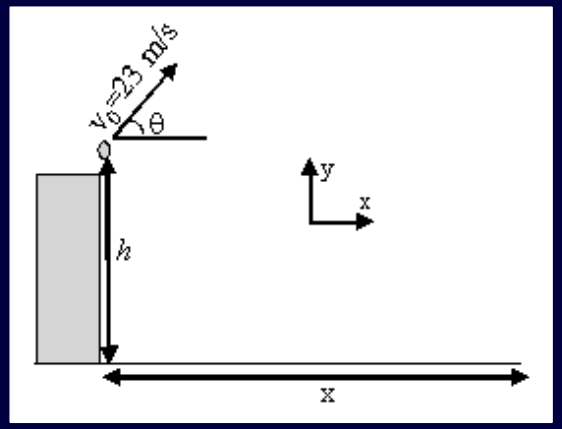


Clicker Question 5:

A student throws a ball off a cliff. When the ball leaves the student's hand it is traveling with a speed of 23 m/s, and the vertical component of the balls velocity is 18 m/s. The ball hits the ground after 4.2 seconds.

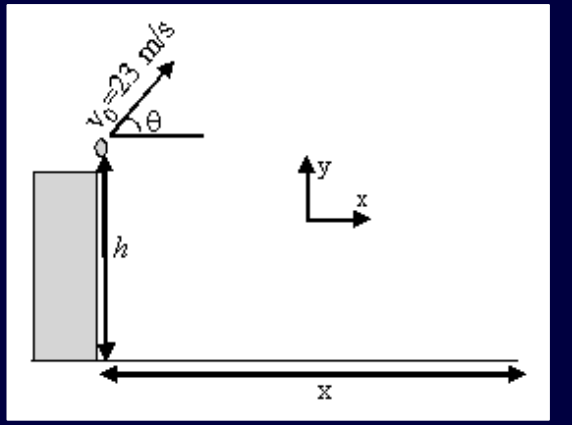
How long does it take for the ball to reach its maximum height?

(a) 1.8 s
(b) 2.3 s
(c) 3.1 s



A student throws a ball off a cliff. When the ball leaves the student's hand it is traveling with a speed of 23 m/s, and the vertical component of the balls velocity is 18 m/s. The ball hits the ground after 4.2 seconds.

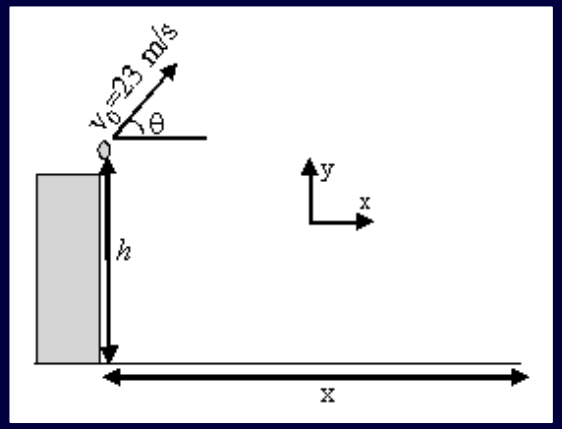
How long does it take for the ball to reach its maximum height?



Clicker Question 6:

A student throws a ball off a cliff. When the ball leaves the student's hand it is traveling with a speed of 23 m/s, and the vertical component of the balls velocity is 18 m/s. The ball hits the ground after 4.2 seconds.

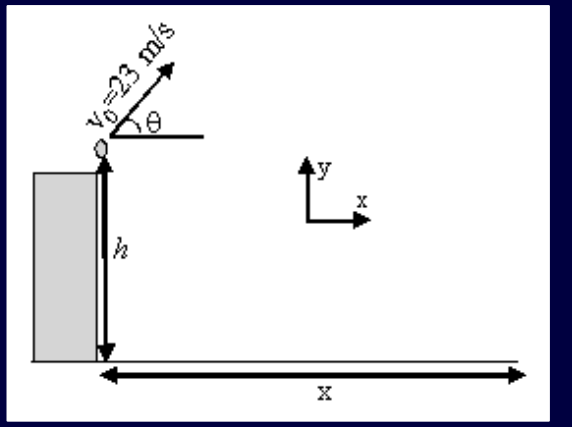
(c) What height *h* was the ball thrown from?



(a) 9.1 m
(b) 10.8 m
(c) 13.1 m

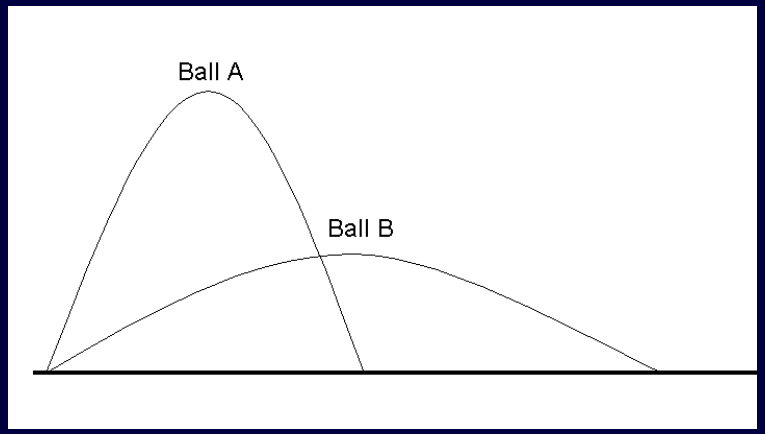
A student throws a ball off a cliff. When the ball leaves the student's hand it is traveling with a speed of 23 m/s, and the vertical component of the balls velocity is 18 m/s. The ball hits the ground after 4.2 seconds.

What height *h* was the ball thrown from?



Clicker Question 7:

Two balls are launched at the same time. The balls follow the paths below. Which ball is in the air the longest?



(A) Ball A

(B) Ball B

(C) They are in the air the same amount of time

(D) Not enough information

Clicker Question 8:

A physics student standing on the edge of a cliff throws a stone vertically downward with an initial speed of 10.0 m/s. The instant before the stone hits the ground below, it is traveling at a speed of 30.0 m/s. If the physics student were to throw the rock horizontally outward from the cliff instead, with the same initial speed of 10.0 m/s, what is the magnitude of the velocity of the stone just before it hits the ground? Ignore any effects of air resistance.

a) 10.0 m/s

b) 20.0 m/s

c) 30.0 m/s

d) 40.0 m/s

e) The height of the cliff must be specified to answer this question.

A physics student standing on the edge of a cliff throws a stone vertically downward with an initial speed of 10.0 m/s. The instant before the stone hits the ground below, it is traveling at a speed of 30.0 m/s. If the physics student were to throw the rock horizontally outward from the cliff instead, with the same initial speed of 10.0 m/s, what is the magnitude of the velocity of the stone just before it hits the ground?

Clicker Question 9:

A man and his son are standing at the edge of a cliff. They both pick up very similar rocks and throw them horizontally off of the cliff. The man's rock travels twice as far from the base of the cliff as the rock that the boy threw. If they both threw their rocks at the same time and from the same height which one hits the ground first?

(A) The mans
(B) The boys
(C) They'll hit at the same time