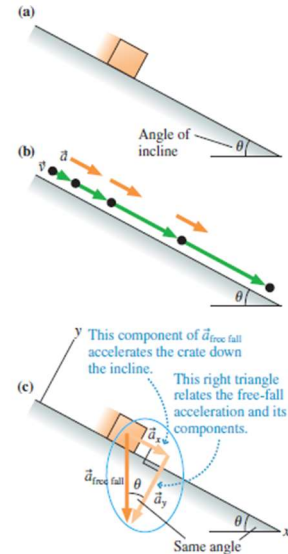


2-D KINEMATICS

- Most objects don't travel purely in the horizontal or vertical direction. Most travel in both.
 - Must break those vector quantities (displacement, velocity, acceleration, etc.) into their horizontal and vertical components.

Inclined Planes

- An object sliding down an incline is accelerated by the force of gravity, but it is forced to move along an incline that has both vertical and horizontal components.
- It is *not* accelerating at a rate of g , but rather at some component of g that depends on the angle of the incline.
 - As the angle approaches 90° , the acceleration down the ramp approaches g .
 - As the angle approaches 0° , the acceleration down the ramp approaches 0 m/s^2 .



Example 3.6 Maximum possible speed for a skier

The Willamette Pass ski area in Oregon was the site of the 1993 U.S. National Speed Skiing Competition. The skiers started from rest and then accelerated down a stretch of the mountain with a reasonably constant slope, aiming for the highest possible speed at the end of this run. During this acceleration phase, the skiers traveled 360 m while dropping a vertical distance of 170 m. What is the fastest speed a skier could achieve at the end of this run?

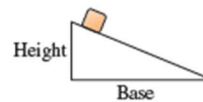
Example 3.7 Speed of a roller coaster

A classic wooden coaster has cars that go down a big first hill, gaining speed. The cars then ascend a second hill with a slope of 30° . If the cars are going 25 m/s at the bottom and it takes them 2.0 s to climb this hill, how fast are they going at the top?



Stop to Think 3.5

A block of ice slides down a ramp. For which height and base length is the acceleration the greatest?



- A. Height 4 m, base 12 m
- B. Height 3 m, base 6 m
- C. Height 2 m, base 5 m
- D. Height 1 m, base 3 m

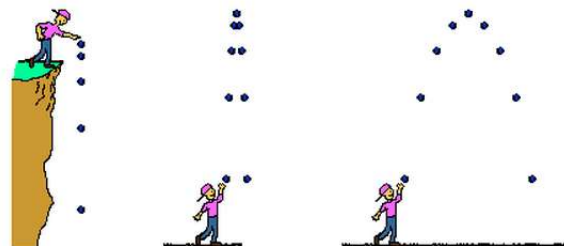
Projectile Motion

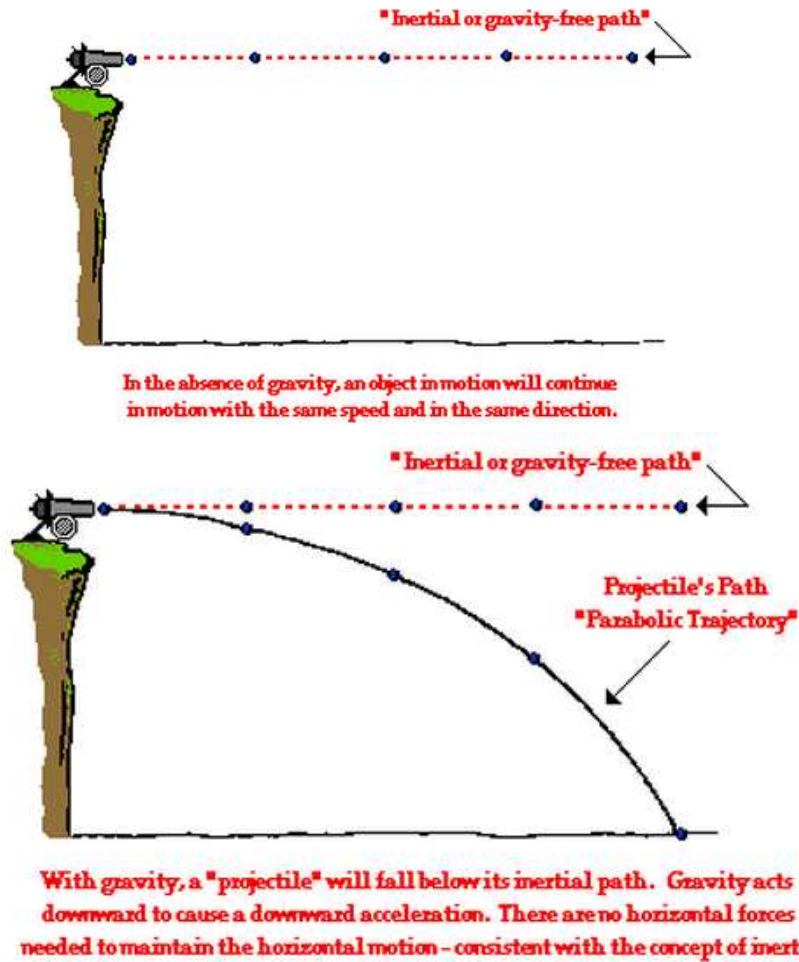
- **Projectile** → an object upon which the only force acting on it is gravity.
 - A projectile is any object that *once projected* continues in motion by its own inertia and is influenced **ONLY** by gravity.
 - Ex: A cannon ball, throwing a baseball, a ball rolling off a table, throwing a rock.

- Common misconceptions:

- “How can an object be moving upward if the only force acting on it is gravity?”
- A force is **not** necessary to keep an object in motion. A force causes **acceleration**.

Types of Projectiles





- The vertical and horizontal components of motion *must* be evaluated separately.
 - Acceleration due to gravity (g) only affects the vertical motion of the projectile.
 - The horizontal motion is unaffected by gravity.

	Horizontal	Vertical
Forces Present	None	Gravity
Acceleration	None	g
Velocity	Constant	Changing

Conceptual Example 3.10 Time and distance for balls rolled off the table

Two balls are rolling toward the edge of a table, with ball 2 rolling twice as fast as ball 1. Both balls leave the edge table at the same time. Which ball hits the ground first?

Which ball goes farther?

Stop to Think 3.7

A 100 g ball rolls off a table and lands 2 m from the base of the table. A 200 g ball rolls off the same table with the same speed. How far does it land from the base of the table?

- A. < 1 m
- B. 1 m
- C. Between 1 m and 2 m
- D. 2 m
- E. Between 2 m and 4 m
- F. 4 m