

# Particular Projectiles

PHYSICS 203: PROFS. MARTENS YAVERBAUM & BEAN  
JOHN JAY COLLEGE OF CRIMINAL JUSTICE, THE CUNY

## 1. A Projectile

a) Independent Parts.

- i. A hockey puck slides *purely horizontally* at a speed of 10 m/s relative to the ice. Its velocity remains essentially constant. How far will it have traveled in precisely 3 seconds (not a trick question, super simple)?
- ii. A baseball is tossed *purely vertically* at an initial *upward* speed of 30 m/s relative to the Earth. The ball *is* affected by gravity, but not noticeably by air. How high will it get before it starts coming back down? What will be its total air time?

b) The Sum of its Independent Parts.

A cannonball is shot from the ground. It is shot so that, initially, it has a forward velocity of 10 m/s and, *at the same instant*, an upward velocity of 30 m/s.

How? It is shot an angle.

- i. Relative to the ground, what is the initial velocity (speed *and* direction [angle measured from the horizontal]) of the cannonball?
- ii. How much time will pass before the cannonball returns to the ground?
- iii. How far away (horizontally) from where it was shot will the cannonball land?
- iv. What is the *speed* of the cannonball as it strikes the ground?"

## 2. A Picture of a Projectile

A cannonball is shot from ground level at an angle of 30 degrees above the horizontal. The cannonball has an initial speed of 50 m/s.

- a) Find the initial vertical velocity of the cannonball.
- b) Find the initial horizontal velocity of the cannonball.
- c) Find how long the cannonball will be in the air.
- d) Find the location (horizontal & vertical) of the cannonball after 0, 1, 2, 3, 4, and 5 secs.
- e) Make a *scale diagram* showing the cannonball at each of these moments in time.

### 3. Yaver-Bomber

The Yaver-Bomber flies purely horizontally and constantly at 200 m/s relative to the ground. It does so an altitude of 1000 meters.

The instant the Yaver-Bomber passes a certain fig tree, it drops a nectar-filled balloon.

The balloon is *not* thrust from the plane. The balloon is dropped so that its *initial* velocity *relative* to the plane is 0.

How far away from the fig tree does the nectar balloon land?

### 4. EXTRA CREDIT: The Monkey & the Hunter

A monkey sits in a tall tree, 15 yards above the height of a hunter's gun.

The hunter stands 50 yards from the tree.

A typical bullet emerges from her gun at an initial speed of 200 yard/sec.

The hunter squeezes the trigger. At that precise moment, however, the monkey falls straight down from its branch.

Much to the hunter's joy, her bullet nonetheless hits the monkey (at some time during the monkey's descent).

Measured from the horizontal, at what precise angle must the gun have been aimed?

HINT: First ask yourself whether the gun must have been aimed higher than, lower than or directly at the monkey.