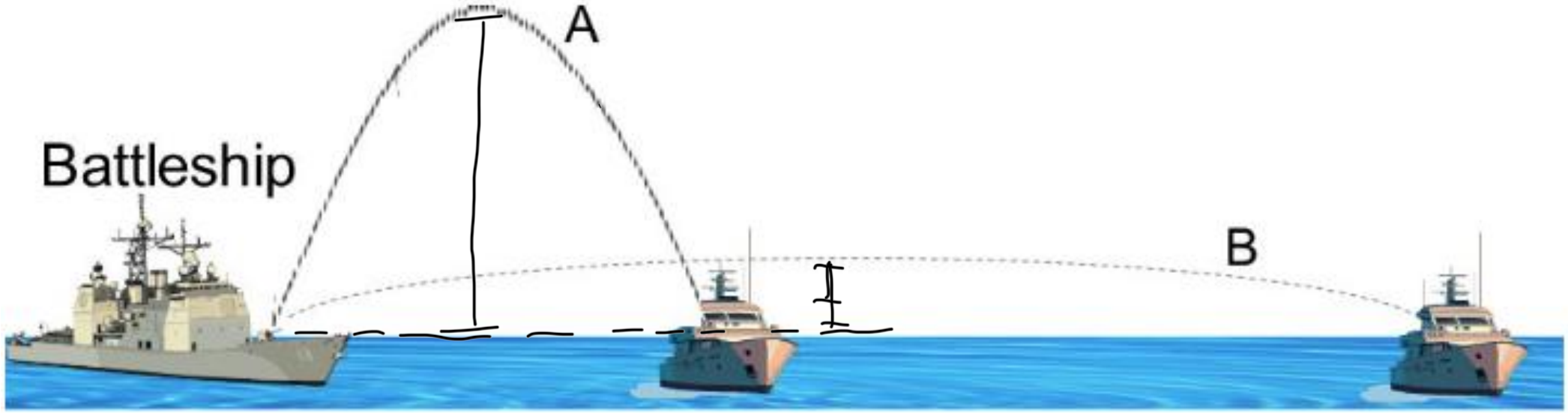
SQUARECAP

The battleship below fires two shells simultaneously, at A and B. Which target is hit first?



A) Target A
B) Target B
C) Both simultaneously
D) Not enough information given

$$T = \frac{2v_y}{g}$$

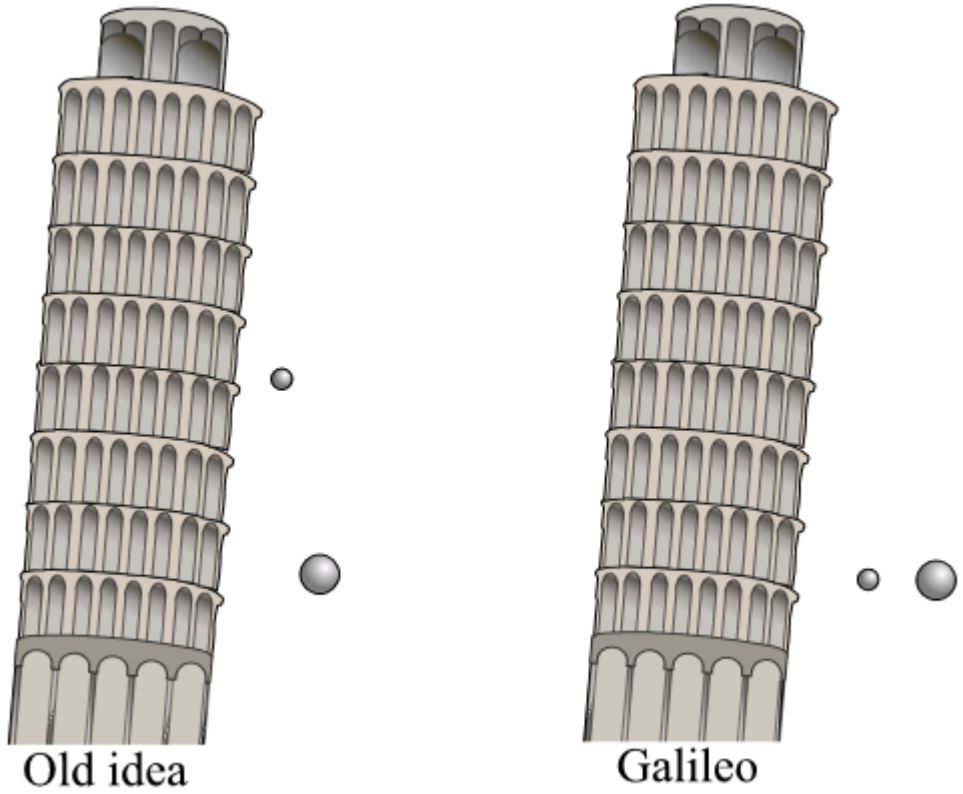
$$H = \frac{(v_y)^2}{2g}$$

Recap: Air Resistance?

- The max angle decreases w/ air resistance
- Air resistance has more of an effect the longer the projectile is in the air → shorter flights better
- Formula:

$$\theta_{max} \approx \frac{\pi}{4} - \frac{1}{3\sqrt{2}}\frac{\mu v_0}{g}$$

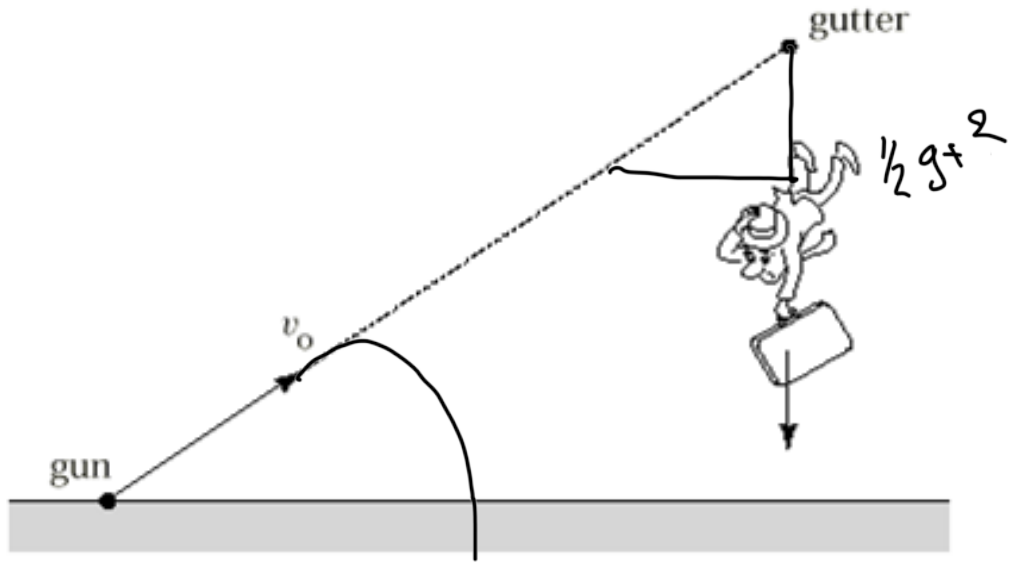
- Note: not surprising it took so long to understand gravitational acceleration!



SQUARECAP

Concept Check:

4-7: A gun is accurately aimed at a dangerous criminal hanging from the gutter of a building. The target is well within the gun's range, but the instant the gun is fired and the bullet moves with a speed vo , the criminal lets go and drops to the ground. What happens?



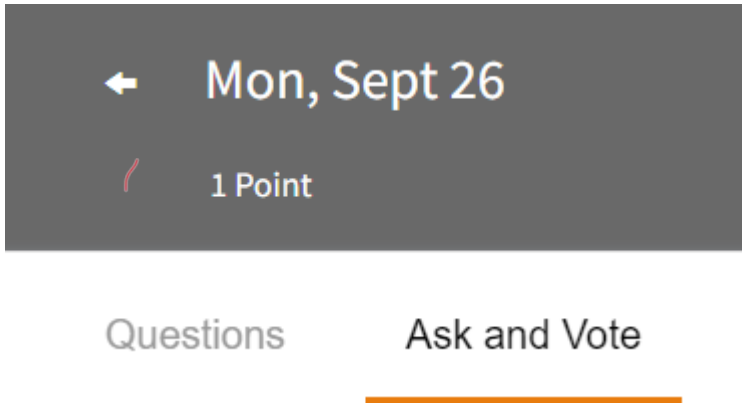
The bullet

A: hits the criminal regardless of the value of vo .

B: hits the criminal only if vo is large enough.

C: misses the criminal.

Note: Ask and Vote



HW3: Due Next Friday (2D Motion)
HW4: Open Friday but not due until after exam

Midterm I: Wed, Sept 25

Prelecture Review: Motion in 2D - Projectiles

$$a_c = \frac{v_t^2}{r}$$

$$r = \frac{v_t^2}{a_c}$$

What are our questions and/or comments?

Comments and Questions

- I sort of understand the concept of circular motion, but how does that relate to centripetal force?
- What is causing the force to be generated so that the force is directed inwards, so that an object rotates in circle? Also, I did not understand the concept of the "fictious force."
- Are forces such as wind resistance and friction as centrifugal forces?
- I understand how a frame of reference can give a different feeling of acceleration, but what are other examples of fictitious forces

My Comments and Questions

- Comment/Question: This is important for highway design

→Designers usually aim for less than ½ of g=9.81 m/s^2 = a

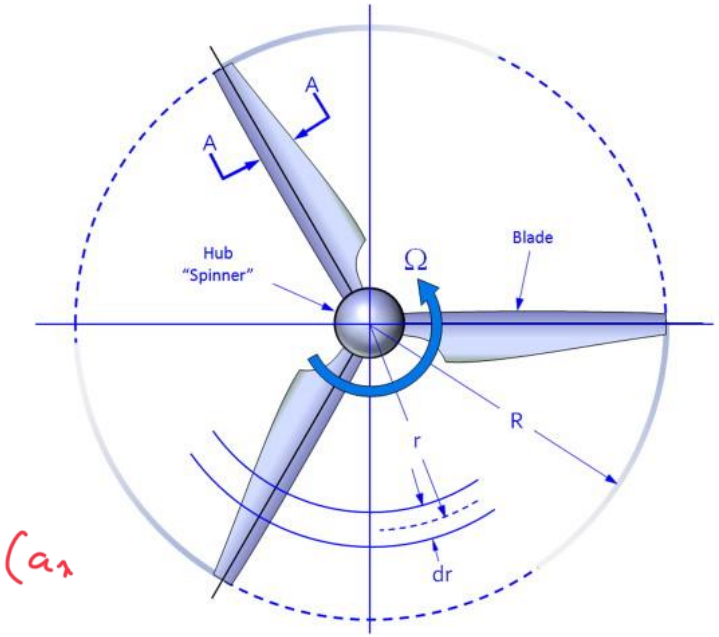
→The speed is the highway speedlimit

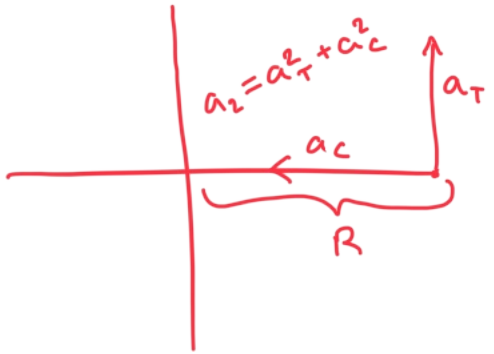
$$a_c = \frac{v_t^2}{r}$$

Example: From Homework

A propeller blade, measured from the rotational axis to the tip, has a length of 2.19 m. Starting from rest, the tip of the blade has a tangential acceleration of 2.27 m/s^2.

a. What is the magnitude of the total acceleration of the tip of the blade, in meters per squared second, 1.53 s after the blade begin to rotate?





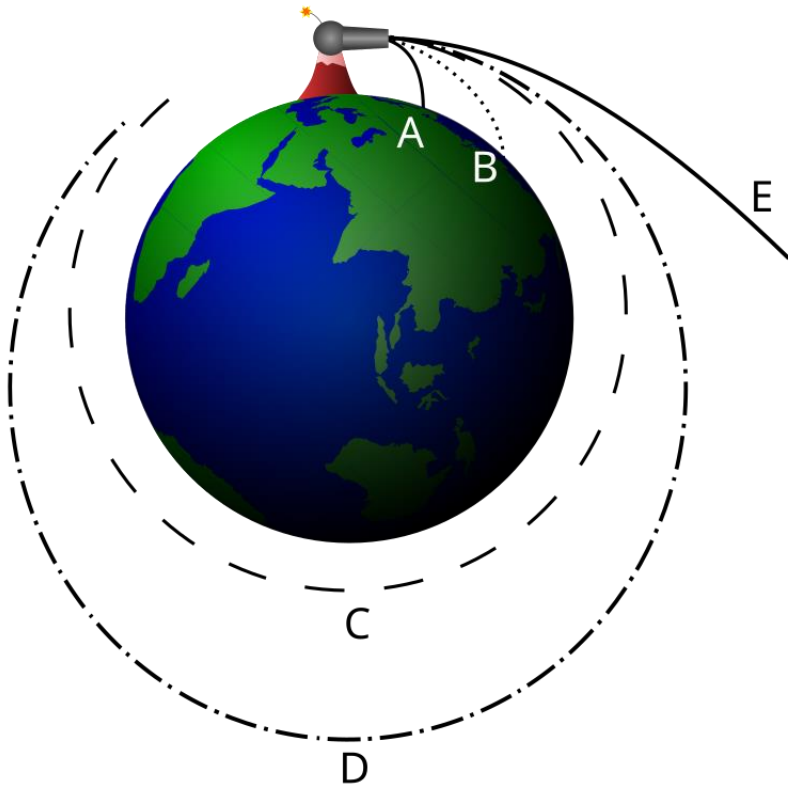
$|\vec{a}| = (a_1$

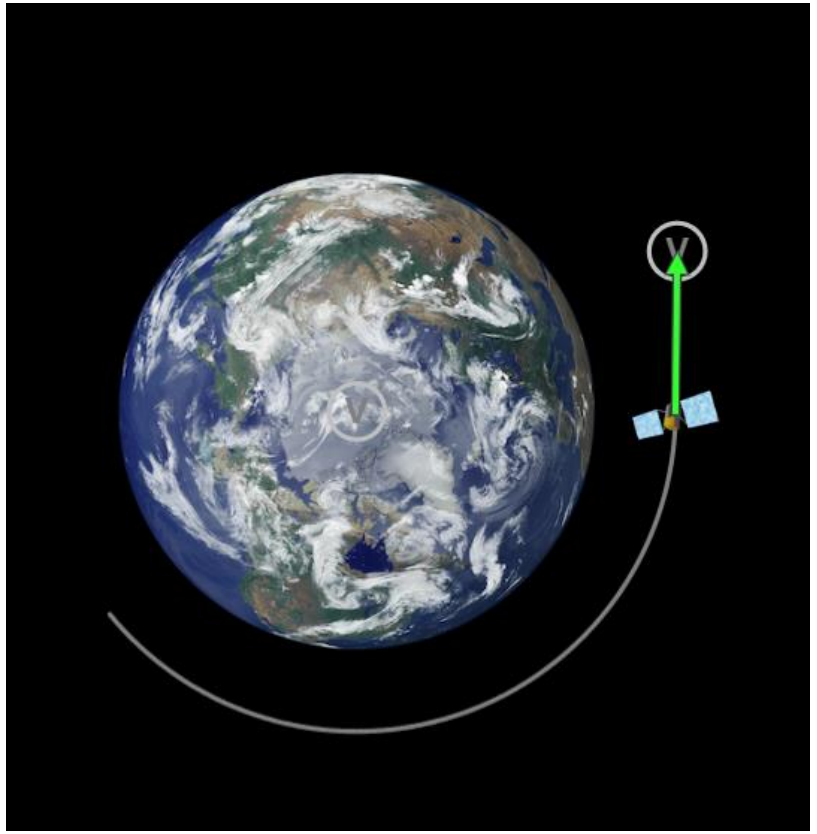
$\therefore a = \sqrt{a_T^2 + \left(\frac{(a_T T)^2}{l}\right)^2} \approx 5.96\ m/s^2$

$v_T = a_T^2 \cdot T$

$a_c = \frac{v_T^2}{r \cdot l}$

Prelecture Review: Newton's Cannonball





Newton's Cannonball

Thought experiments are an important method in theoretical physics because they allow us to investigate our ideas rigorously.
Isaac Newton devised a famous thought experiment that unifies our recent studies of projectiles and uniform circular motion.

- Read about the thought experiment here.
- Open this simulation, click "Model", select the Earth-Satellite system, and check the "velocity" box, and hit go. Is the satellite accelerating? How does its motion compare to a projectile?

What are our questions and/or comments?

Comments and Questions

- I understand the satellite speeding up when orbiting the earth, but as it moves farther away shouldnt it also speed up because of the suns gravity because it seems like slowing down?
- The external mass of the satellite had no direct correlation with the time it too for the satellite to go around the earth.
- While I understand that there is constant velocity for the satellite, it is orbiting around the earth and the direction of the velocity changes, so I think it could be accelerating around the earth due to uniform circular motion.
- Why is the motion circular/elliptical?

My Comments and Questions

- Comment/Question: I understand this was originally just a thought experiment, but have we sense managed this in practice? (besides that one manhole…)

Project HARP, for **high altitude research project**, was a joint venture of the United States Department of Defense and Canada's Department of National Defence created with the goal of studying ballistics of re-entry vehicles and collecting upper atmospheric data for research. Unlike conventional space launching methods that rely on rockets, HARP instead used very large guns to fire projectiles into the atmosphere at extremely high speeds.[1][2]

A 16-inch (41 cm) HARP gun operated by the U.S. Army's Ballistic Research Laboratory (now called the U.S. Army Research Laboratory) at Yuma Proving Ground currently holds the world record for the highest altitude that a gun-fired projectile has achieved:180 kilometres (111.8 mi).[3][4]

Next: Study of Forces