Text ‘PHYSJC’ and your answer to 22333

You have a slingshot that fires balls at a constant initial speed. At what angle of firing will you be able to maximize the range of the slingshot? Assume any targets are the same level as the slingshot.

A. 0-20 degrees from horizontal.
B. 20-40 degrees
C. 40-60 degrees
D. 60-90 degrees
E. None of the above

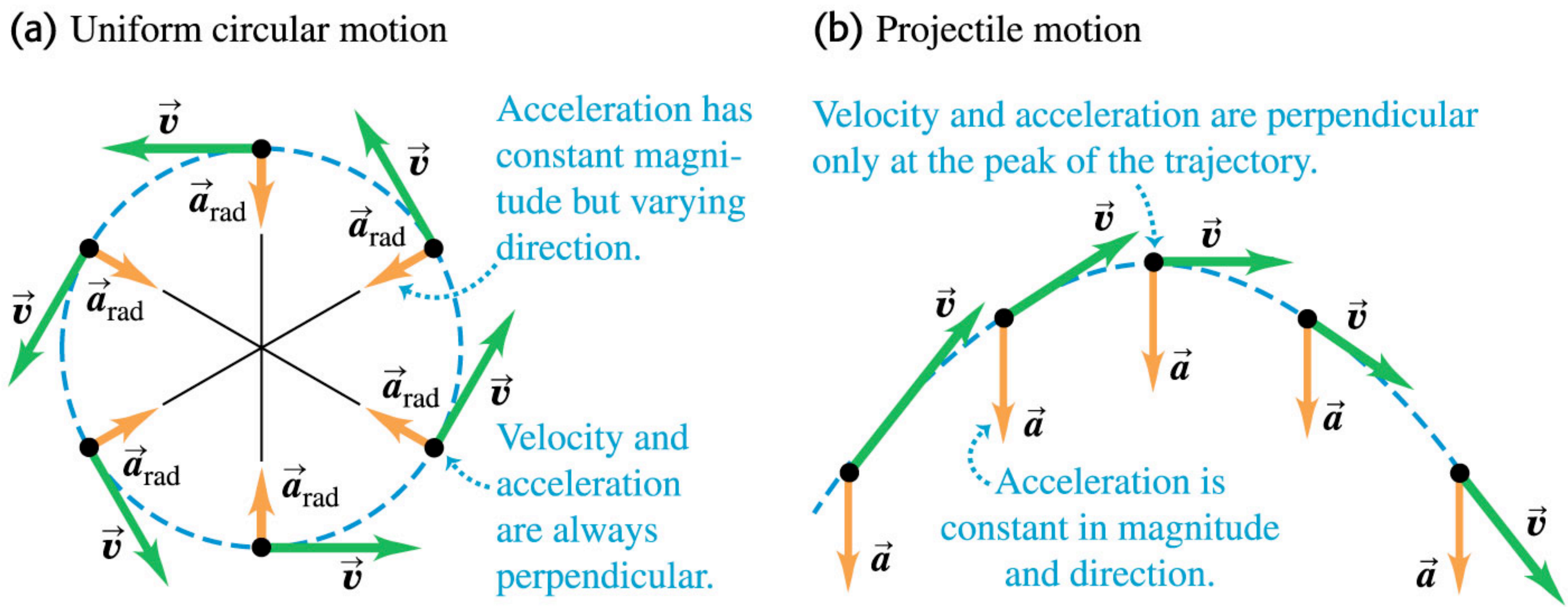
Ch 3.4-5: Projectile Motion and Relative Velocity

PHYS 1210 - Prof. Jang-Condell

Goals for Chapter 3

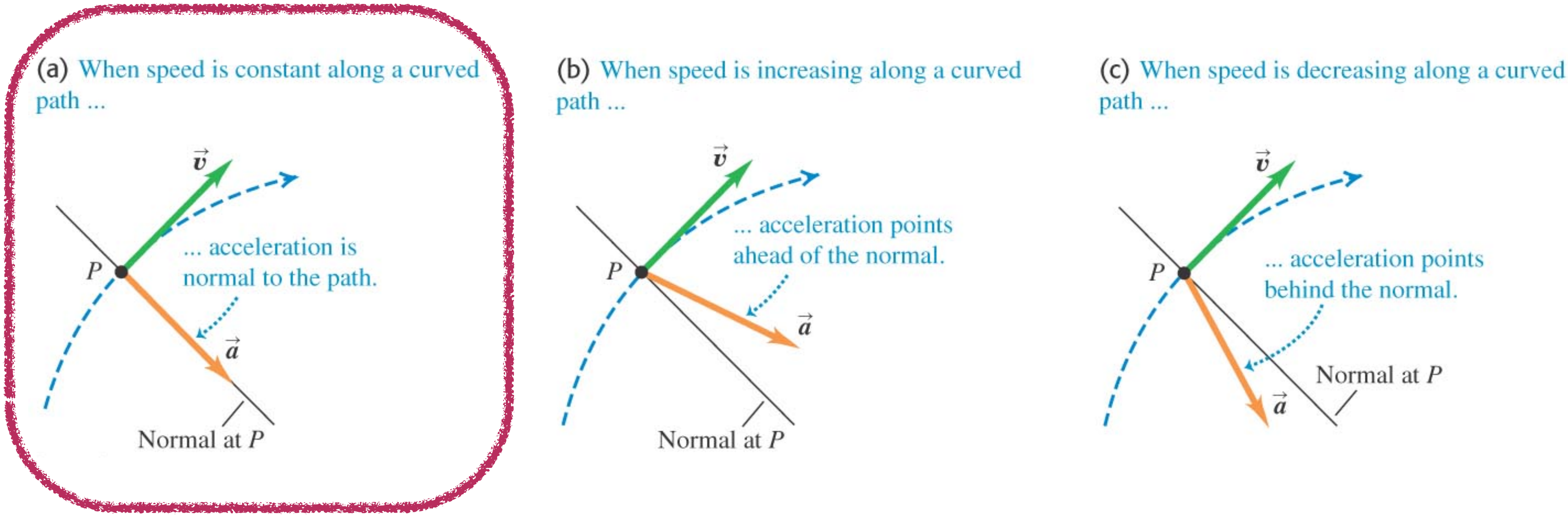
- To use vectors to represent the position of a body
- To determine the velocity vector using the path of a body
- To investigate the acceleration vector of a body
- To describe the curved path of projectile
- To investigate circular motion
- To describe the velocity of a body as seen from different frames of reference

Uniform Circular Motion vs. Projectile Motion



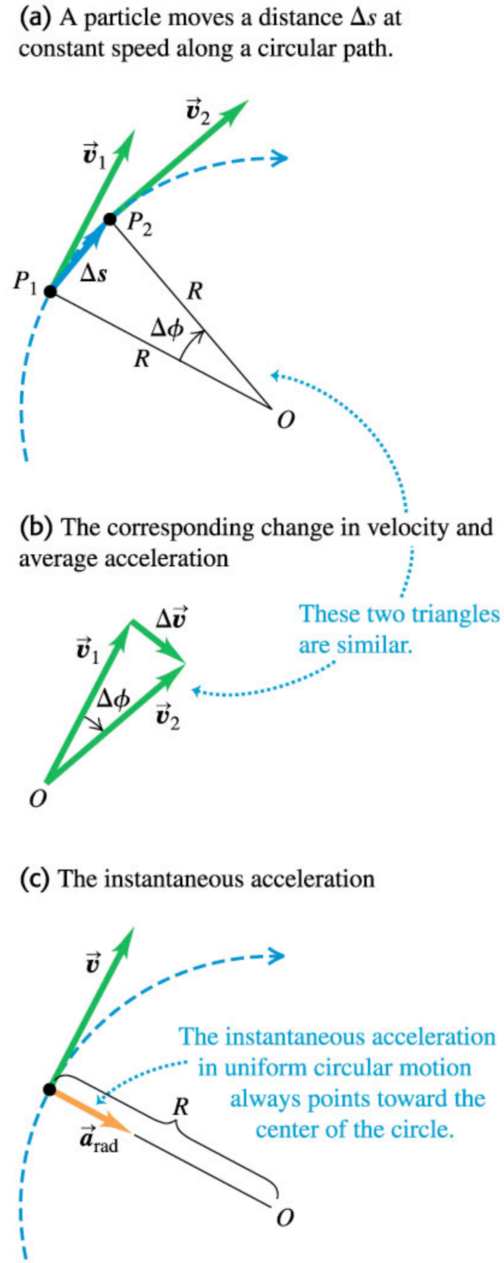
Uniform circular motion—Figure 3.27

- For *uniform circular motion*, the speed is constant and the acceleration is perpendicular to the velocity.



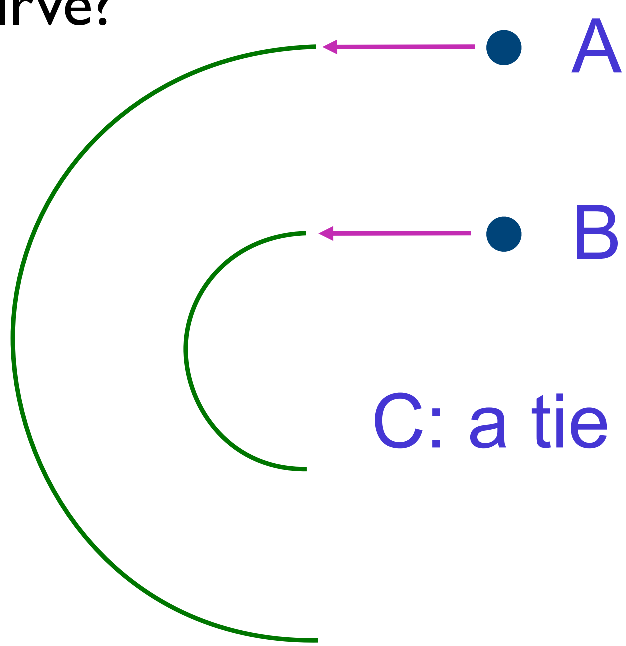
Acceleration for uniform circular motion

- For uniform circular motion, the instantaneous acceleration always points toward the center of the circle and is called the *centripetal acceleration*.
- The magnitude of the acceleration is $a_{rad} = v^2/R$.
- The *period T* is the time for one revolution, and $a_{rad} = 4\pi^2 R/T^2$.

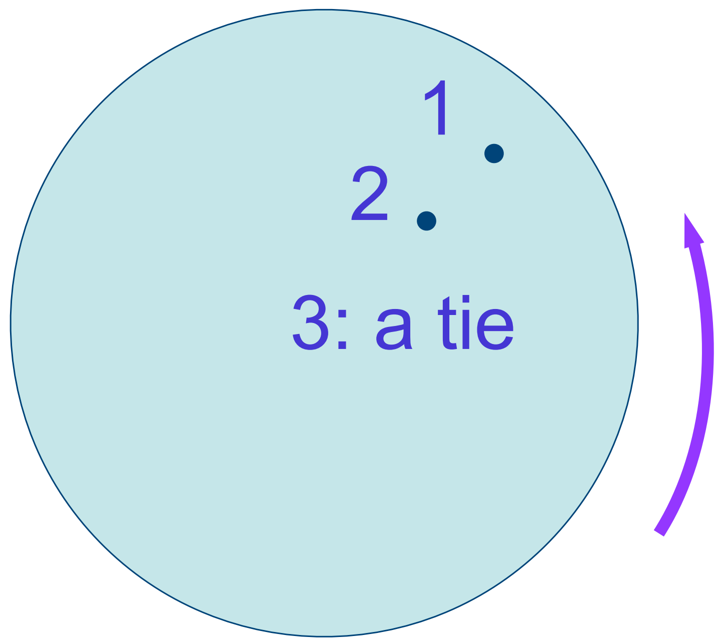


Text 'PHYSJC' and your answers to 22333

Two balls with the **same speed** contact different semicircular guides. Which accelerates the most in the curve?



Points **1** and **2** are different distances from the center of a rotating disk. Which accelerates the most?



Enter your answer for each scenario

Non-uniform circular motion

Which of the following are true?

K. The magnitude of the radial acceleration (a_{rad}) stays constant.

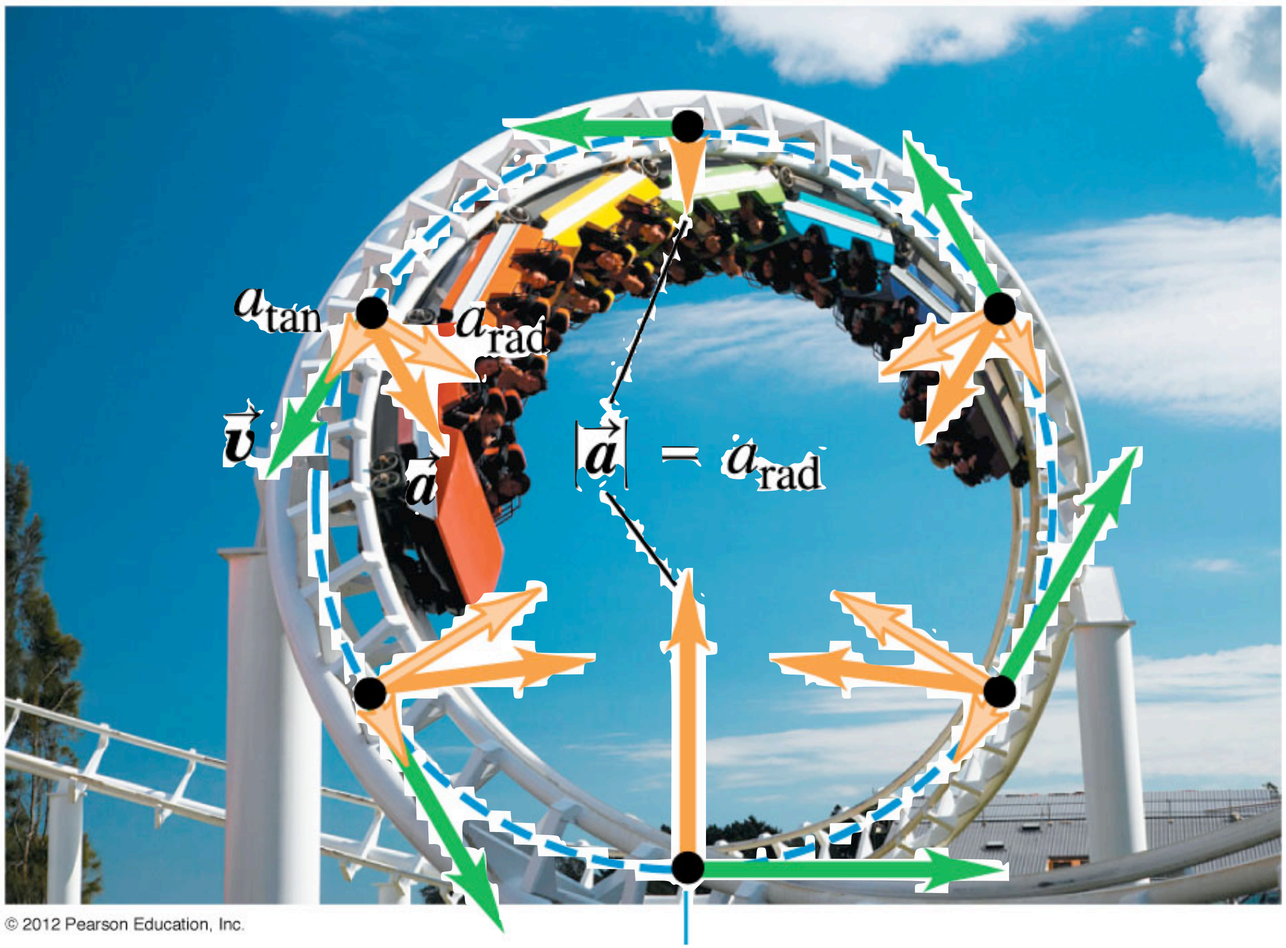
L. The magnitude of the tangental acceleration (a_{tan}) stays constant.

M. The magnitude of the total acceleration (a_{tot}) stays constant.

N. None of the above.

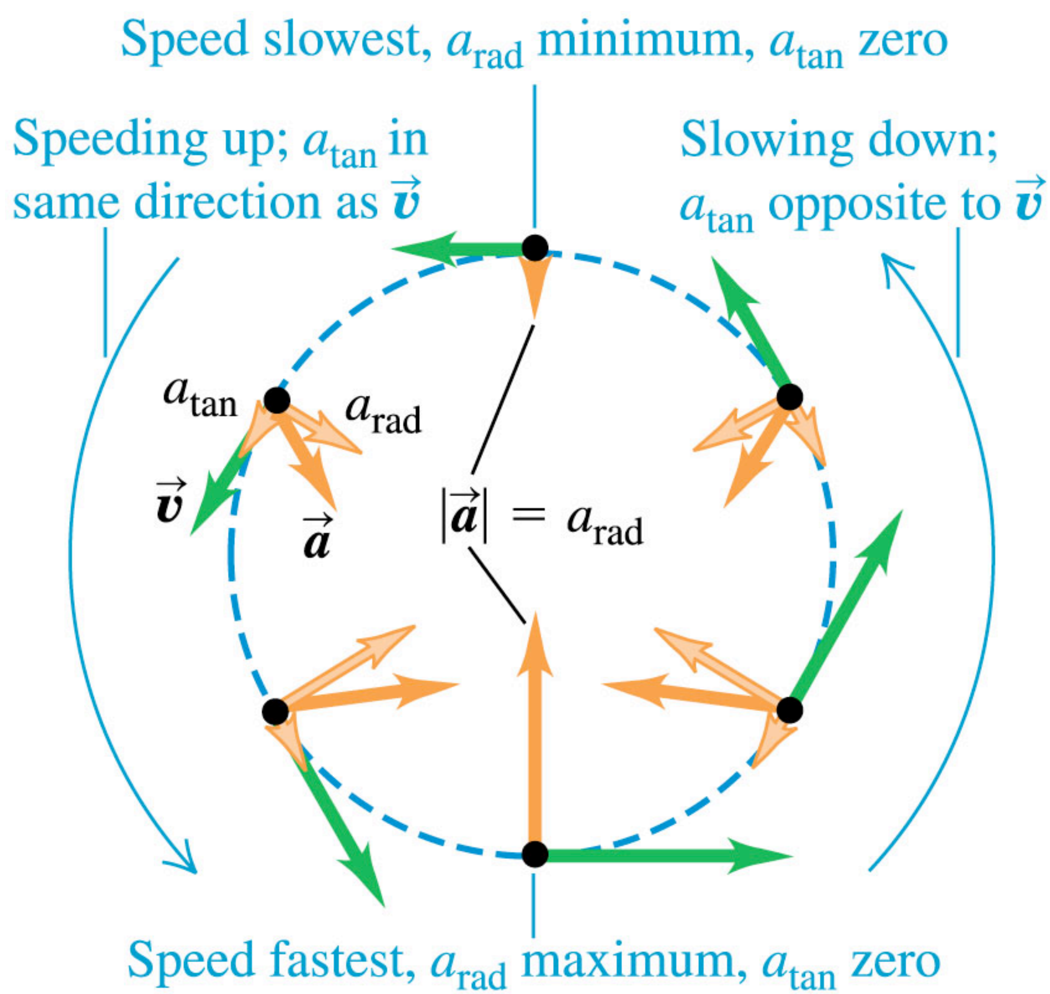
Text your answer to 22333

Non-uniform circular motion



Nonuniform circular motion—Figure 3.30

- If the speed varies, the motion is *nonuniform circular motion*.
- The radial acceleration component is still $a_{rad} = v^2/R$, but there is also a tangential acceleration component a_{tan} that is *parallel* to the instantaneous velocity.



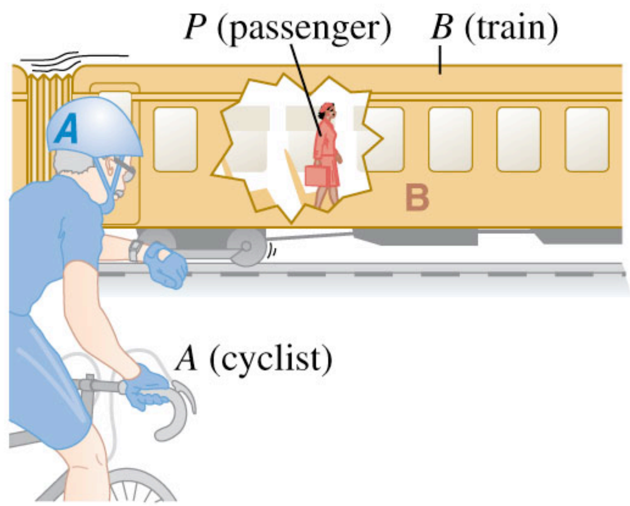
Relative velocity—Figures 3.31 and 3.32

- The velocity of a moving body seen by a particular observer is called the velocity *relative* to that observer, or simply the *relative velocity*.
- A *frame of reference* is a coordinate system plus a time scale.

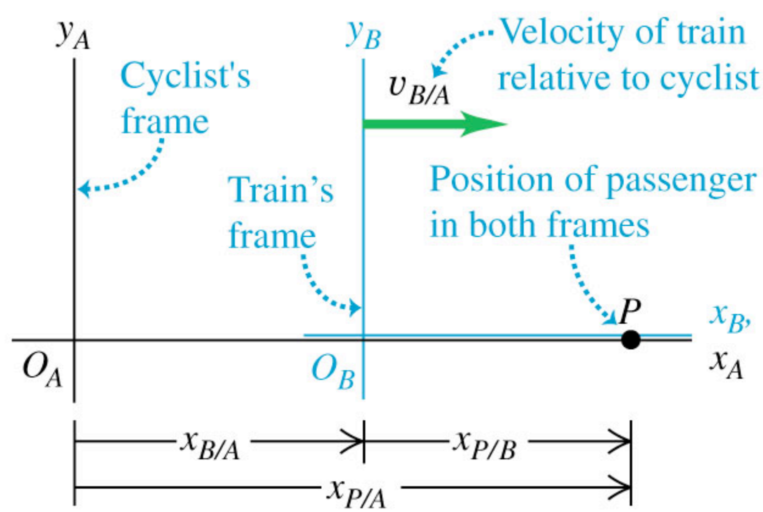
Relative velocity in one dimension

- If point *P* is moving relative to reference frame *A*, we denote the velocity of *P* relative to frame *A* as $v_{P/A}$.
- If *P* is moving relative to frame *B* and frame *B* is moving relative to frame *A*, then the *x*-velocity of *P* relative to frame *A* is $v_{P/A\text{-}x} = v_{P/B\text{-}x} + v_{B/A\text{-}x}$.

(a)



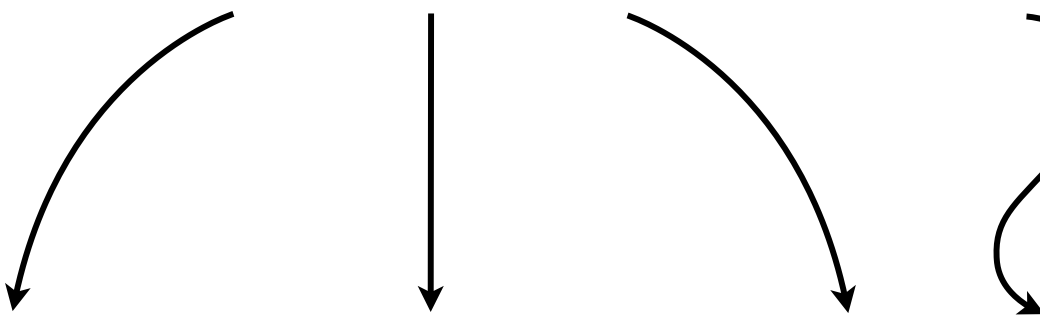
(b)



A cannon shoots objects at an initial horizontal velocity of 50 mph. It shoots a ball out the back of car traveling 50 mph. To a stationary observer, what will the trajectory of the ball look like?

v_{car}=50 mph ←

F. G. H. I. J.



J. None of these

- https://www.youtube.com/watch?v=BLuI118nhzc

Relative velocity in two or three dimensions

- We extend relative velocity to two or three dimensions by using vector addition to combine velocities.
- In Figure 3.34, a passenger's motion is viewed in the frame of the train and the cyclist.