University Physics 226N/231N
Old Dominion University

More on Circular Motion

First "Midterm" is Wednesday, September 19!
Today's quiz is 2 problems on MasteringPhysics
starting around 9:20
Hardcopies are also available if you want to work on paper

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Happy Birthday to Amy Winehouse, Wendy Thomas (Wendy's) and Walter Koenig (Chekhov)!
Happy Cream-Filled Donut day, Feast of the Cross, and Eat a Hoagie Day.

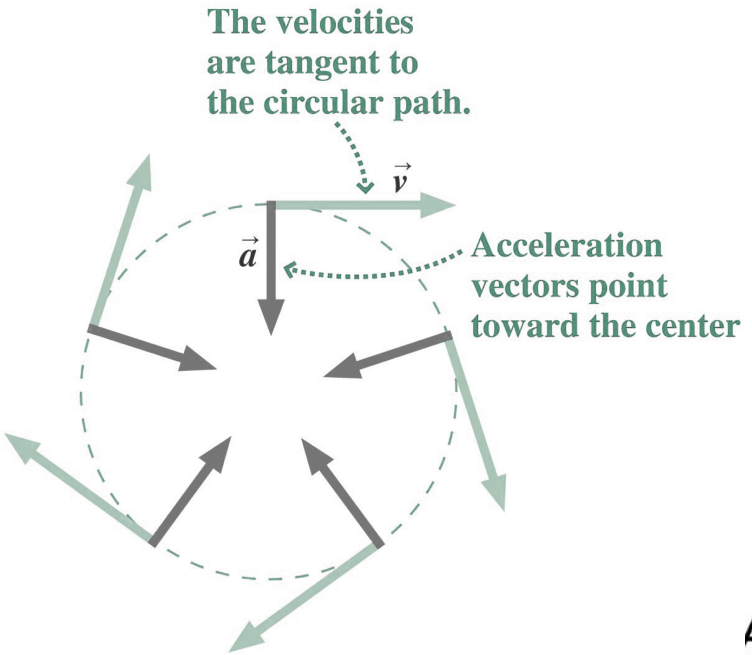
Uniform Circular Motion

- When an object moves in a circular path of radius *r* at constant speed *v*, its acceleration has magnitude

$$a = \frac{v^2}{r}$$

  - The acceleration vector points toward the center of the circle.
  - Since the direction of the acceleration keeps changing, this is **not** constant acceleration.

– Constant acceleration in two dimensions implies a **parabolic** trajectory, not a **circular** one.



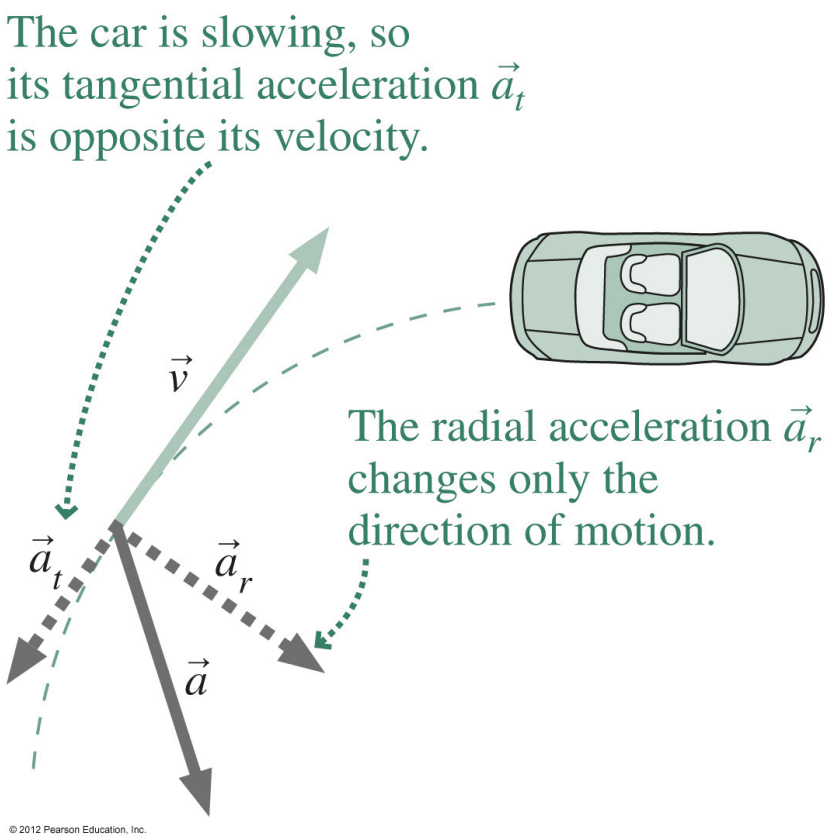
Nonuniform Circular Motion

- In nonuniform circular motion, speed and path radius can both change.
- The acceleration has both radial and tangential components, and these here also make a right triangle in those coordinates:

$$\vec{a} = \vec{a}_r + \vec{a}_t$$

$$a = \sqrt{a_r^2 + a_t^2}$$

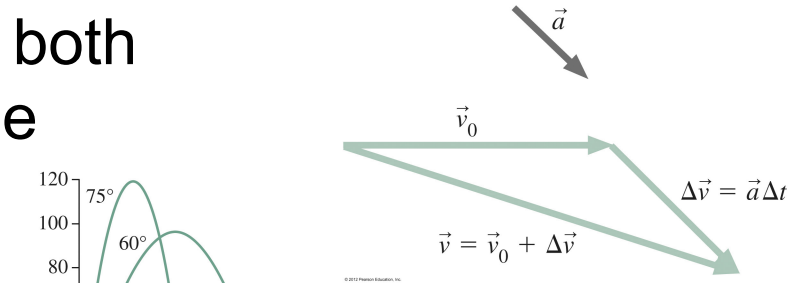
- $\vec{a}_r$ is perpendicular to $\vec{v}$ while $\vec{a}_t$ is tangential to $\vec{v}$.
  - The figure shows a car **braking** as it rounds a curve.

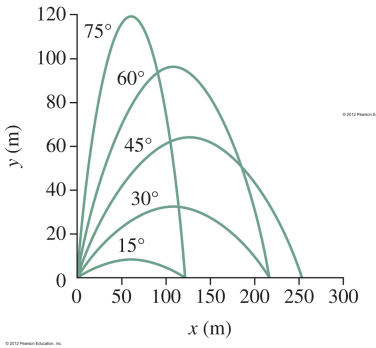


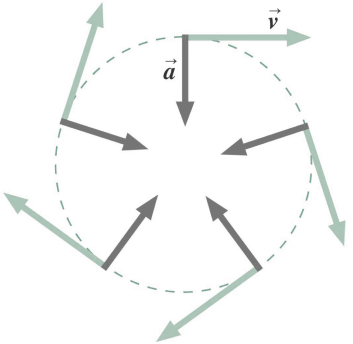
Summary

- In two and three dimensions, position, velocity, and acceleration become vector quantities.
  - Velocity is the rate of change of position: $\vec{v} = \frac{d\vec{r}}{dt}$
  - Acceleration is the rate of change of velocity: $\vec{a} = \frac{d\vec{v}}{dt}$

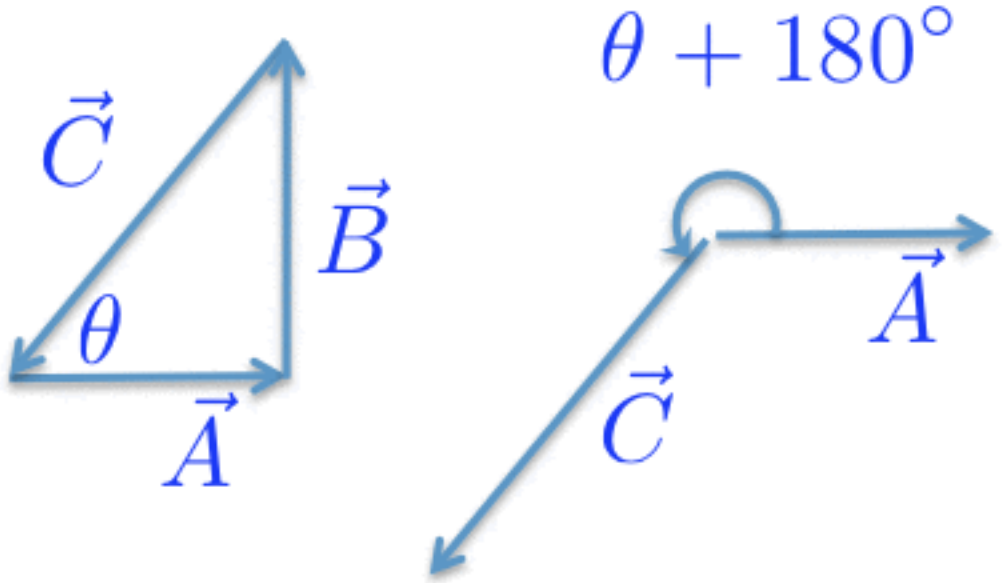
- In general, acceleration changes both the magnitude and direction of the velocity.
- Projectile motion results from the acceleration of gravity.
- In uniform circular motion, the acceleration has magnitude v^2/r and points toward the center of the circular path.







Homework 3.14 Review



- Recommendations:
  - Always draw a picture: visual cues often help (like the direction of C here, since the problem states that C is such that

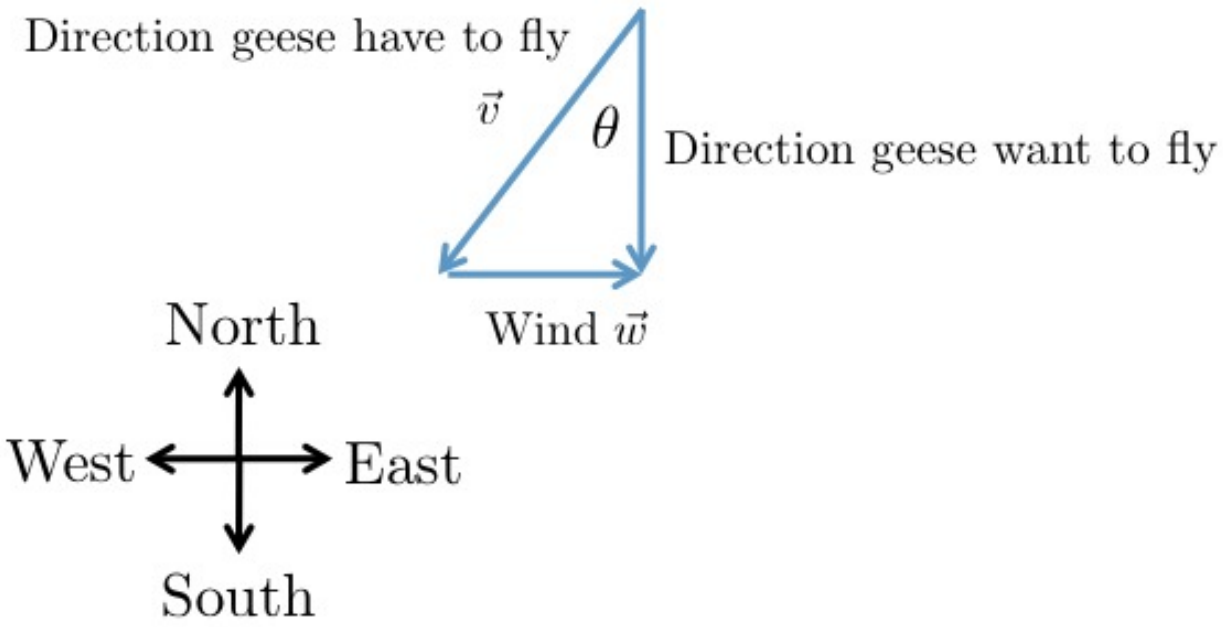
$$\vec{A} + \vec{B} + \vec{C} = 0$$

  - Practice trigonometry and the sohcahtoa mnemonic. Here

$$\sin\theta = \frac{\text{opposite}}{\text{hypoteneuse}} = \frac{B}{C} \qquad \cos\theta = \frac{\text{adjacent}}{\text{hypoteneuse}} = \frac{A}{C} \qquad \tan\theta = \frac{\text{opposite}}{\text{adjacent}} = \frac{B}{A}$$

    - Know both vector components? Use the tangent!

Homework 3.29 Review



- The geese can fly 7.0 m/s relative to air (i.e. in still air)
  - But the wind is moving air, so part of their velocity needs to cancel out the wind speed
  - If the geese flew straight south, the wind on the side would push them off course.
  - Here again, the picture helps: $\sin\theta = \frac{w}{v}$