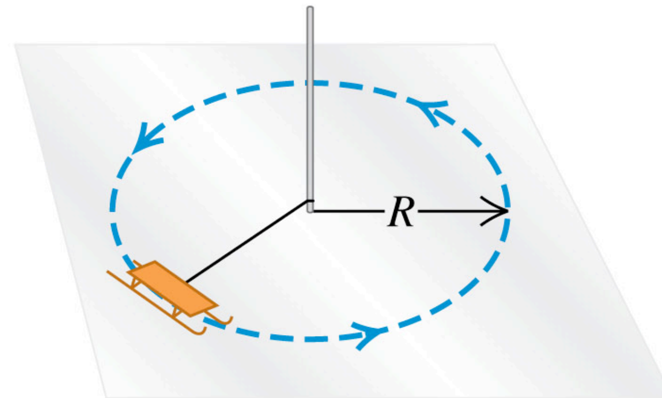
Q5.11

A sled moves on essentially frictionless ice. It is attached by a rope to a vertical post set in the ice. Once given a push, the sled moves around the post at constant speed in a circle of radius R.



If the rope breaks,

A. the sled will keep moving in a circle.

B. the sled will move on a curved path, but not a circle.

C. the sled will follow a curved path for a while, then move in a straight line.

D. the sled will move in a straight line.

Text 'PHYSJC' and your answer to 22333

Exam #1

- Thursday, March 3. 5-7pm. CR 306
- Chapters 1-5
- Closed notes, closed book. 1 page of equations is allowed.
- Calculators are allowed.

Chapter 5.4
Circular Motion

PHYS1210 - Prof. Jang-Condell

Goals for Chapter 5

- To use Newton's first law for bodies in equilibrium
- To use Newton's second law for accelerating bodies
- To study the types of friction and fluid resistance
- To solve problems involving circular motion

Fluid resistance

- Small objects, low speed:

$$f = k\,v$$

- Large objects, high speed:

$$f = D\,v^2$$

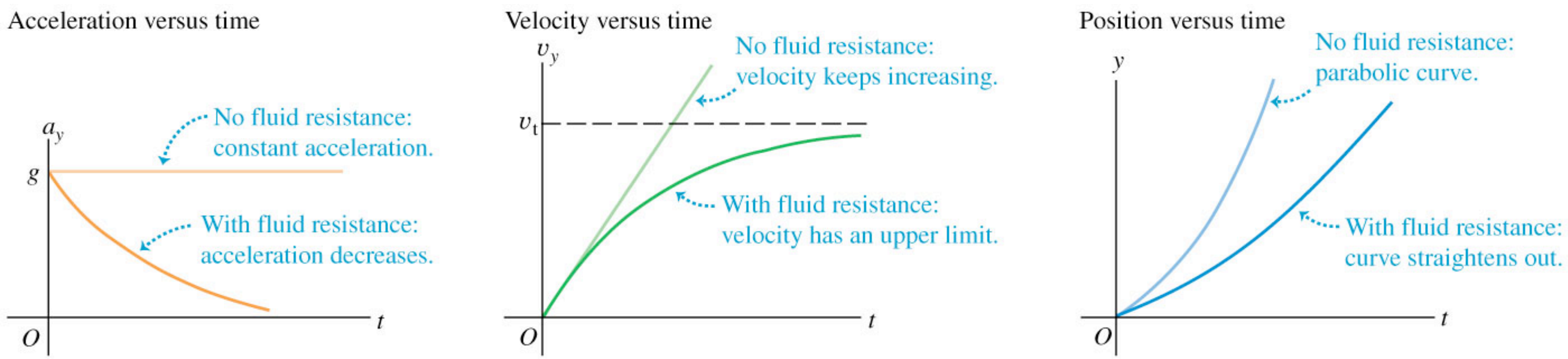
Fluid resistance, small objects, low speed

- Terminal speed:

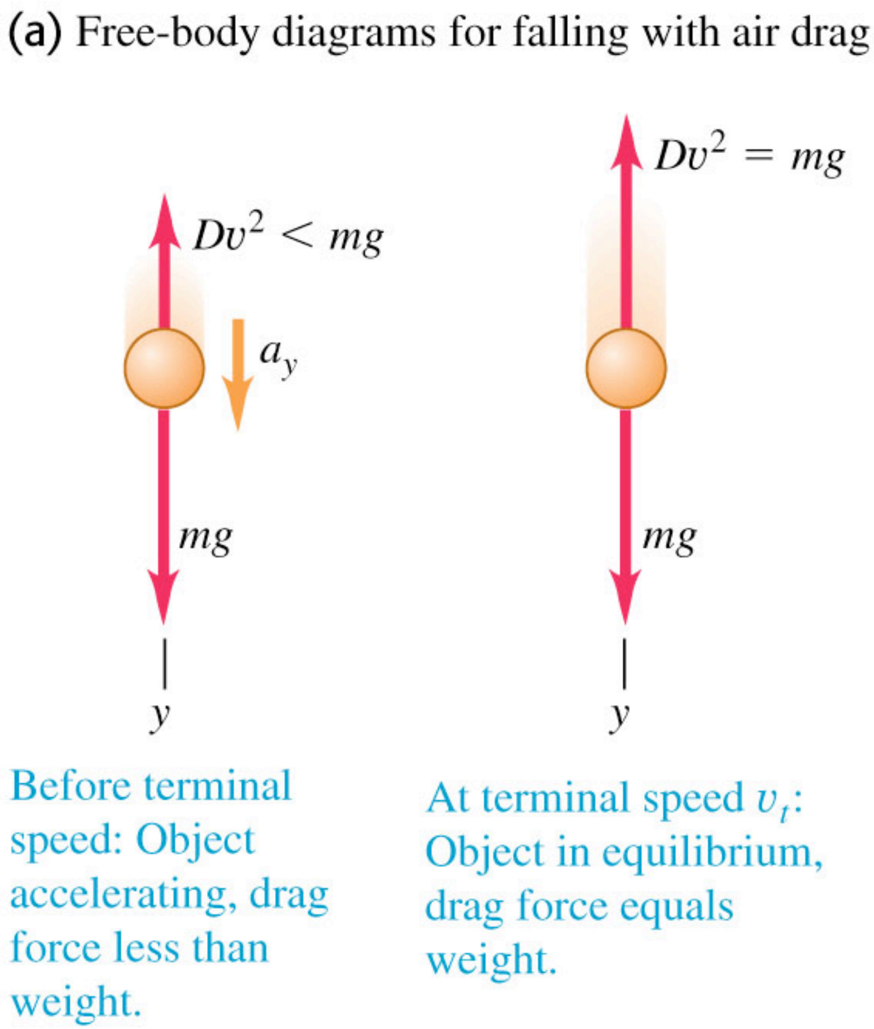
$$v_t = mg/k$$

- Equation of motion:

$$v_y = v_t\,[\,1\text{-}e^{-kt/m}]$$



Fluid resistance, large objects, high speed



- Friction force

$$f = D\,v^2$$

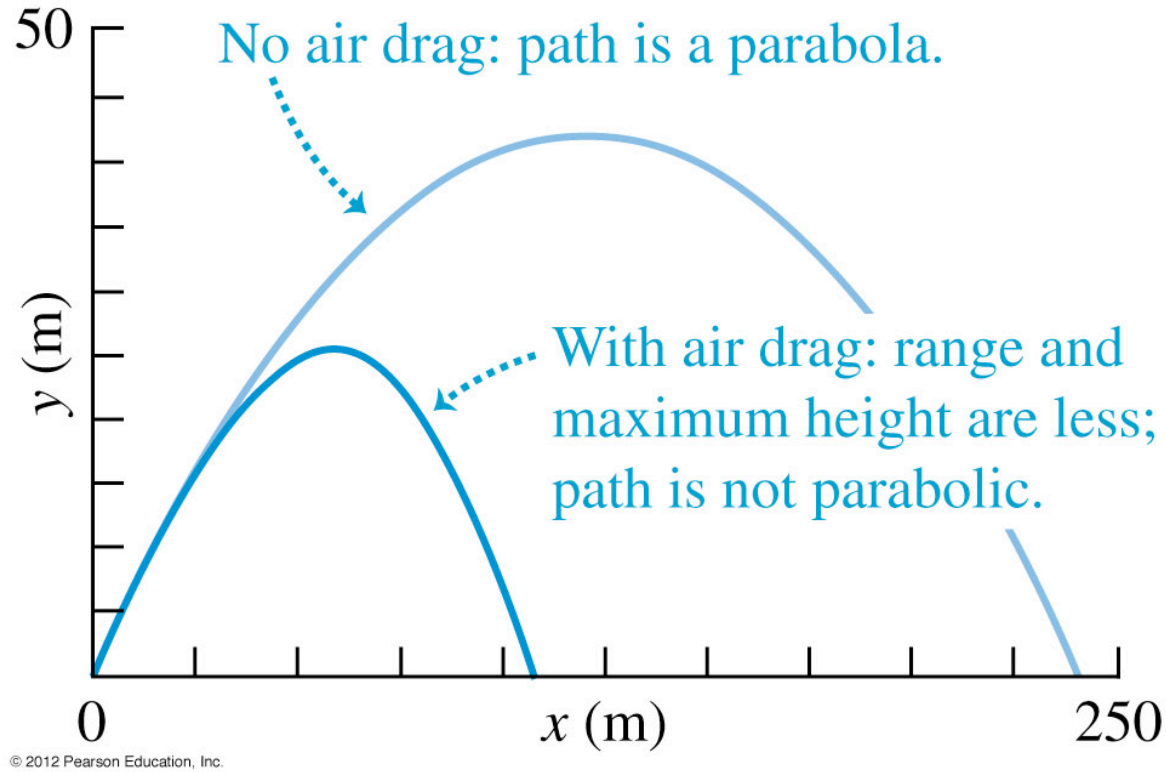
- Terminal speed:

$$v_t = \sqrt{mg/D}$$

Fluid resistance

	Small objects, low speed:	Large objects, high speed:
Force	$f = k\,v$	$f = D\,v^2$
Terminal speed	$v_t = mg/k$	$v_t = \sqrt{mg/D}$

Fluid resistance,
$f = Dv^2$

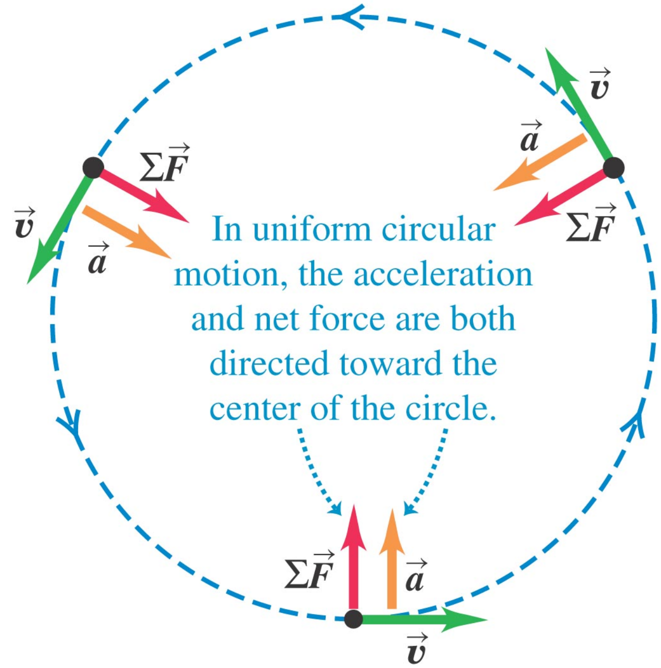


Trajectory of a baseball

Circular Motion

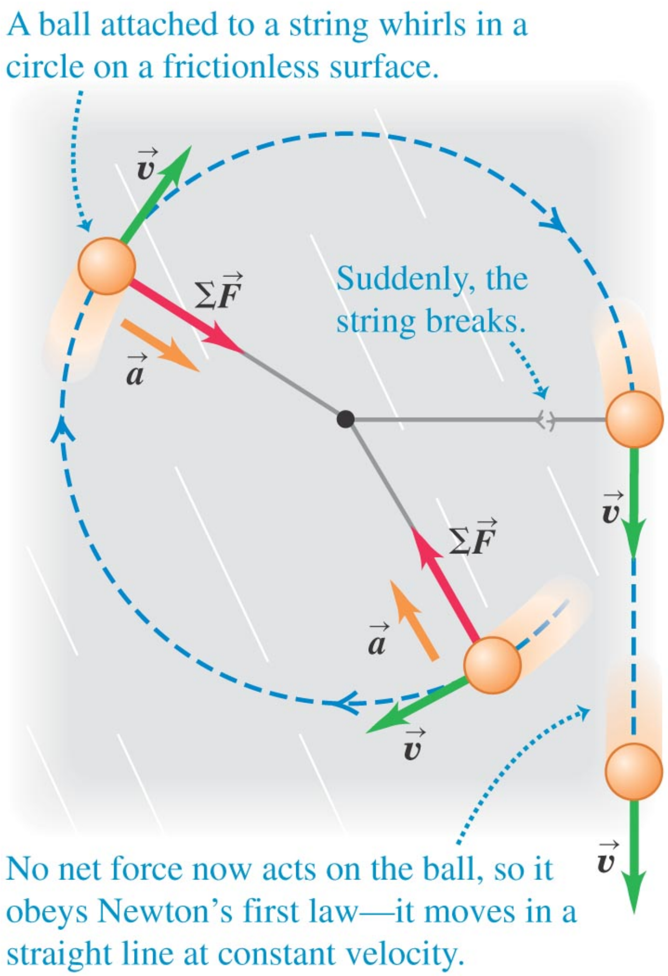
Dynamics of circular motion

- If a particle is in uniform circular motion, both its acceleration and the net force on it are directed toward the center of the circle.
- The net force on the particle is $F_{net} = mv^2/R$.



What if the string breaks?

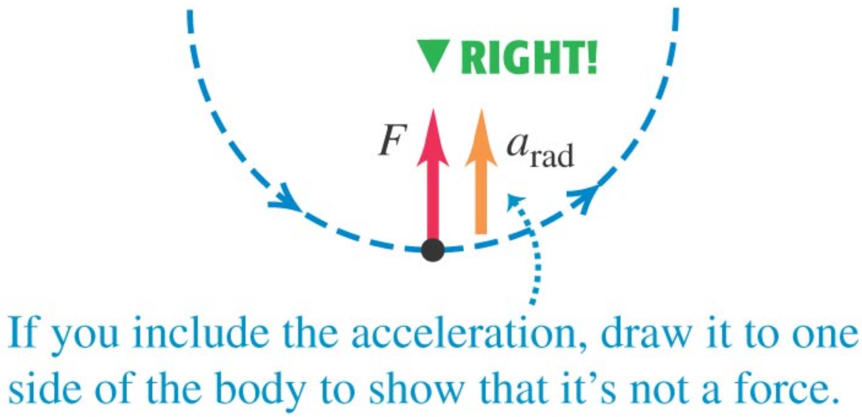
- If the string breaks, no net force acts on the ball, so it obeys Newton’s first law and moves in a straight line.



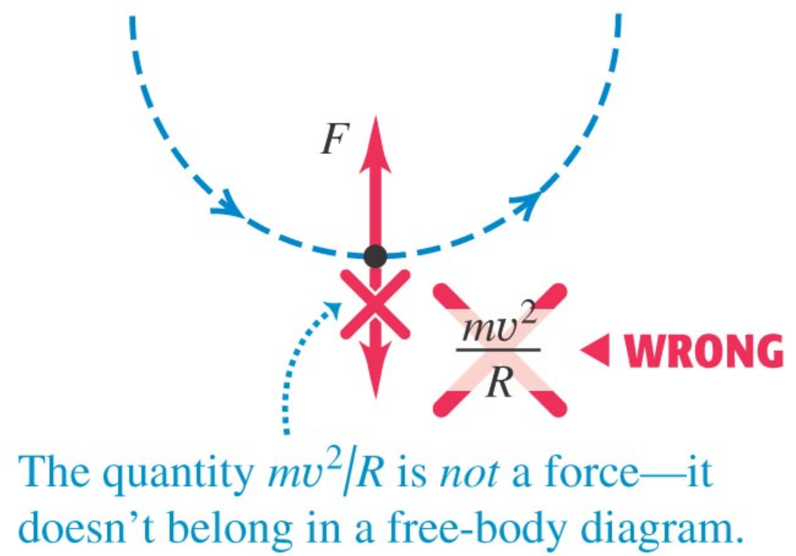
Avoid using "centrifugal force"

- Figure (a) shows the correct free-body diagram for a body in uniform circular motion.
- Figure (b) shows a common error.
- In an inertial frame of reference, there is no such thing as "centrifugal force."

(a) Correct free-body diagram

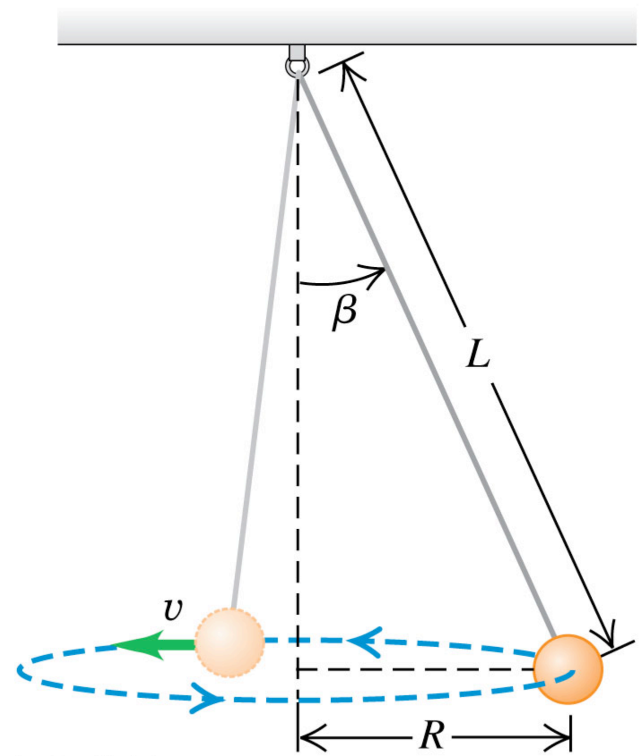


(b) Incorrect free-body diagram



Q5.12

A pendulum bob of mass m is attached to the ceiling by a thin wire of length L. The bob moves at constant speed in a horizontal circle of radius R, with the wire making a constant angle β with the vertical. The tension in the wire



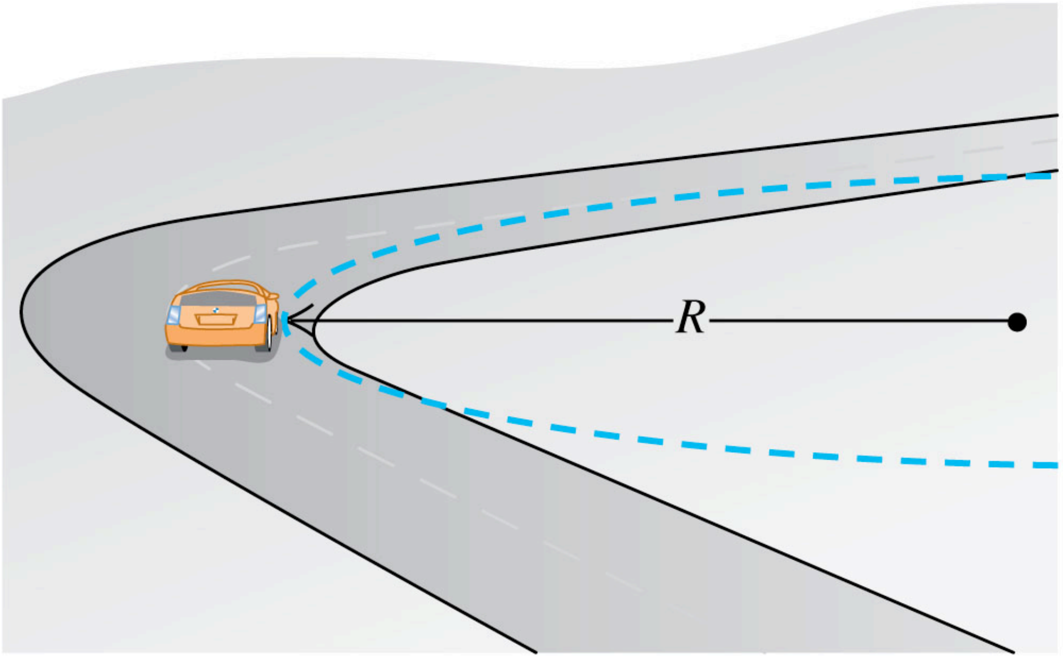
F. is greater than mg.

G. is equal to mg.

H. is less than mg.

I. is any of the above, depending on the bob's speed v.

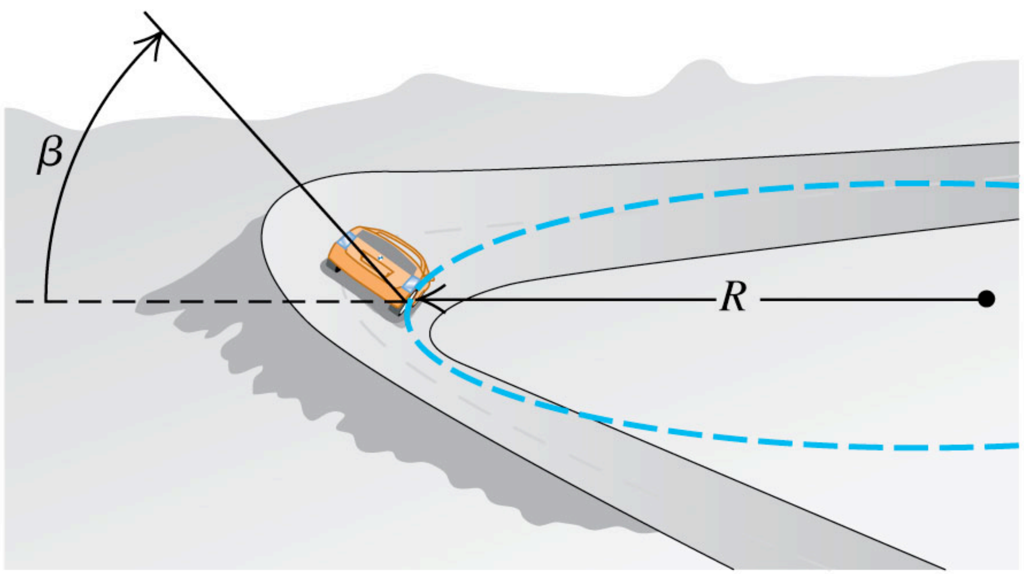
When a car goes around a curve, what keeps it on the road?



A car rounds a banked curve

- At what angle should a curve be banked so a car can make the turn even with no friction?

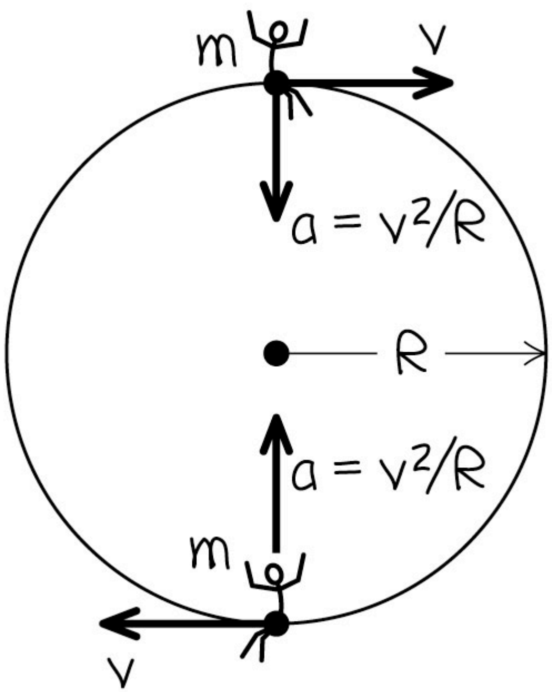
(a) Car rounding banked curve



Uniform motion in a vertical circle

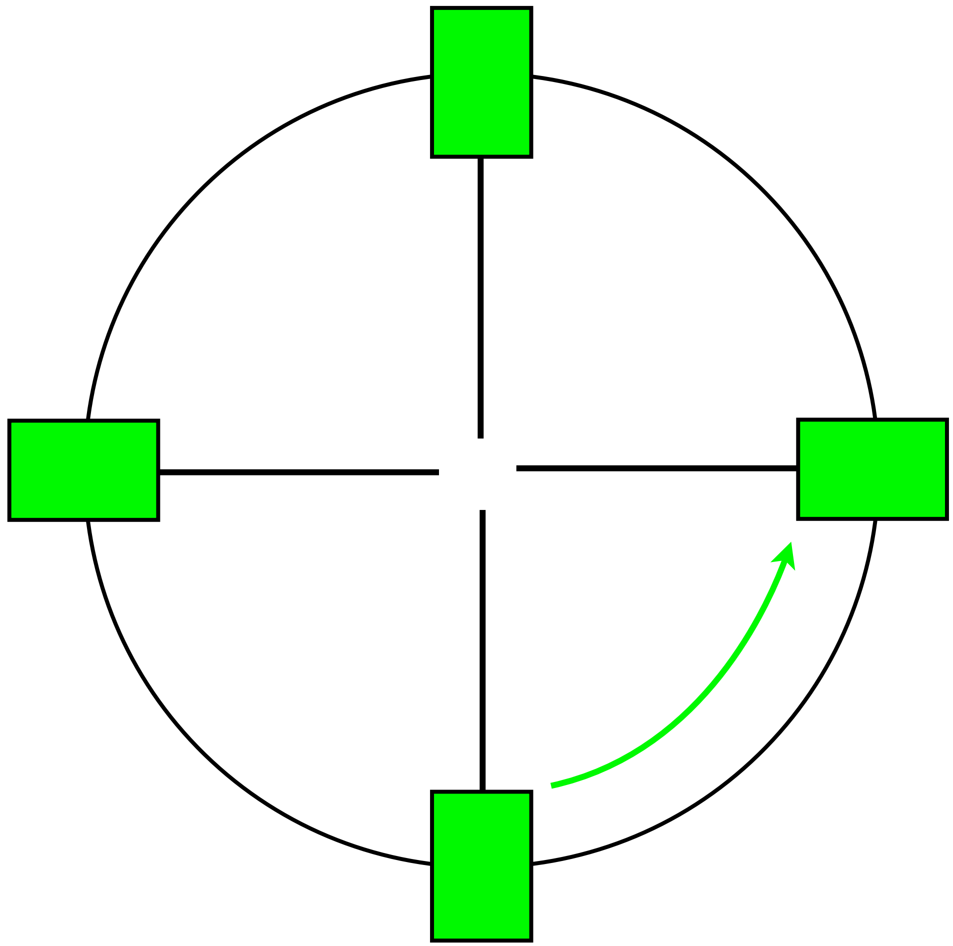
- A person on a Ferris wheel moves in a vertical circle.
- Follow Example 5.23.

(a) Sketch of two positions



Vertical Circular Motion

How fast do I need to swing a bucket around so that objects do not fall out of it?



The fundamental forces of nature

- According to current understanding, all forces are expressions of four distinct *fundamental* forces:
- *gravitational interactions*
- *electromagnetic interactions*
- the *strong interaction*
- the *weak interaction*