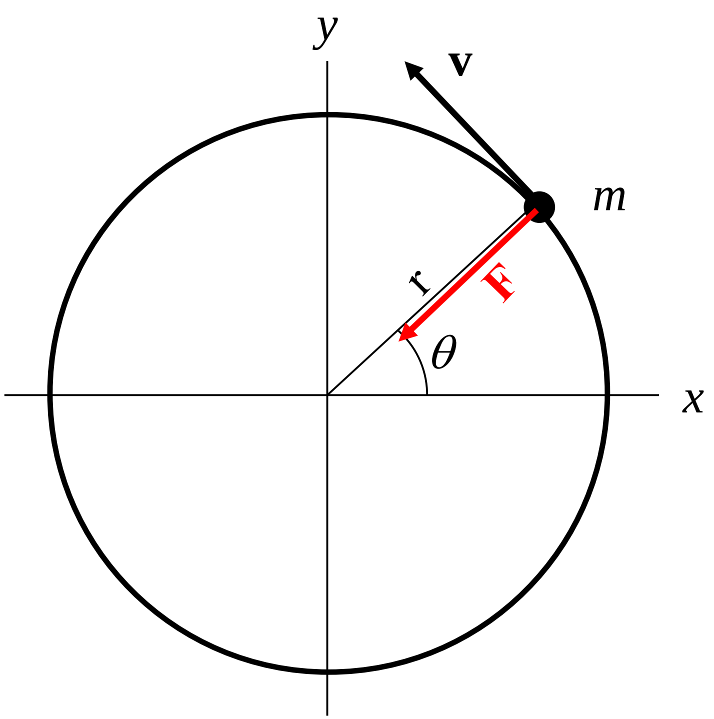
Uniform Circular Motion

Recall that a particle traveling in a circle with a constant speed has a centripetal acceleration. So, there is a centripetal force given by:

$$\vec{F}_c = \frac{mv^2}{r}$$

radially inward.



Example #1: Astronaut

An 79-kg astronaut orbits the Earth at an altitude of 520 km at a speed of v = 7.6 km/s.

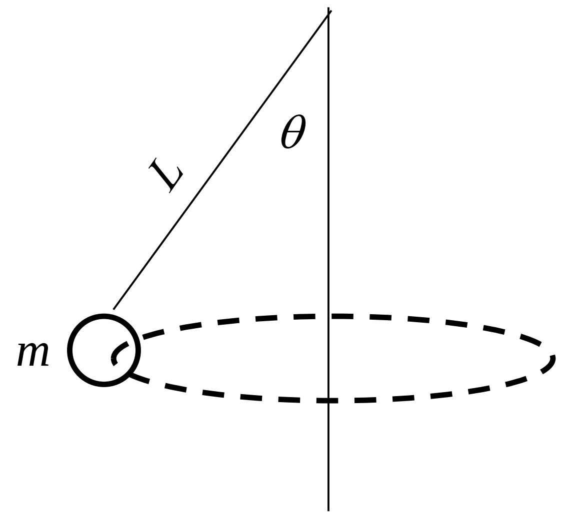
- Calculate the centripetal acceleration and the centripetal force that acts on the astronaut.

(The radius of the Earth is 6.37×10^6 m.)

Example #2: Conical Pendulum

A mass of 1.5 kg turning in horizontal circle with a constant speed at the end of length L = 1.7 m. The cord makes an angle of 37^{o} with the vertical.

Calculate the period of the revolution.



Example #3: Unbanked roadway

A car just barely rounds a curve on a flat roadway without skidding. The car travels with a constant speed of 20 m/s. The curve has a radius of 190 m.

Calculate the minimum coefficient of (static) friction for this situation.

Example #4: Banked Roadway

What is the roadway is wet or icy? Then we cannot rely of static friction to make the car turn.

Therefore, highways, entrance/exit ramps are banked to minimize reliance on static friction.

For the car in the previous example, calculate the angle the curve should be banked in order to make reliance on static friction unnecessary.

Example #5: The "Cliffhanger"

A popular amusement part ride is the "Rotor" (a.k.a. the "Cliffhanger") in which a riders stand against the inside a cylindrical drum that rotates at high speed such that the riders remain pressed against the wall as the floor drops from below.

Take R = 2.1 m and μ_s = 0.40.

- Calculate the minimum speed that a rider can have before starting to slip.
- At this speed, calculate the (centripetal) acceleration experienced by a rider.

Example 6: Loop-the-loop

A circus performer rides a bicycle around a vertical loop of radius 2.7 m.

- Calculate the minimum speed that the performer must have in order to just barely make it around the loop without falling.