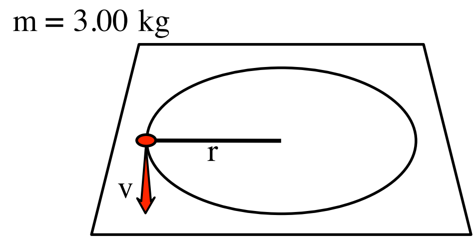
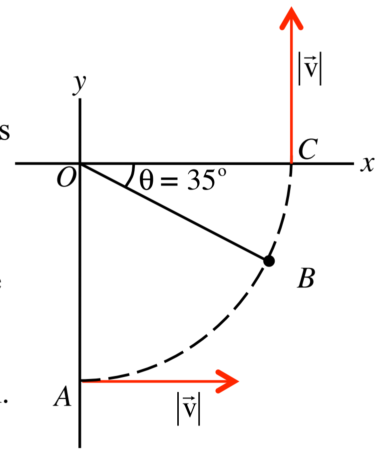
6-Series Problem

6.1) A puck of mass *m = 3.00 kg* sits on a frictionless table. A string that is rated to hold a 25.0 kg hanging mass before breaking is attached to the puck and is itself attached to the center of the table a distance *r = 0.800 meters* away. If motivated to move in a circle, what is the maximum speed the puck can attain without breaking the string?



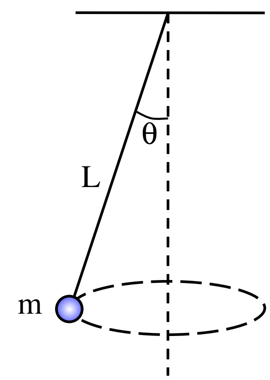
6.6.) A particle moving in the *x-direction* at *Point A* follows a circular path as it transitions to motion in the *y-direction* at *Point C*. If the magnitude of the particle's velocity stays constant during the transition, and if the arc length between *A* to *C* is 235 meters, and if the transition takes 36.0 seconds:

a.) Determine the particle's *acceleration* when at the $\theta = 35^\circ$ point (use *unit vector notation* here).
b.) Determine the particle's *average speed* through the transition.
c.) Determine the particle's *average acceleration* through the transition.



6.8) A bob of mass *m = 80 kg* is attached to a string of length *L = 10.0 m* which is itself attached to the ceiling. The bob is thrown so as to circle in the horizontal at an angle $\theta = 5^\circ$ with the vertical, as shown in the sketch.

a.) Determine the force components in the horizontal and vertical on the bob.
b.) Determine the bob's radial (centripetal) acceleration.



6.9) A box sitting on the bed of a truck. The truck executes a turn along a circle of radius *r = 35 meters*. What is the maximum speed the truck can take the curve if the *coefficient of static friction* between the box and the bed is 0.600 and the box is not to break loose and slide over the bed?

6.12) A classic classroom demonstration is having an instructor with a pail of water attached to a rope swing the pail in the vertical fast enough so the water does not leave the pail even when the bucket is overhead in its flight.

a.) In general, what are the external forces acting on the water during the demo?

b.) What force(s) are important in motivating the water to move in a circular path?

c.) If the water is to just barely make it through the top of the arc without spilling out, how fast does it (the water) and the pail have to be moving, minimum, if the radius of the arc was 1.00 m?

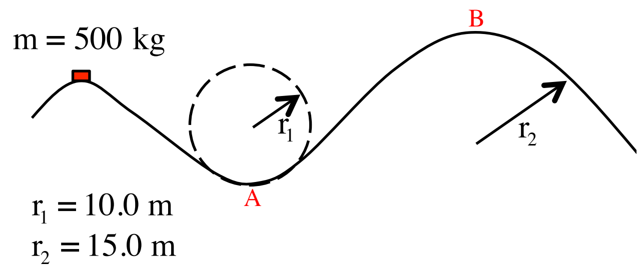
d.) What would happen if you cut the string when the pail was at the top of the arc and the situation outlined in *Part c* was in effect. Put a little differently, if the bucket magically disappeared just as it and the water passed through the top (under the circumstances outlined in *Part c)*, what would happen to the water? Would there be any difference in the motion of the pail if the string was cut when at the top of the arc, and the motion of the water if the pail magically disappeared when the pail was at the top of the arc?

6.14) A kid sits on a swing. Two, 3.00-meter long ropes support the "massless" plank upon which sits the 40-kg child. The tension in each of the ropes as the assembly swing through its lowest point is 350 N.

a.) At the lowest point, what is the child's speed?

b.) At the lowest point, what is the force on the child due to the presence of the seat?

6.16) When completely filled with people, a roller coaster's mass is 500 kg. The section of the coaster ride shown is straight-line motion (i.e., no *into* or *out-of* the page motion). Assume the section of track that includes *Point A* can be approximated as a circle of radius $r_1 = 10.0\ \text{m}$ and the part that includes *Point B* can be approximated as a circle of radius $r_2 = 15.0\ \text{m}$. Additionally, note that at *Point A*, the coaster car will be moving with velocity magnitude 20.0 m/s.

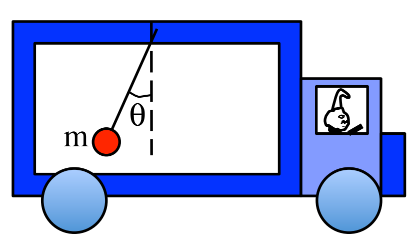


a.) The track will exert what force on the car when at *Point A*?

b.) Assuming the car is not attached to the track, what is the maximum velocity it can have and not lift off as it passes over the top of the highest loop (i.e., at *Point B*)?

6.17) The mass of Tarzan's son's is 85.0 kg (he's a big kid). He tries to make it across a raging river by swinging on a 10.0 meter long vine, where he is moving 8.00 m/s at the bottom of his arc. Unfortunately, the vine can only handle 1000 N of force. Does he make it across the river?

6.21) A pendulum bob of mass $m = 0.500\ kg$ has its string attached to the ceiling of a truck. The truck's acceleration magnitude is $3.00\ \text{m/s}^2$.



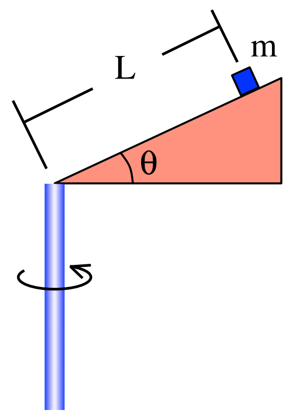
a.) Looking at the sketch, is the acceleration to the right or left?

b.) During the acceleration, at what angle θ will the string make with the vertical?

c.) During the acceleration, what will the tension in the line be?

6.23) A scale in an elevator reads 591 N. Later as the elevator is stopping, the scale reads 391 N. Assuming the man has been standing on the scale the whole time, all accelerations have been constant and the magnitude of the increasing and decreasing acceleration has been the same.

a.) Determine the individual's weight.
b.) Determine the individual's mass.
c.) Determine the elevator's upward acceleration as a vector.



6.42) A light-weight, frictionless incline of angle θ is rigidly (and awkwardly) attached to a shaft that can be rotated, as shown in the sketch. A mass *m* is positioned a distance *L* units up the incline. If the shaft, the incline and *m* are made to rotate too fast, *m* will migrate up the incline. If the shaft, the incline and *m* are made to rotate too slowly, *m* will migrate down the incline. At what speed must *m* move so as to sit on the incline without migrating up the incline or down the incline?

ADDED THRILL (an old-school AP question in this case, for those who would like to chew on a little more . . .)

The ring: Securely fixed on a frictionless surface is a frictional, circular wall (coefficient of friction μ_k) of radius *R*. A mass *m* is given an initial speed v_o moving around the wall. How long will it take for the mass to reach a speed of $\frac{v_o}{2}$?