Uniform Circular Motion

Let's extend our application of Newton's Laws to circular motion.

Let's start by considering an object traveling in a circular path at constant speed *v*. We'll Pick one point on the path and sketch the velocity vector just before the object reaches that point, and sketch the velocity vector just after the object reaches that point.

Knowing that the acceleration is given by $\vec{a} = \frac{\Delta \vec{v}}{\Delta t}$, think about the direction of the change in velocity $\Delta \vec{v}$. The acceleration is in the same direction as $\Delta \vec{v}$. Which direction is the acceleration?

Let's say we now double the speed. We draw the two velocity vectors at the same points as before. Are they different? If so, how?

Is the change in velocity $\Delta \vec{v}$ any different? If so, how?

Has the time interval Δt changed? If so, how?

Based on all this, if we double the speed what happens to the magnitude of the acceleration?

Now let's think about whether changing the radius would have any effect on the acceleration. If the object was moving in a circle of half the original radius but with the original speed *v* how would the acceleration compare to what it was originally?

Let's get some more practice drawing free-body diagrams. Consider the situation of an object placed on a turntable and rotating with the turntable. Draw a free-body diagram for the object when it is to the right of the center of the turntable.

Now apply Newton's Second Law twice, once for each direction.

Consider a ball on a string. The ball is being whirled in a horizontal circle, with the string at some angle with respect to the vertical. Draw a free-body diagram for the ball.

Now apply Newton's Second Law twice, once for each direction.

Consider the carnival ride in which the rider is pinned to the wall of a rotating cylinder. Sketch a free-body diagram of the rider when the rider is to the right of the center of the cylinder.

Now apply Newton's Second Law twice, once for each direction.