Tracking the Coriolis Force[1]

Introduction: This activity requires Tracker (download it if you do not already have a version on your computer) and the Coriolis.trk and Coriolis.mov files (www.compadre.org/osp/xxxx) based on the YouTube video: at http://www.youtube.com/watch?v=LAX3ALdienQ . Open the files in Tracker. Describe the motion of the ball after the woman releases it:

How can you tell that the woman and man are in a non-inertial reference frame?

Immediately after the ball leaves the hand…

what is the direction of the velocity?

what is the direction of the force (i.e., the Coriolis force because the reference frame is non-inertial)?

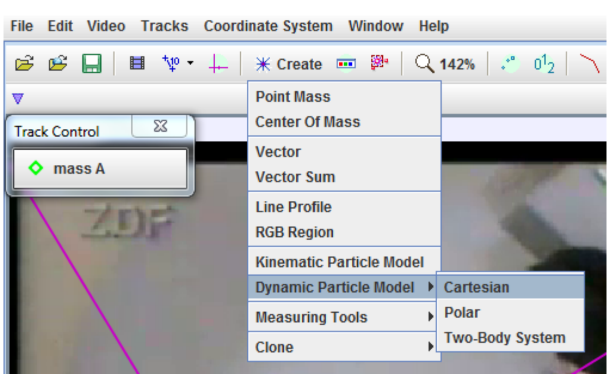
The Coriolis force is given by $\vec{F}_{\text{Coriolis}} = 2m\vec{\omega} \times \vec{v}$. Using your answers above, then, what is the direction of the angular velocity, $\vec{\omega}$? (You can check your answer by watching the full clip on YouTube).

If the angular velocity is only in the z-direction (into or out of the screen), what are the component of the force in the x and y directions (in terms of vx, vy, ω and m)?

F_x = ________________

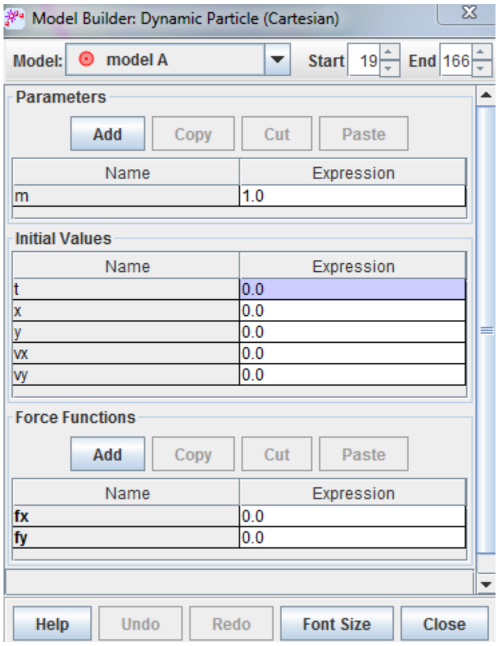
F_y= ________________

You will use this to create a model of the motion. In Tracker, Create a new "Dynamical Particle Model" track:



[1] An extension of the exercise found at http://www.compadre.org/osp/items/detail.cfm?ID=10437 by A. Titus.

The Model Builder tool will open:



"Add" a new parameter, ω (for the angular velocity), and give it a value.

Then, enter a force function. For example, if you found $F_x=2m\cdot vx^2\cdot w$ (this is incorrect!) then you would type in

fx = 2*m*vx*vx*w (incorrect expression).

Please type in your expressions (the correct ones) for fx and fy (if the box is yellow, push "Enter" so Tracker will read the expression).

If you play your movie and track again, the model still probably doesn't change. This is because we still need to define initial conditions.

To find the initial conditions, look at the original track (Green "Mass A") track and find the initial conditions from plots of position and velocity. Enter them into in your Model and the Table below:

Initial Values	
t	0
x	
y	
vx	
vy	

Now, adjust your value of ω so that the red "Model A" track matches the track of Mass A as closely as possible.

ω = ____________________

From the original YouTube video recording at http://www.youtube.com/watch?v=LAX3ALdienQ, estimate the angular velocity (watch a full revolution or half a revolution and record the time). What value do you get for the angular velocity?

ω = ____________________

If you recorded the motion of the ball from a camera fixed to the ground (instead of attached to the reference frame), what would the motion look like and why?

The earth is a non-inertial reference frame (it rotates on its axis) yet we don't often observe this effect when we toss a tennis ball. Why not? (Hint: what is the value of ω for the rotation of the Earth? How big would v need to be to have a noticeable effect?)