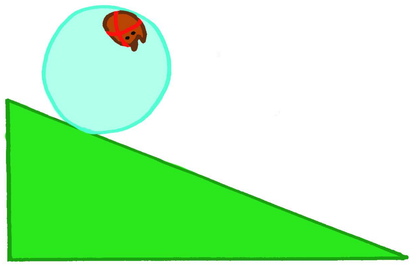
Out of Control Hamster Balls : Hamster Survival Stories

by Michael Sheets and Jiaying Wei

Introduction

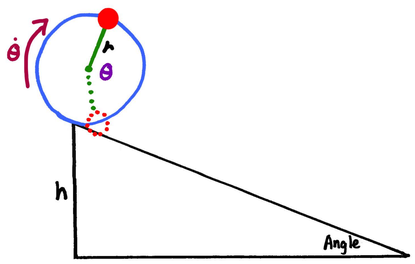
An out of control hamster ball is a situation where the the hamster ball controls the hamster. In order to replicate this scenario we are putting the hamster and hamster ball system on a hill and allowing it to roll down the hill.



Question

How long can hamsters safely survive on slopes of various inclines?

Hamster Ball System



We made several assumptions in order to simplify our model.

1. The system is 2D
2. The hamster is a particle
3. The hamster is strapped into the ball
4. There is neither drag nor slipping

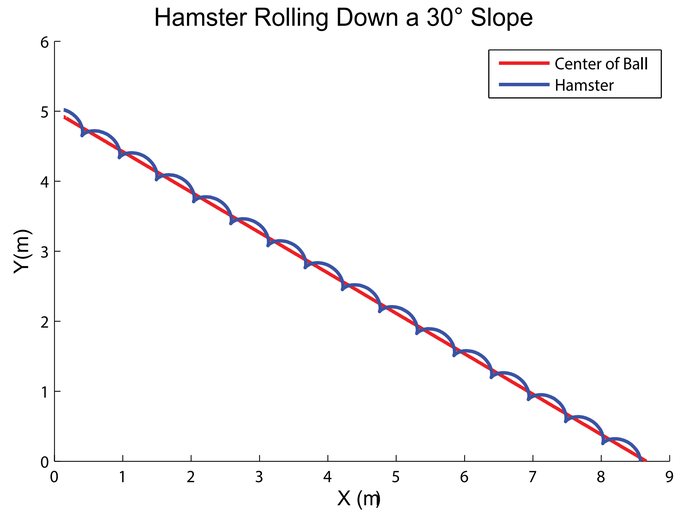
We used lagrangian mechanics to derive our equation of motion.

$$\alpha = \frac{g[MsinA + m(sinA - cos\theta)]}{r(\frac{2}{3}M + m) + M + m}$$

We kept track of the θ (position of the hamster inside the hamster ball) which allowed us to figure out total travel distance and velocity of both the hamster ball and the hamster.

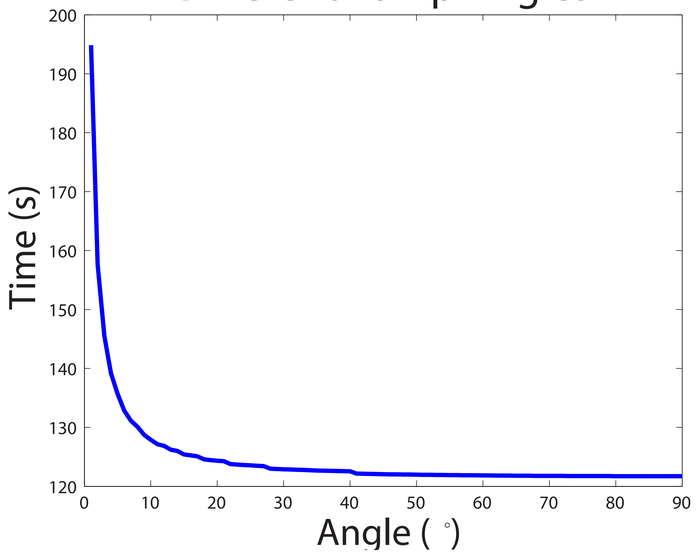
Abstract

We wanted to know how long hamsters could safely stay in a hamster ball it has no control over. We abstracted our system to a hamster strapped to the side of a hamster ball. Using math derived from lagrangian mechanics we determined that in a frictionless, drag-less world, hamsters will not survive very long on slopes greater than 5°.



A hamster strapped into a ball would travel in a non-linear path down the hill, and in an oscillatory pattern.

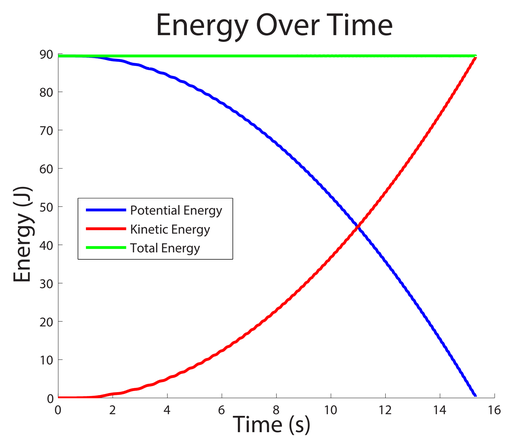
Hamster Survival



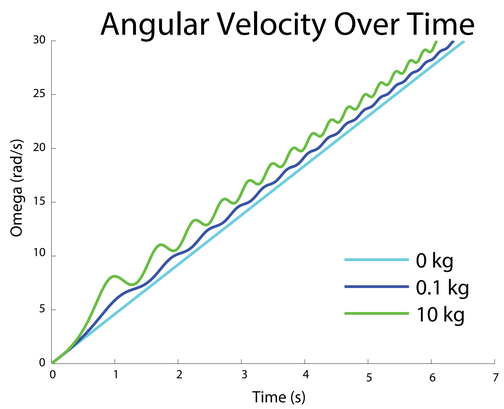
In our research, we found that G-forces kill because it makes it difficult for the hamster to pump blood around its body. Hamsters should remain conscious until about 2 minutes after hitting 3 g's ($27 m/s^2$).

Is the Model Plausible

We expected our model to conserve energy because we used lagrangian mechanics to derive our equations.



The graph below shows us how the hamster's mass affects it's velocity.



Limitations & Future Work

Realistically drag would eventually stop the hamster at some terminal velocity, which would cap the centripetal force the hamster experiences. Also, hamsters are usually free to move inside their hamster balls so the next step would be to include drag force and to allow the hamster to move freely inside the ball.