PHY115: Midterm Project

Spring 2021

Deadline: February 22th

Discussion Questions (30 p)

1. You tie a brick to the end of a rope and whirl the brick around you in a horizontal circle. Describe the path of the brick after you suddenly let go of the rope.
2. The acceleration of a falling body is measured in an elevator traveling upward at a constant speed of What result is obtained?
3. "It's not the fall that hurts you; it's the sudden stop at the bottom."
4. When a string barely strong enough lifts a heavy weight, it can lift the weight by a steady pull; but if you jerk the string, it will break. Explain in terms of Newton's laws of motion.

Exercise 1 (30 p)

A ball is moving on a helicoidal structure of radius $R = 1\ m$ (see figure 1). The motion has an angular velocity in the plane x-y $\omega = 90\ Deg/s$ and an initial vertical velocity $v_z = 20\ m/s$. The only forces acting are the gravity and the contact force with the helicoid.

- Make a sketch of the problem, choose the coordinate axes, and draw the free-body diagram for the ball.
- Find the expressions that describe the motion in x, y and z.
- What is the maximum height that the ball reaches?
- Reproduce the motion in 3ds Max using the math expressions for x y and z.

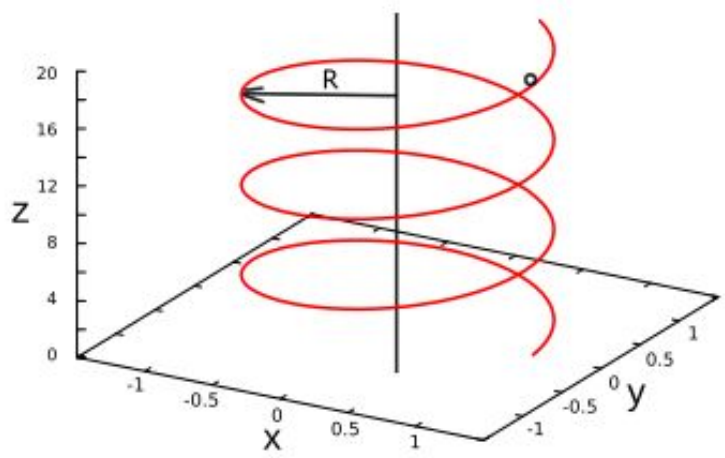

Figure 1: Helicoid of radius R

Exercise 2 (20 p)

Watch the link 1 and the scene in the link 2 that happens inside the space station. Estimate what is the radius of the space station.

link 1: https://www.youtube.com/watch?v=0ZoSYsNADtY
link 2: https://www.youtube.com/watch?v=vG6CjOFlo7A

Hint: You must use the second law of Newton and the expressions for circular motion with constant angular acceleration.

Exercise 3 (20 p)

A ball moves in the xy-plane. Its coordinates are given as functions of time by

$$x(t) = R(\omega t - sin\omega t) \quad y(t) = R(\omega t - cos\omega t) \tag{1}$$

where R and ω are constants.

- Choose values for ω and R and model the motion in 3dsMax.
- Look at the curves in curve editor and determine:
  - At which times is the ball at rest? What are the coordinates at these times?
  - Print the curves and the motion path and indicate the answers on the images.
  - Compare to the motion in exercise 1, what are the differences?