Exercises in Physics
Assignment # 6

Date Given: May 19, 2022
Date Due: May 26, 2022

P1. (2 points) A horse on the merry-go-round moves according to the equations $r = 3$ m, $\dot{\theta} = 2$ rad/s, and $z = (2\sin\theta)$ m. Determine the maximum and minimum magnitudes of the velocity and acceleration of the horse during the motion.

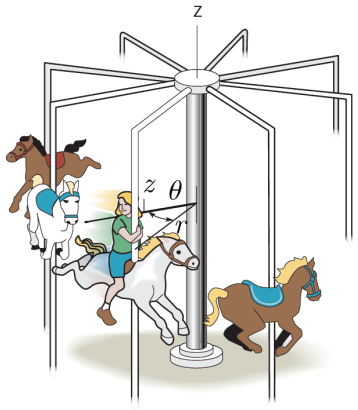

Figure 1: Illustration to Problem 1.

P2. (1 points) An amusement ride called the "corkscrew" takes the passengers through the upside-down curve of a horizontal cylindrical helix. The velocity of the cars as they pass position A is 8 m/s, and the component of their acceleration measured along the tangent to the path is 6 m/s^2 at this point. The effective radius of the cylindrical helix is 6 m, and the helix angle is $\gamma = 30^o$. Compute the magnitude of the acceleration of the passengers as they pass position A.

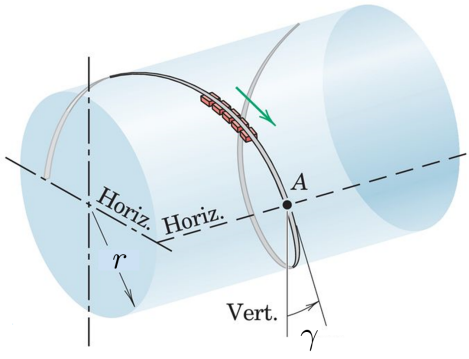

Figure 2: Illustration to Problem 2.

P3. (2 points) The rod OA is held at the constant angle $\beta = 30^o$ while it rotates about the vertical with a constant angular rate $\dot{\theta} = 120$ revolutions per minute. Simultaneously, the sliding ball P oscillates

along the rod with its distance in millimeters from the fixed pivot O given by $R = 200 + 50 \sin 4\pi t$, where t is the time in seconds. Calculate the magnitudes of the velocity and acceleration of P for an instant when its velocity along the rod from O toward A is a maximum.
Hint: Use spherical coordinates.

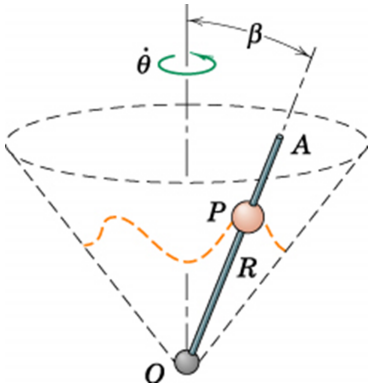

Figure 3: Illustration to Problem 3.

P4. (3 points) In the design of an amusement-park ride, the cars are attached to arms of length R which are hinged to a central rotating collar which drives the assembly about the vertical axis with a constant angular rate $\omega = \dot{\theta}$. The cars rise and fall with the track according to the relation $z = (h/2)(1 - \cos 2\theta)$. Find the R-, θ-, and φ-components of the velocity $\boldsymbol{v}$ of each car as it passes the position $\theta = \pi/4$ rad.
Hint: Use spherical coordinates.

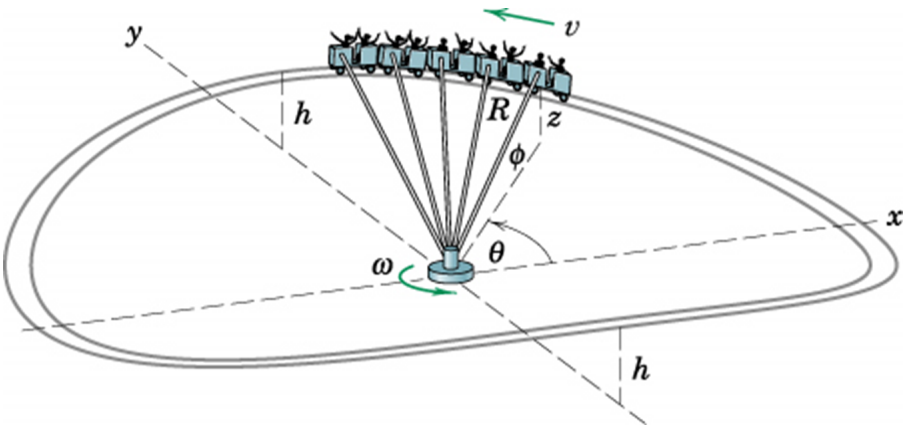

Figure 4: Illustration to Problem 4.