

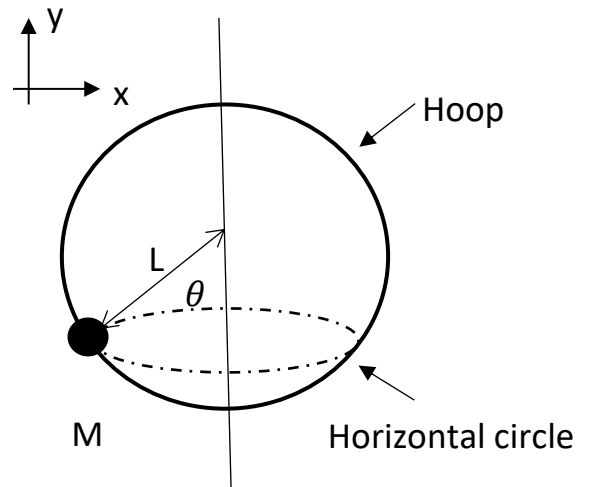
Physics 1135: Homework # 8: Circular Motion

1. A toy car of mass 1.2 kg is driving vertical circles inside a hollow cylinder of radius 2.0 m . It is moving at a constant speed of 6 m/s .

- Calculate the magnitude of the normal force acting on the car when it is on the top of the circle and when it is on the bottom of the circle, respectively.
- What is the minimum speed the car needs to go around the circle without falling off?

2. A small bead of mass M can slide without friction on a circular hoop that is in a vertical plane and has a radius L . The hoop rotates about a vertical diameter, as shown in the figure. It takes time T to complete one revolution.

You observe that the bead is located at an angle θ with respect to the vertical. It is moving in a **horizontal** circle (dashed line) and is not sliding up or down the hoop. Derive an expression for the angle θ in terms of system parameters so that the bead does not slide up or down the hoop.



3. A car is driving on a road which makes a curve of radius R . The road is banked at an angle θ with the horizontal. The coefficient of static friction between tires and roadway is μ .

- Derive an expression for the **maximum** speed V the car can have before **sliding up** the banking.
- What would change in the setup of your problem if you had to find the minimum speed at which the car can go around the curve?

4. A ball of mass M is attached to a string of length L whose other end is attached to point C . The ball is moving in a **vertical** circle about C . A wind blowing to the right exerts a constant horizontal force of magnitude B on the ball. At a certain instant of time, the speed of the ball is V and the angle between the string and the wind direction is θ .

- Derive an expression for the tension in the string at the moment shown in the diagram, in terms of system parameters.

- In terms of system parameters, derive an expression for the rate at which the ball's speed changes, i.e. dv/dt , at this instant.

