

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Department of Physics

Physics 8.01T

Fall Term 2004

In-Class Problems 11-13: Uniform Circular Motion

Section _____ Table and Group Number _____

Names _____

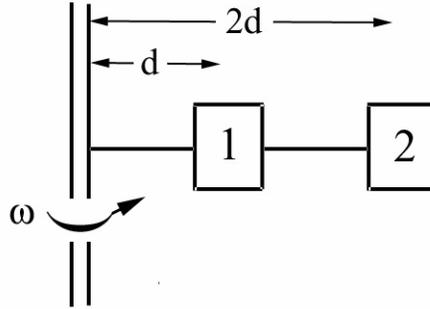
Hand in one solution per group.

We would like each group to apply the problem solving strategy with the four stages (see below) to answer the following two problems.

- I. Understand – get a conceptual grasp of the problem**
- II. Devise a Plan - set up a procedure to obtain the desired solution**
- III. Carry out your plan – solve the problem!**
- IV. Look Back – check your solution and method of solution**

In-Class-Problem 11: Whirling Objects

Two objects of equal mass m are whirling around a shaft with a constant angular velocity ω . The first object is a distance d from the central axis, and the second object is a distance $2d$ from the axis. You may assume the strings are massless and inextensible. You may ignore the effect of gravity. Find the tensions in the two strings.

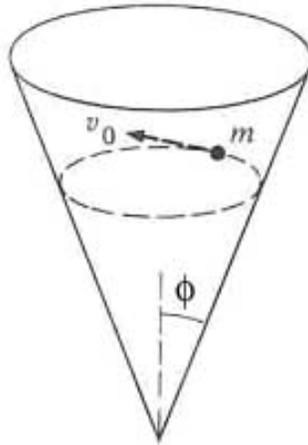


As you begin this problem, consider what types of force diagrams you may need. In particular what body or system of bodies will use for your free body diagram. It never hurts to draw as many free body diagrams as you can.

Solution:

In-Class Problem 12: Object undergoing Circular Motion on the Inside of a Cone

Consider an object of mass m that moves in a circular orbit with constant velocity v_0 along the inside of a cone. Assume the wall of the cone is frictionless. The cone makes an angle ϕ with respect to a vertical axis.



a) Find the radius of the orbit of the object in terms of the given information.

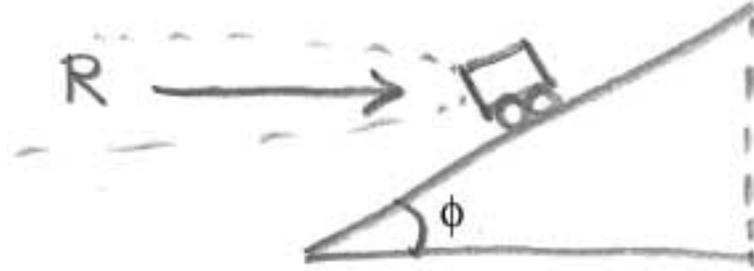
In the *Look Back – check your solution and method of solution* part of our methodology answer the following questions.

- b) Is the normal force a centripetal force or is a component of the normal force the centripetal force in this problem?
- c) Is the radius of the circular orbit independent of the mass of the object? Explain why or why not.

Solution:

In-Class Problem 13: Car on a Banked turn

A car of mass m is going around a circular turn of radius R with constant speed v , which is banked at an angle ϕ with respect to the ground. The car is held up on the bank by static friction between the wheels and the road with a coefficient of static friction μ_s . Let g be the magnitude of the acceleration due to gravity. Derive an expression for the minimum velocity necessary to keep the car moving in a circle without slipping down the embanked turn. Express your answer in terms of the given quantities.



Car on banked turn undergoing circular motion

Solution

As you try to *Understand* – *get a conceptual grasp of the problem* consider the following question. There are all types of resistive forces acting on the car along the direction of motion of the car; for example: air friction and rolling resistance. Do you need to know these in order to model this problem? Explain your reasoning.