Lesson 8

Circular Motion

The most important lesson we covered in the last section was "F = ma". This is true for this class for the rest of the semester and for 230 throughout the semester. The idea is that when non-zero net outside force is applied (to the system), it accelerates. Acceleration results three possibilities.

1. Linear (linear) speed changes
2. Direction changes
3. Both speed and direction change

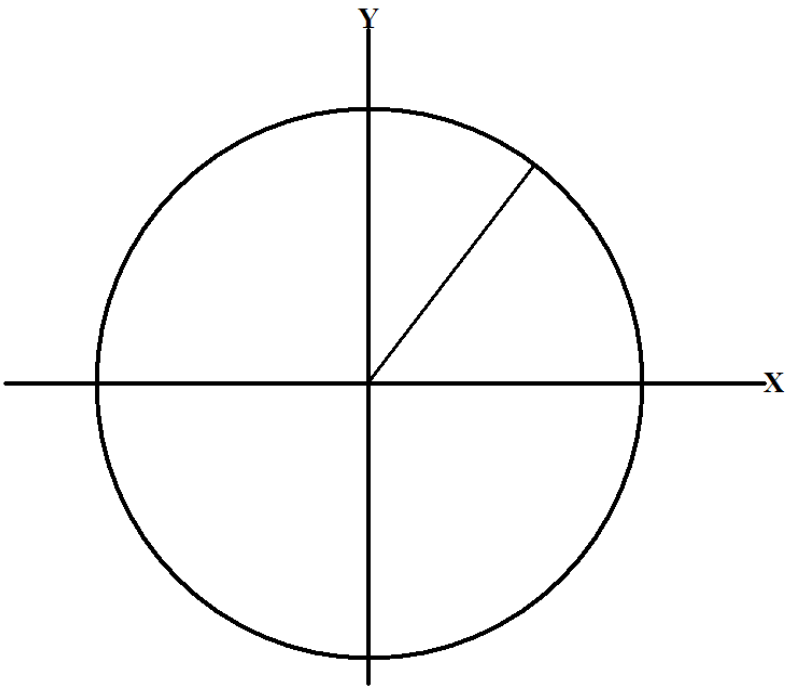
Lesson 7 covered the change of a linear speed. In this lesson, we want to focus on "Change of Direction (without changing speed)", thus, a circular motion.

Question 1: Which direction should the outside force be applied so that the system changes only direction (but not speed)?

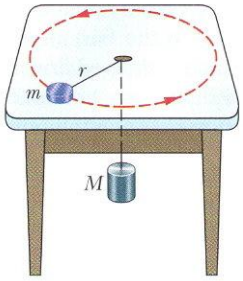
Question 2: When an object is making a circular motion, which way is the direction of resultant of applied forces? What is that force called?

For a circular motion, when we add all the forces applied to the system, the resultant force is pointing toward the center and is called centripetal force.

Proof of centripetal acceleration



Hence $F_{centripetal} = m\frac{v^2}{r}$, m is the mass of the (circulating) object, v is the speed, and r is the radius of the circular motion.

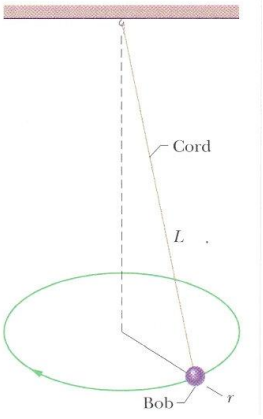


Example 1

A puck of mass m = 1.50 kg slides in a circle of radius r = 20.0 cm on a frictionless table while attached to a hanging cylinder of mass M = 2.50 kg by a cord through a hole in the table. What speed keeps the cylinder at rest?

Example 2

The figure shows a conical pendulum, in which the bob (the small object at the lower end of the cord) moves in a horizontal circle at constant speed. (The cord sweeps out a cone as it rotates.) The bob has a mass of 0.040 kg, the string has a length L = 0.90 m and negligible mass, and the bob follows a circular path of circumference 0.94 m. What are (a) the tension in the string and (b) the period of the motion?



Example 3

A car is making a circular motion without sliding. If μ_s = 1.0 and radius of the circle is 50 m, calculate the maximum speed.

Example 4

What is the maximum speed of the same question above if the same circular motion is executed on a banked curve of 25 degree tilt?