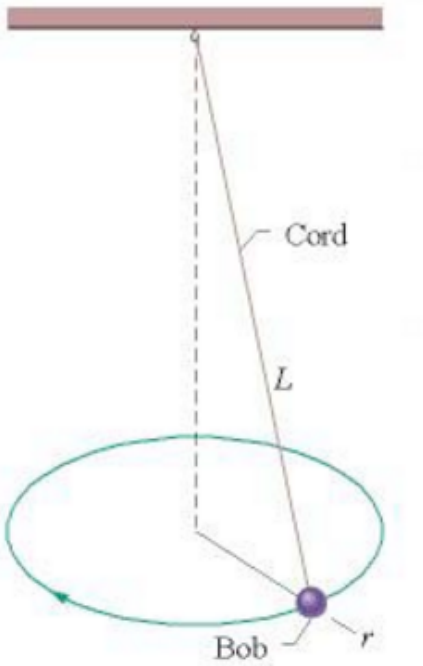
AP Physics C
HW Set 5
Frictional and Centripetal Forces

1. **A superconducting mass (m = 250 [g]) moves around a circular magnetic track of radius 0.5 [m]. The mass circulates around the track at a constant rate of 60 revolutions per minute.**

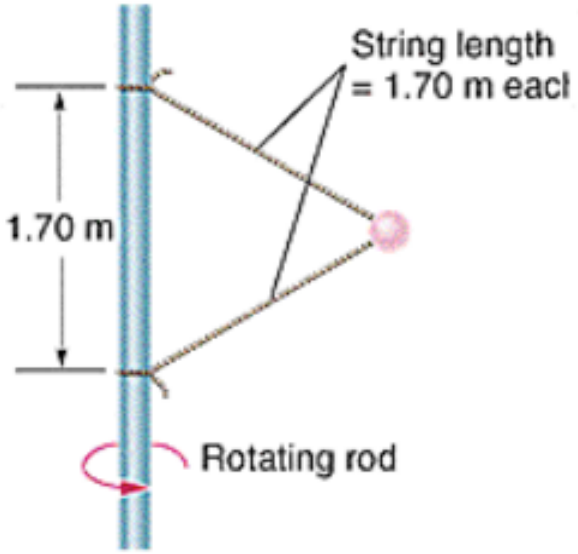
- **a.** **What is the centripetal force acting on the mass?**
- **b.** **If the mass were replaced by an AP Physics C senior (mass = 70 [kg]) traveling at 20 [rev/s], what centripetal force would be acting on him?**
- **c.** **What acceleration rate does the student experience?**
- **d.** **How many g's would the student experience? (1g = 9.8 m/s^2).**

2. **The figure below 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 the bob rotates.) The bob has a mass of 0.035 [kg], the string has length L = 0.62 [m] and negligible mass, and the bob follows a circular path of circumference 0.88 [m].**



- **a.** **What is the tension in the string?**
- **b.** **What is the period of the motion (i.e., the time needed to make one revolution)?**

3. In the figure below, a 1.34 [kg] ball is connected by means of two massless strings to a vertical, rotating rod. The strings are tied to the rod and are taut. The tension in the upper string is 32 [N].



a. What is the tension in the lower string?
b. What is the speed of the ball?
c. What is the magnitude of the net force on the ball?
d. What is the direction of the net force?

4. **AP Exam FRQ 2016 #1**

5. **AP Exam FRQ 1998 #3**

6. **A child places a picnic basket on the outer rim of a merry-go-round that has a radius of 4.9 [m] and revolves once every 29 [s].**
   a. **What is the speed of a point on the rim?**
   b. **What is the minimum value of the coefficient of static friction between basket and merry-go-round that allows the basket to stay on the ride?**

7. **AP Exam FBD's**
   a. **2008 #1 a only**
   b. **2007 #1 a only**
   c. **2006 #1 a only**

8. **The velocity of a particle moving along a straight line is given as a function of time by the expression $v(t) = 3t^3 - 6t - 1$ where x is in meters and t is in seconds.**
   a. **At what time is the acceleration of the object 0 [m/s^2]?**
   b. **What is the velocity of the particle at this time?**

9. **The position of an object is moving along the x-axis is given as a function of time by the expression $x(t) = 8t^3 + 4t + 1$ where x is in meters and t is in seconds. The mass of the object is 6 [kg].**
   a. **What is the average velocity of the object in the time interval t = 2 [s] to t = 5 [s]?**
   b. **What is the velocity of the object at t = 2 [s].**
   c. **What is the acceleration of the object at t = 3 [s].**
   d. **What is the force acting on the object at t = 4 [s]**

1a. 4.93 [N]
1b. 552,697.85 [N]
1c. 7895.67 [m/s^2]
1d. 805 [g's]

2a. 0.352 N]
2b. 1.56 [s]

3a. 5.74 [N]
3b. 5.99 [m/s]
3c. 32.7 [N]
3d. Radially inward

4a. FBD will be discussed in class
4bi. Graph will be discussed in class
4bii. mass = 0.463 [kg]
4biii. $F_{friction}$ = 0.272 [N]
4ci. a = 0.376 [m/s^2]
4cii. t = 1.28 [s]
4di. "Equal to"
4dii. "Greater than"

5a. FBDs will be discussed in class

5b. $$M = \mu_{s2}\left(m_1 + m_2\right)$$

5c. $$a = \left[\frac{M - \mu_{k2}\left(m_1 + m_2\right)}{M + m_1 + m_2}\right]g$$

5di. $$a_1 = \mu_{k1}g$$

5dii. $$a_2 = \left[\frac{M - \mu_{k1}m_1 - \mu_{k2}\left(m_1 + m_2\right)}{M + m_2}\right]g$$

6a. 1.06 [m/s]
6b. 0.0235 [1]

7. FBD's will be discussed in class

8a. 0.82 [s]
8b. -4.27 [m/s]

9a. 316 [m/s]
9b. 100 [m/s]
9c. 144 [m/s^2]
9d. 864 [N]