

HW #6: Circular Motion

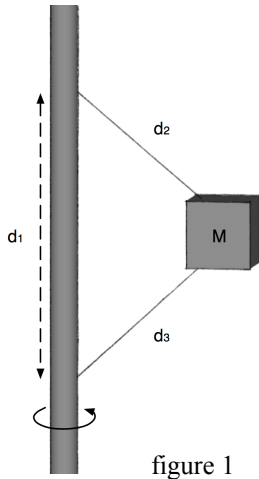


figure 1

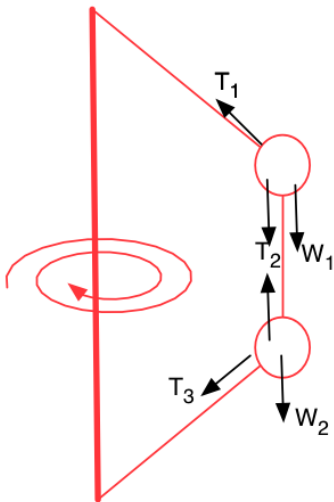
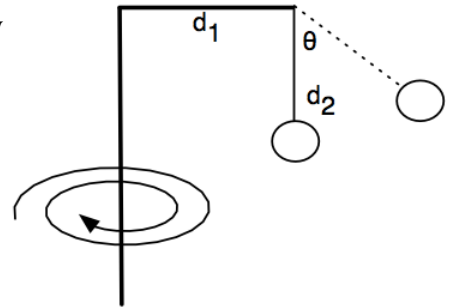
Problems 1 to 3 refer to figure 1.

1. If $d_1 = 2.0$ m, $d_2 = d_3 = 1.5$ m, and $M = 1.5$ kg, what are the tensions in the top and bottom strings if the vertical rod is rotating the system at 100 RPM? [$T_b = 112.1$ N]

2. If $d_1 = 2.0$ m, $d_2 = d_3 = 1.25$ m, $M = 1.5$ kg, and tension in the top string is 30% more than the bottom string, what is the velocity in RPM of the mass? [82.8 RPM]

3. What is M (to 3 decimals) and the tension in the top string if $d_1 = 1.0$ m, $d_2 = d_3 = 1.25$ m, the tension in the bottom string is 90 N, and vertical rod is rotating the system at 150 RPM? [0.631 kg, 102.8 N]

4. In the second figure, calculate how many RPMs the 1.0 kg object must rotate about the vertical axis (the vertical pole) in order that the cord makes an angle of 60° with the vertical. $d_1 = 1.5$ m, $d_2 = 1.2$ m, $\theta = 60^\circ$. [24.7 RPM] What is the tension in the cord? [19.6 N]



5. What is the force analysis on the 2-body problem shown in figure 3? What would you need to know to determine the radius (the horizontal distance from the axis to the vertical portion of the string)?

6. When you take your 1500 kg car out for a spin, you go around an unbanked corner of radius 75 m with a speed of 20 m/s.

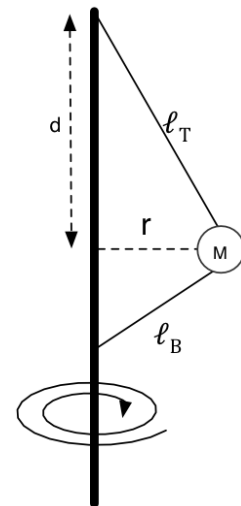
a. Assuming your car does not skid, what is the static friction force? [8,000 N]

b. The coefficient of static friction between the car and the road is 0.80, what is the maximum static friction force? [11,760 N] Does it compare well with the answer in part (a)? If not why?

c. Calculate the maximum speed a car travel for $\mu_k =$

0.80. [24.25 m/s = 87.3 kph]

7. If $\ell_T = 1.5$ m, $\ell_B = 1.0$ m, $d = 1.2$, and $m_1 = 5$ kg, and the system is rotating at 90 RPM, what are the tensions? [$T_t = 222$ N, $T_b = 296$ N]



USE SOLVING METHODS FROM THE CM LAB

8. A ball is attached to a pole by a string that is 0.85 m long. The pole is rotating.
 - a. At what angle is the ball inclined with the horizontal if the time for one revolution is 1.410 s? [$\theta = 35.5^\circ$]
 - b. What is the radius? [0.69m]
 - c. What is F_{net} ? [13.7m N; the calculated answer is 13.7m as the mass is unknown]
9. A ball is attached to a pole by a string. When the pole is rotating, the distance from the center to the ball is 0.75 m.
 - a. What is F_{net} if the time for one revolution is 1.10 s and the mass is 2.6 kg? [63.2 N]
 - b. What is the length of the string? [0.81 m]