Uniform Circular Motion

Phys109

November 6, 2019

1. In a uniform circular motion with a speed of 6 m/s and the radius of 0.05 km.
   (a) What is the centripetal acceleration? (0.72 m/s^2)
   (b) For an object with weight of 980 N what is the centripetal force? (72 N)
   (c) What is the period of this uniform circular motion? (52.36 s)
   (d) Find the frequency. (0.019 Hz)
2. A pilot of mass 80 kg in a jet aircraft executes a loop-the-loop. In this manoeuvre, the aircraft moves in a vertical circle 2.7 km at a constant speed of 225 m/s. Determine the force exerted by the seat on the pilot.
   (a) At the bottom of the loop, (2284 N)
   (b) at the top of the loop (716 N)
   (c) Which one is larger?

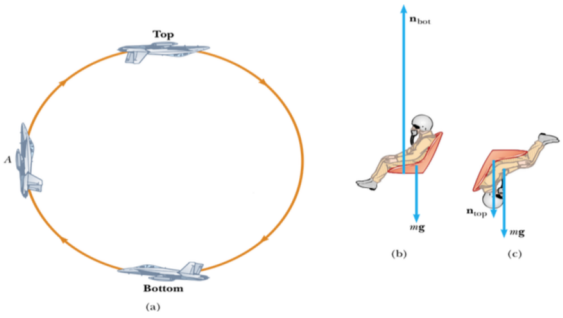

Figure 1: Problem no.2

3. During an Olympic bobsled run, the Jamaican team makes a turn of radius 7.6 m at a speed of 96.6 km/h. What is their acceleration? (94.71 m/s^2)

4. A small sphere of mass 400 g is attached to the end of a cord of length 1.2 m and set into motion in a vertical circle about a fixed point O, as illustrated in the figure below. Determine the magnitude of the tension in the cord.

   (a) when the object passes the top point with a speed of 6m/s.(8.1 N)

   (b) when the object passes bottom point with a speed of 8m/s.(25.3 N)

   (c) when the object passes the points whose angles are $\theta = 90°, 30°$ with speeds of 7m/s and 7.8m/s, respectively.
   (16.3N) and (23.7N)

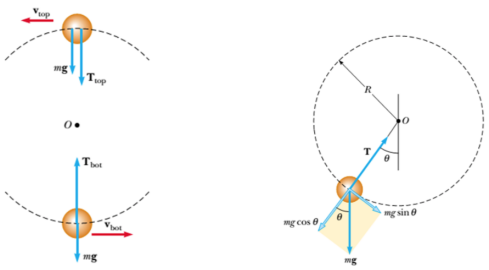

Figure 2: Problem no.4

5. A curve in a road forms part of a horizontal circle. As a car with 1 ton mass goes around it at constant speed 14.0 m/s, the total horizontal force on the driver has magnitude 130 N. What is the total horizontal force on the driver if the speed on the same curve is 18.0 m/s instead? (Hint: the horizontal force is radially exerted on the car)
   (214.9 N)

6. A small remote controlled car with mass 1.6 kg moves with a constant speed of $v = 12\ m/s$ in a vertical circle inside a vertical metal cylinder that has a radius of 5 m.

   (a) What is the magnitude of the normal force exerted on the car by the walls of the cylinder at the point A (at the bottom of the vertical cylinder)? (61.76 N)

   (b) at the point B (at the top of the vertical cylinder)? (30.4N)

7. A flat puck of mass 2 kg is rotating on a frictionless tabletop with radius 0.5 m. A light cord is connected to a block of mass 1 kg through a central hole as shown in the figure.

   (a) Find the magnitude of the tension in the cord. (9.8 N)

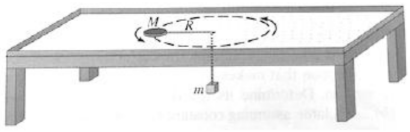

Figure 3: Problem no.7

(b) Find the speed of the rotating puck. (1.57 m/s)

8. A small sphere of mass 1 kg is attached to the end of a massless cord of length 1 m and set into motion in a horizontal circle about a fixed point O on a frictionless surface as shown in the figure below. (The cord remains horizontal during the motion)

   (a) Draw the free body diagram for the mass m.

   (b) If the tension of the cord is 16N, calculate the speed of the sphere. (4 m/s)

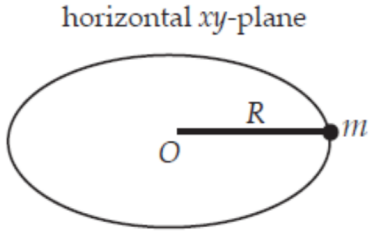

Figure 4: Problem no.8

9. A small sphere of mass 10.0 g is attached to the end of a massless cord of length 1.0 m and set into motion in a vertical circle about a fixed point O as given in the figure below.

   (a) Draw the free body diagrams at the positions A,B,C, and D.

   (b) Find the tension in the string at the points A and C if the speed at A is 2.0 m/sand the speed at C is 4.0 m/s. (0.058 N, 0.258 N)

10. The seat of a swing is suspended from a cable of length 5.0 m rotating horizontally about the central axis. (Canonical pendulum). The seat moves uniformly on a circle, where the cable makes an angle 30° with the vertical rotation axis. Assume that the mass of the seat and the person is 60 kg.

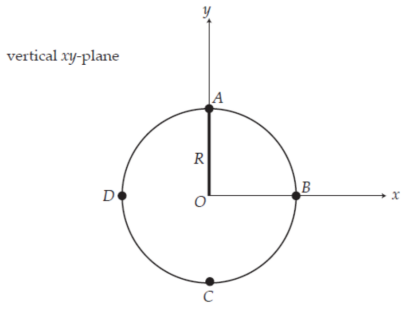

Figure 5: Problem no.9

(a) Calculate the speed of the seat. (3.76 N)

(b) Calculate the tension in the cable. (679 m/s)

(c) Calculate the magnitude of the centripetal force (force in radial direction). (339 N)

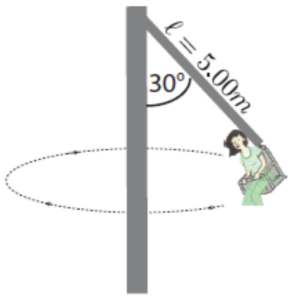

Figure 6: Problem no.10