Course: Physics 401, 2004
Instructor: Chung-Sang Ng

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Homework 4

Due: Monday, June 7, 2004 11:59 PM EDT

About this assignment

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Saved on: Tuesday, June, 1 2004 09:30 PM EDT

1. [CJ6 5.P.004.] Review Conceptual Example 2 in preparation for this problem. In Figure 5.4, an object, after being released from its circular path, travels the distance *OA* in the same time it would have moved from *O* to *P* on the circle. The speed of the object on and off the circle remains constant at the same value. Suppose that the radius of the circle in Figure 5.4 is 4.2 m and the angle is θ is 28°. What is the distance *OA*?

_____ m

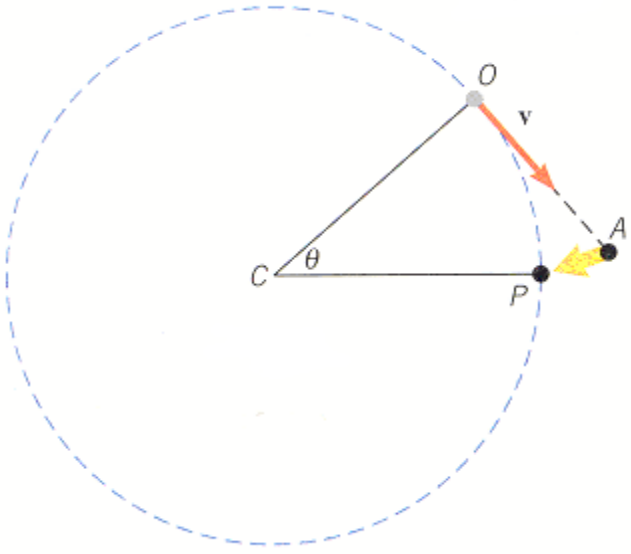


Figure 5.4

2. [CJ6 5.P.006.] There is a clever kitchen gadget for drying lettuce leaves after you wash them. It consists of a cylindrical container mounted so that it can be rotated about its axis by turning a hand crank. The outer wall of the

cylinder is perforated with small holes. You put the wet leaves in the container and turn the crank to spin off the water. The radius of the container is 12 cm. When the cylinder is rotating at 1.7 revolutions per second, what is the magnitude of the centripetal acceleration at the outer wall?

[ ] m/s^2

3. [CJ6 5.P.012.] In a skating stunt known as "cracking-the-whip," a number of skaters hold hands and form a straight line. They try to skate so that the line rotates about the skater at one end, who acts as the pivot. The skater farthest out has a mass of 80.0 kg and is 5.80 m from the pivot. He is skating at a speed of 6.00 m/s. Determine the magnitude of the centripetal force that acts on him.

[ ] N

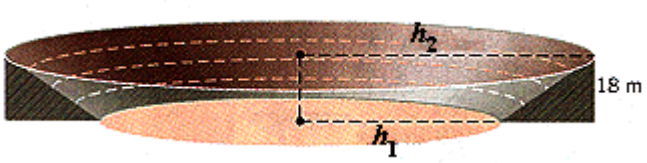
4. [CJ6 5.P.018.] A block is hung by a string from the inside roof of a van. When the van goes straight ahead at a speed of 32 m/s, the block hangs vertically down. But when the van maintains this same speed around an unbanked curve (radius = 165 m), the block swings toward the outside of the curve. Then the string makes an angle θ with the vertical. Find θ.

θ = [ ] °

5. [CJ6 5.P.020.] At what angle should a curve of radius 150 m be banked, so cars can travel safely at 22 m/s without relying on friction?

[ ] °

6. [CJ6 5.P.022.] On a banked race track, the smallest circular path on which cars can move has a radius r_1 = 105 m, while the largest has a radius r_2 = 161 m, as the drawing illustrates. The height of the outer wall is 18 m.



(a) Find the smallest speed at which cars can move on this track without relying on friction.

[ ] m/s

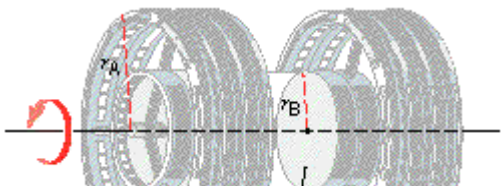
(b) Find the largest speed at which cars can move on this track without relying on friction.

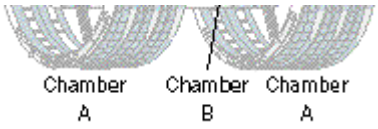
[ ] m/s

7. [CJ6 5.P.028.] A rocket is used to place a synchronous satellite in orbit about the earth. What is the speed of the satellite in orbit?

[ ] m/s

8. [CJ6 5.P.035.] To create artificial gravity, the space station shown in the drawing is rotating at a rate of 1.00 rpm. The radii of the cylindrically shaped chambers have the ratio r_A/r_B = 4.10. Each chamber A simulates an acceleration due to gravity of 10.0 m/s^2.





(a) Find r_A.

[ ] m

(b) Find r_B.

[ ] m

(c) Find the acceleration due to gravity that is simulated in chamber B.

[ ] m/s^2

9. [CJ6 5.P.036.] A roller coaster at an amusement park has a dip that bottoms out in a vertical circle of radius r. A passenger feels the seat of the car pushing upward on her with a force equal to six times her weight as she goes through the dip. If r = 23.5 m, how fast is the roller coaster traveling at the bottom of the dip?

[ ] m/s

10. [CJ6 5.P.038.] For the normal force in Figure 5.21 to have the same magnitude at all points on the vertical track, the stunt driver must adjust the speed to be different at different points. Suppose, for example, that the track has a radius of 2.9 m and that the driver goes past point 1 at the bottom with a speed of 17 m/s. What speed must she have at point 3, so that the normal force at the top has the same magnitude as it did at the bottom?

[ ] m/s

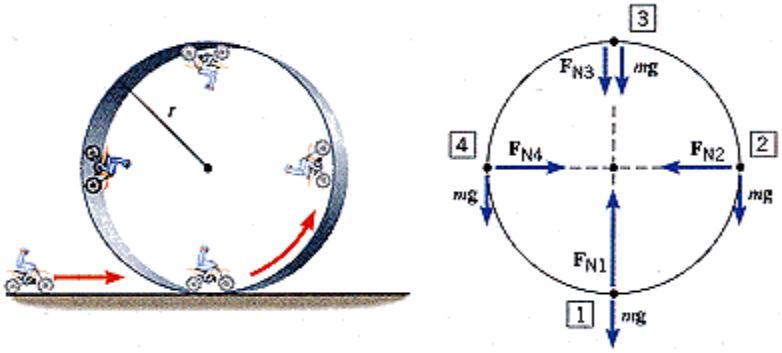


Figure 5.21

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