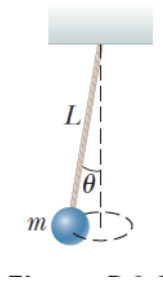


## Chapter 6 Homework Problems

5. In a cyclotron (one type of particle accelerator), a deuteron (of mass  $2.00 \text{ u}$ ) reaches a final speed of  $10.0\%$  of the speed of light while moving in a circular path of radius  $0.480 \text{ m}$ . What magnitude of magnetic force is required to maintain the deuteron in a circular path?

8. Consider a conical pendulum (Fig. P6.8) with a bob of mass  $m = 80.0 \text{ kg}$  on a string of length  $L = 10.0 \text{ m}$  that makes an angle of  $\theta = 5.00^\circ$  with the vertical. Determine (a) the horizontal and vertical components of the force exerted by the string on the pendulum and (b) the radial acceleration of the bob.



11. A coin placed  $30.0 \text{ cm}$  from the center of a rotating, horizontal turntable slips when its speed is  $50.0 \text{ cm/s}$ . (a) What force causes the centripetal acceleration when the coin is stationary relative to the turntable? (b) What is the coefficient of static friction between coin and turntable?

15. **S** A child of mass  $m$  swings in a swing supported by two chains, each of length  $R$ . If the tension in each chain at the lowest point is  $T$ , find (a) the child's speed at the lowest point and (b) the force exerted by the seat on the child at the lowest point. (Ignore the mass of the seat.)

17. An adventurous archeologist ( $m = 85.0 \text{ kg}$ ) tries to cross a river by swinging from a vine. The vine is  $10.0 \text{ m}$  long, and his speed at the bottom of the swing is  $8.00 \text{ m/s}$ . The archeologist doesn't know that the vine has a breaking strength of  $1\,000 \text{ N}$ . Does he make it across the river without falling in?

18. **Q/C** One end of a cord is fixed and a small  $0.500\text{-kg}$  object is attached to the other end, where it swings in a section of a vertical circle of radius  $2.00 \text{ m}$  as shown in Figure P6.18. When  $\theta = 20.0^\circ$ , the speed of the object is  $8.00 \text{ m/s}$ . At this instant, find (a) the tension in the string, (b) the tangential and radial components of acceleration, and (c) the total acceleration. (d) Is your answer changed if the object is swinging down toward its lowest point instead of swinging up? (e) Explain your answer to part (d).

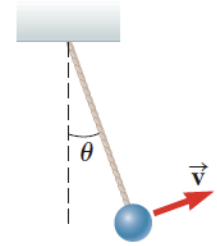


Figure P6.18

21. An object of mass  $m = 0.500 \text{ kg}$  is suspended from the ceiling of an accelerating truck as shown in Figure P6.21. Taking  $a = 3.00 \text{ m/s}^2$ , find (a) the angle  $\theta$  that the string makes with the vertical and (b) the tension  $T$  in the string.

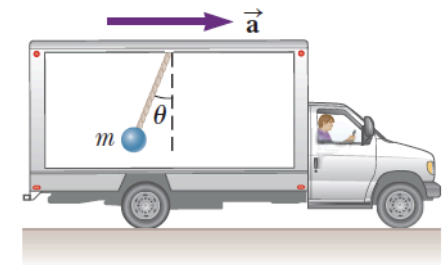


Figure P6.21

23. A person stands on a scale in an elevator. As the elevator starts, the scale has a constant reading of  $591 \text{ N}$ . As the elevator later stops, the scale reading is  $391 \text{ N}$ . Assuming the magnitude of the acceleration is the same during starting and stopping, determine (a) the weight of the person, (b) the person's mass, and (c) the acceleration of the elevator.

30. A small piece of Styrofoam packing material is dropped from a height of 2.00 m above the ground. Until it reaches terminal speed, the magnitude of its acceleration is given by  $a = g - Bv$ . After falling 0.500 m, the Styrofoam effectively reaches terminal speed and then takes 5.00 s more to reach the ground. (a) What is the value of the constant  $B$ ? (b) What is the acceleration at  $t = 0$ ? (c) What is the acceleration when the speed is 0.150 m/s?

39. A string under a tension of 50.0 N is used to whirl a rock in a horizontal circle of radius 2.50 m at a speed of 20.4 m/s on a frictionless surface as shown in Figure P6.39. As the string is pulled in, the speed of the rock increases. When the string is 1.00 m long and the speed of the rock is 51.0 m/s, the string breaks. What is the breaking strength, in newtons, of the string?

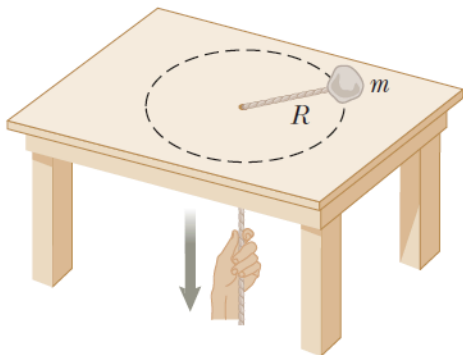


Figure P6.39

51. **S** A truck is moving with constant acceleration  $a$  up a hill that makes an angle  $\phi$  with the horizontal as in Figure P6.51. A small sphere of mass  $m$  is suspended from the ceiling of the truck by a light cord. If the pendulum makes a constant angle  $\theta$  with the perpendicular to the ceiling, what is  $a$ ?

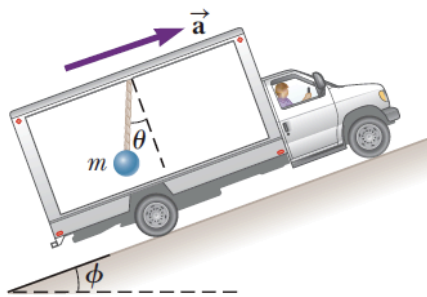


Figure P6.51

59. **Q.C.S** An amusement park ride consists of a large vertical cylinder that spins about its axis fast enough that any person inside is held up against the wall when the floor drops away (Fig. P6.59). The coefficient of static friction between person and wall is  $\mu_s$ , and the radius of the cylinder is  $R$ . (a) Show that the maximum period of revolution necessary to keep the person from falling is  $T = (4\pi^2 R \mu_s / g)^{1/2}$ . (b) If the rate of revolution of the cylinder is made to be somewhat larger, what happens to the magnitude of each one of the forces acting on the person? What happens in the motion of the person? (c) If the rate of revolution of the cylinder is instead made to be somewhat smaller, what happens to the magnitude of each one of the forces acting on the person? How does the motion of the person change?

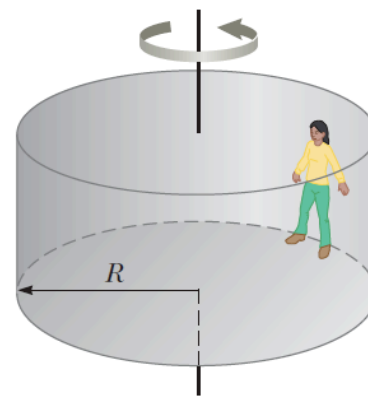


Figure P6.59

61. **S** A car rounds a banked curve as discussed in Example 6.4 and shown in Figure 6.5. The radius of curvature of the road is  $R$ , the banking angle is  $\theta$ , and the coefficient of static friction is  $\mu_s$ . (a) Determine the range of speeds the car can have without slipping up or down the road. (b) Find the minimum value for  $\mu_s$  such that the minimum speed is zero.