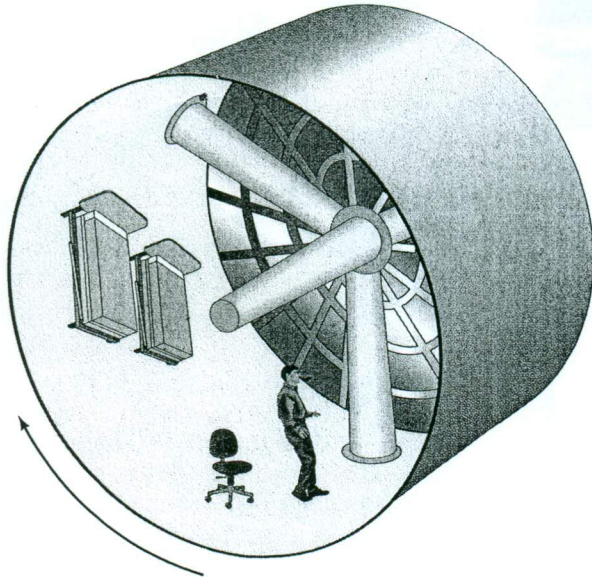


1) Astronauts who spend long periods in outer space could be adversely affected by weightlessness. One way to simulate gravity is to shape the spaceship like a cylindrical shell that rotates, with the astronauts walking on the inside surface (Fig. 5-32). Explain how this simulates gravity. Consider (a) how objects fall, (b) the force we feel on our feet, and (c) any other aspects of gravity you can think of.



2) A 0.45-kg ball, attached to the end of a horizontal cord, is rotated in a circle of radius 1.3 m on a frictionless horizontal surface. If the cord will break when the tension in it exceeds 75 N, what is the maximum speed the ball can have?

3) What is the maximum speed with which a 1050-kg car can round a turn of radius 77 m on a flat road if the coefficient of static friction between tires and road is 0.80? Is this result independent of the mass of the car?

2) A child sitting 1.10 m from the center of a merry-go-round moves with a speed of 1.25 m/s. Calculate (a) the centripetal acceleration of the child, and (b) the net horizontal force exerted on the child (mass = 25.0 kg).

3) A jet plane traveling 1890 km/h (525 m/s) pulls out of a dive by moving in an arc of radius 6.00 km. What is the plane's acceleration in g's?

4) A horizontal force of 210 N is exerted on a 2.0-kg discus as it rotates uniformly in a horizontal circle (at arm's length) of radius 0.90 m. Calculate the speed of the discus.

5) A ball on the end of a string is revolved at a uniform rate in a vertical circle of radius 72.0 cm, as shown in Fig. 5-33. If its speed is 4.00 m/s and its mass is 0.300 kg, calculate the tension in the string when the ball is (a) at the top of its path, and (b) at the bottom of its path.

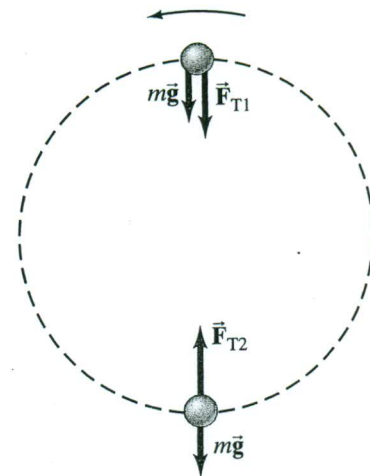


FIGURE 5-33

8) How large must the coefficient of static friction be between the tires and the road if a car is to round a level curve of radius 85 m at a speed of 95 km/h?

9) A device for training astronauts and jet fighter pilots is designed to rotate a trainee in a horizontal circle of radius 12.0 m. If the force felt by the trainee on her back is 7.85 times her own weight, how fast is she rotating? Express your answer in both m/s and rev/s.

10) A coin is placed 11.0 cm from the axis of a rotating turntable of variable speed. When the speed of the turntable is slowly increased, the coin remains fixed on the turntable until a rate of 36 rpm is reached and the coin slides off. What is the coefficient of static friction between the coin and the turntable?

11) At what minimum speed must a roller coaster be traveling when upside down at the top of a circle (Fig. 5-34) so that the passengers will not fall out? Assume a radius of curvature of 7.4 m.

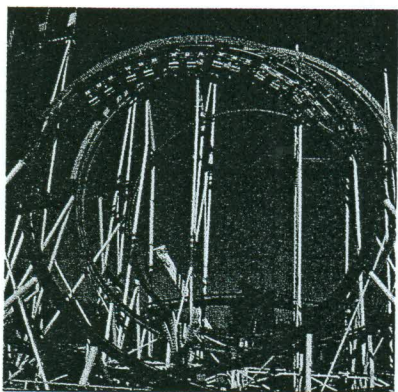


FIGURE 5-34 Problem 13.

12) A sports car of mass 950 kg (including the driver) crosses the rounded top of a hill (radius = 95 m) at 22 m/s. Determine (a) the normal force exerted by the road on the car, (b) the normal force exerted by the car on the 72-kg driver, and (c) the car speed at which the normal force on the driver equals zero.

13) How many revolutions per minute would a 15-m-diameter Ferris wheel need to make for the passengers to feel "weightless" at the topmost point?

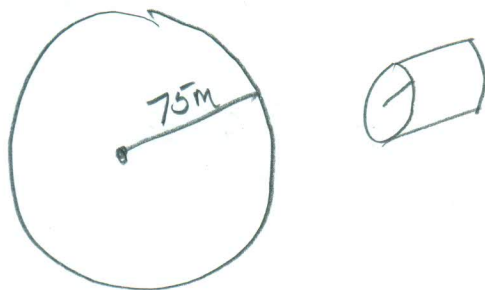
14) A bucket of mass 2.00 kg is whirled in a vertical circle of radius 1.10 m. At the lowest point of its motion the tension in the rope supporting the bucket is 25.0 N. (a) Find the speed of the bucket. (b) How fast must the bucket move at the top of the circle so that the rope does not go slack?

15) How fast (in rpm) must a centrifuge rotate if a particle 9.00 cm from the axis of rotation is to experience an acceleration of 115,000 g's?

16) Calculate the speed of a satellite moving in a stable circular orbit about the Earth at a height of 3600 km.

17) The space shuttle releases a satellite into a circular orbit 650 km above the Earth. How fast must the shuttle be moving (relative to Earth) when the release occurs?

18) Given a space station



a) Determine how fast it would have to spin to create artificial gravity in  
 $\text{m/s}$ ,  $\frac{\text{rev}}{\text{s}}$ ,  $\frac{\text{s}}{\text{rev}}$ .

b) what would be the artificial gravity of a chamber 25 m from the center?