General Problems

62. A 0.145-kg baseball pitched horizontally at 35.0 m/s strikes a bat and is popped straight up to a height of 55.6 m. If the contact time is 1.4 ms, calculate the average force on the ball during the contact.

63. A rocket of mass m traveling with speed v_0 along the x axis suddenly shoots out fuel, equal to one-third of its mass, parallel to the y axis (perpendicular to the rocket as seen from the ground) with speed $2v_0$. Give the components of the final velocity of the rocket.

* 64. A novice pool player is faced with the corner pocket shot shown in Fig. 7–43. Relative dimensions are also shown. Should the player be worried about this being a "scratch shot," in which the cue ball will also fall into a pocket? Give details.

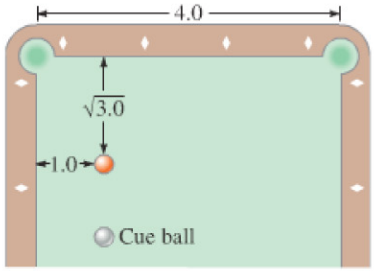

FIGURE 7–43
Problem 64.

65. A 140-kg astronaut (including space suit) acquires a speed of 2.50 m/s by pushing off with his legs from an 1800-kg space capsule. (*a*) What is the change in speed of the space capsule? (*b*) If the push lasts 0.40 s, what is the average force exerted on the astronaut by the space capsule? As the reference frame, use the position of the space capsule before the push.

66. Two astronauts, one of mass 60 kg and the other 80 kg, are initially at rest in outer space. They then push each other apart. How far apart are they when the lighter astronaut has moved 12 m?

67. A ball of mass m makes a head-on elastic collision with a second ball (at rest) and rebounds in the opposite direction with a speed equal to one-fourth its original speed. What is the mass of the second ball?

68. You have been hired as an expert witness in a court case involving an automobile accident. The accident involved car A of mass 1900 kg which crashed into stationary car B of mass 1100 kg. The driver of car A applied his brakes 15 m before he crashed into car B. After the collision, car A slid 18 m while car B slid 30 m. The coefficient of kinetic friction between the locked wheels and the road was measured to be 0.60. Show that the driver of car A was exceeding the 55-mph (90 km/h) speed limit before applying the brakes.

69. A golf ball rolls off the top of a flight of concrete steps of total vertical height 4.00 m. The ball hits four times on the way down, each time striking the horizontal part of a different step 1.0 m lower. If all collisions are perfectly elastic, what is the bounce height on the fourth bounce when the ball reaches the bottom of the stairs?

70. A bullet is fired vertically into a 1.40-kg block of wood at rest directly above it. If the bullet has a mass of 29.0 g and a speed of 510 m/s, how high will the block rise after the bullet becomes embedded in it?

71. A 25-g bullet strikes and becomes embedded in a 1.35-kg block of wood placed on a horizontal surface just in front of the gun. If the coefficient of kinetic friction between the block and the surface is 0.25, and the impact drives the block a distance of 9.5 m before it comes to rest, what was the muzzle speed of the bullet?

72. Two people, one of mass 75 kg and the other of mass 60 kg, sit in a rowboat of mass 80 kg. With the boat initially at rest, the two people, who have been sitting at opposite ends of the boat 3.2 m apart from each other, now exchange seats. How far and in what direction will the boat move?

73. A meteor whose mass was about 1.0×10^8 kg struck the Earth ($m_E = 6.0 \times 10^{24}$ kg) with a speed of about 15 km/s and came to rest in the Earth. (*a*) What was the Earth's recoil speed? (*b*) What fraction of the meteor's kinetic energy was transformed to kinetic energy of the Earth? (*c*) By how much did the Earth's kinetic energy change as a result of this collision?

74. An object at rest is suddenly broken apart into two fragments by an explosion. One fragment acquires twice the kinetic energy of the other. What is the ratio of their masses?

75. The force on a bullet is given by the formula $F = 580 - (1.8 \times 10^5)t$ over the time interval $t = 0$ to $t = 3.0 \times 10^{-3}$ s. In this formula, t is in seconds and F is in newtons. (*a*) Plot a graph of F vs. t for $t = 0$ to $t = 3.0$ ms. (*b*) Estimate, using graphical methods, the impulse given the bullet. (*c*) If the bullet achieves a speed of 220 m/s as a result of this impulse, given to it in the barrel of a gun, what must its mass be?

76. Two balls, of masses $m_A = 40$ g and $m_B = 60$ g, are suspended as shown in Fig. 7–44. The lighter ball is pulled away to a 60° angle with the vertical and released. (*a*) What is the velocity of the lighter ball before impact? (*b*) What is the velocity of each ball after the elastic collision? (*c*) What will be the maximum height of each ball after the elastic collision?

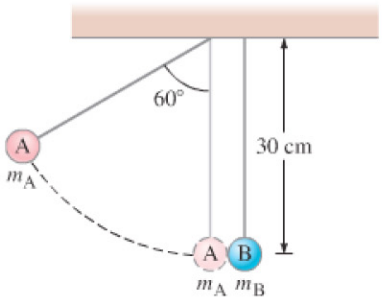

FIGURE 7–44
Problem 76.

77. An atomic nucleus at rest decays radioactively into an alpha particle and a smaller nucleus. What will be the speed of this recoiling nucleus if the speed of the alpha particle is 3.8×10^5 m/s? Assume the recoiling nucleus has a mass 57 times greater than that of the alpha particle.