7. During volcanic eruptions, chunks of solid rock can be blasted out of the volcano; these projectiles are called *volcanic bombs*. Figure 4-22 shows a cross section of Mt. Fuji, in Japan. (a) At what initial speed would a bomb have to be ejected, at angle $\theta_0 = 60.0°$ to the horizontal, from the vent at *A* in order to fall at the foot of the volcano at *B*, at vertical distance $h = 2.60$ km and horizontal distance $d = 9.40$ km? Ignore, for the moment, the effects of air on the bomb's travel. (b) What would be the time of flight? (c) Would the effect of the air increase or decrease your answer in (a)?

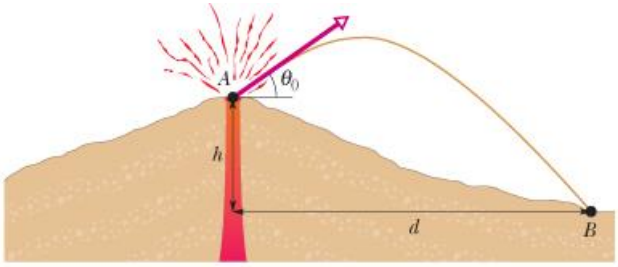

Figure 4-22 Problem 7.

30. You are to throw a ball with a speed of 13.6 m/s at a target that is height $h = 6.20$ m above the level at which you release the ball (Fig. 4-27). You want the ball's velocity to be horizontal at the instant it reaches the target. (a) At what angle θ above the horizontal must you throw the ball? (b) What is the horizontal distance from the release point to the target? (c) What is the speed of the ball just as it reaches the target?

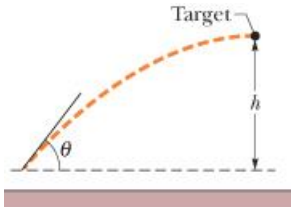

Figure 4-27 Problem 30.

31. At what initial speed must the basketball player in Fig. 4-28 throw the ball, at angle $\theta_0 = 70°$ above the horizontal, to make the foul shot? The horizontal distances are $d_1 = 1.0$ ft and $d_2 = 14$ ft, and the heights are $h_1 = 7.0$ ft and $h_2 = 10$ ft.

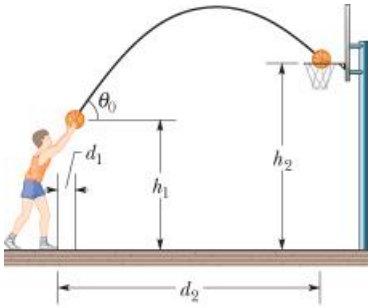

Figure 4-28 Problem 31.

35. For women's volleyball the top of the net is 2.24 m above the floor and the court measures 9.0 m by 9.0 m on each side of the net. Using a jump serve, a player strikes the ball at a point that is 3.0 m above the floor and a horizontal distance of 7.0 m from the net. If the initial velocity of the ball is horizontal, (a) what minimum magnitude must it have if the ball is to clear the net and (b) what maximum magnitude can it have if the ball is to strike the floor inside the back line on the other side of the net?

41. A military jet is detected by radar while approaching directly from the east. At first observation, the airplane is at distance $d_1 = 720$ m from the station and at angle $\theta_1 = 40°$ above the horizon (Fig. 4-33). The airplane is tracked through an angular change $\Delta\theta = 123°$ in the vertical east–west plane; its distance is then $d_2 = 1580$ m. Find the (a) magnitude and (b) direction of the airplane's displacement during this period.

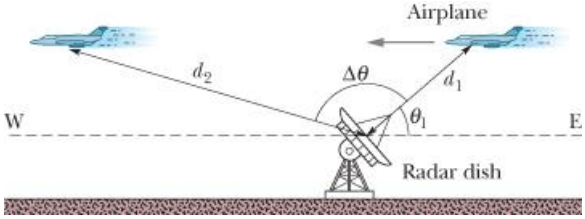

Figure 4-33 Problem 41.

66. A circus mouse rides a merry-go-round turning with uniform circular motion. At time $t_1 = 3.00$ s, the cat's velocity is $\vec{v}_1 = (3.00 \text{ m/s})\hat{i} + (4.00 \text{ m/s})\hat{j}$, measured on a horizontal *xy* coordinate system. At $t_2 = 5.00$ s, the cat's velocity is $\vec{v}_2 = (-3.00 \text{ m/s})\hat{i} + (-4.00 \text{ m/s})\hat{j}$. What are (a) the magnitude of the cat's centripetal acceleration and (b) the cat's average acceleration during the time interval $t_2 - t_1$, which is less than one period?