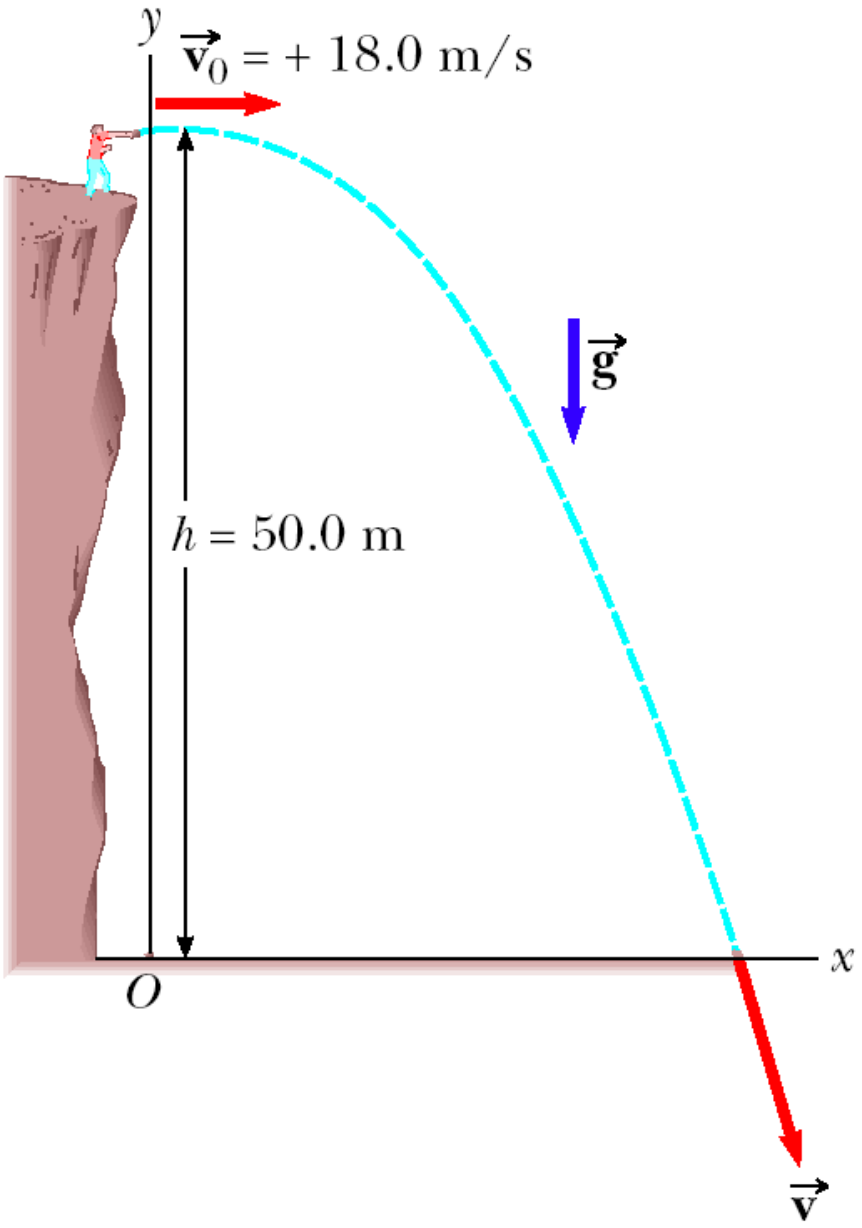
3-22. One of the fastest recorded pitches in major-league baseball, thrown by Billy Wagner in 2003, was clocked at 101.0 mi/h (Fig. P3.22).

If a pitch were thrown horizontally with this velocity, how far would the ball fall vertically by the time it reached home plate, 60.5 ft away?

AP/Wide World Photos

Figure P3.22 Billy Wagner throws a baseball (or should it be Joel Zumaya?).

3-23. A student stands at the edge of a cliff and throws a stone horizontally over the edge with a speed of 18.0 m/s. The cliff is 50.0 m above a flat, horizontal beach, as shown below.



(a) What are the coordinates of the original position of the stone?

(b) What are the components of the initial velocity?

(c) Write the equations for the x- and y-components of the velocity of the stone.

(d) Write the equations for the position of the stone with time, using the coordinates in the figure.

(e) How long after being released does the stone strike the beach below the cliff?

(f) With what speed and angle of impact does the stone land?

3-31. A car is parked on a cliff overlooking the ocean on an incline that makes an angle of 24.0° below the horizontal. The negligent driver leaves the car in neutral, and the emergency brakes are defective. The car rolls from rest down the incline with a constant acceleration of 4.00 m/s^2 for a distance of 50.0 m to the edge of the cliff, which is 30.0 m above the ocean.
Find

(a) the car's position relative to the base of the cliff when the car lands in the ocean and

(b) the length of time the car is in the air.

3-59 In a very popular lecture demonstration, a projectile is fired at a falling target as in the figure below. The projectile leaves the gun at the same instant that the target is dropped from rest. Assuming that the gun is initially aimed at the target, show that the projectile will hit the target. (One restriction of this experiment is that the projectile must reach the target before the target strikes the floor.)