3 REVIEW

32. 3.3 s; 36 m/s

33. 11 m

34. **a.** 2.77×10^5 m
b. 284 s

35. **a.** clears the goal by 1 m
b. falling

36. 4.11 m

37. 80 m; 210 m

38. Displacement and velocity depend on the frame of reference in which they are measured.

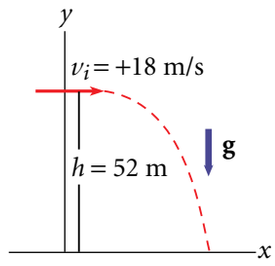
39. the coordinate system used to describe the motion

40. Earth

41. **a.** 70 m/s east
b. 20 m/s

42. **a.** To the passenger, the ball appears to move in a straight line. To an outside observer, the ball moves along a parabolic trajectory.
b. The passenger would see the ball move backward, while the stationary observer would see no change from part (a).

32. A person standing at the edge of a seaside cliff kicks a stone over the edge with a speed of 18 m/s. The cliff is 52 m above the water's surface, as shown at right. How long does it take for the stone to fall to the water? With what speed does it strike the water?



33. A spy in a speed boat is being chased down a river by government officials in a faster craft. Just as the officials' boat pulls up next to the spy's boat, both boats reach the edge of a 5.0 m waterfall. If the spy's speed is 15 m/s and the officials' speed is 26 m/s, how far apart will the two vessels be when they land below the waterfall?

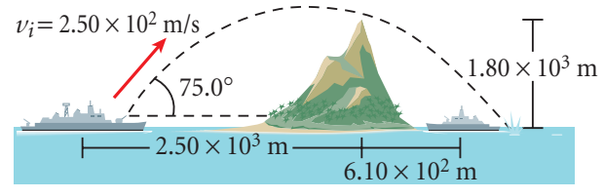
For problems 34–37, see Sample Problem E.

34. A shell is fired from the ground with an initial speed of 1.70×10^3 m/s (approximately five times the speed of sound) at an initial angle of 55.0° to the horizontal. Neglecting air resistance, find
a. the shell's horizontal range
b. the amount of time the shell is in motion

35. A place kicker must kick a football from a point 36.0 m (about 40.0 yd) from the goal. As a result of the kick, the ball must clear the crossbar, which is 3.05 m high. When kicked, the ball leaves the ground with a speed of 20.0 m/s at an angle of 53° to the horizontal.
a. By how much does the ball clear or fall short of clearing the crossbar?
b. Does the ball approach the crossbar while still rising or while falling?

36. When a water gun is fired while being held horizontally at a height of 1.00 m above ground level, the water travels a horizontal distance of 5.00 m. A child, who is holding the same gun in a horizontal position, is also sliding down a 45.0° incline at a constant speed of 2.00 m/s. If the child fires the gun when it is 1.00 m above the ground and the water takes 0.329 s to reach the ground, how far will the water travel horizontally?

37. A ship maneuvers to within 2.50×10^3 m of an island's 1.80×10^3 m high mountain peak and fires a projectile at an enemy ship 6.10×10^2 m on the other side of the peak, as illustrated below. If the ship shoots the projectile with an initial velocity of 2.50×10^2 m/s at an angle of 75.0°, how close to the enemy ship does the projectile land? How close (vertically) does the projectile come to the peak?



RELATIVE MOTION

Review Questions

38. Explain the statement "All motion is relative."

39. What is a frame of reference?

40. When we describe motion, what is a common frame of reference?

41. A small airplane is flying at 50 m/s toward the east. A wind of 20 m/s toward the east suddenly begins to blow and gives the plane a velocity of 70 m/s east.
a. Which vector is the resultant vector?
b. What is the magnitude of the wind velocity?

42. A ball is thrown upward in the air by a passenger on a train that is moving with constant velocity.
a. Describe the path of the ball as seen by the passenger. Describe the path as seen by a stationary observer outside the train.
b. How would these observations change if the train were accelerating along the track?

Practice Problems

For problems 43–46, see Sample Problem F.

43. A river flows due east at 1.50 m/s. A boat crosses the river from the south shore to the north shore by maintaining a constant velocity of 10.0 m/s due north relative to the water.
a. What is the velocity of the boat as viewed by an observer on shore?