42. A speeder passes a parked police car at 30.0 m/s. The police car starts from rest with a uniform acceleration of 2.44 m/s^2.

a. How much time passes before the speeder is overtaken by the police car?

b. How far does the speeder get before being overtaken by the police car?

43. An ice sled powered by a rocket engine starts from rest on a large frozen lake and accelerates at +13.0 m/s^2. At t_1 the rocket engine is shut down and the sled moves with constant velocity v until t_2. The total distance traveled by the sled is 5.30×10^3 m and the total time is 90.0 s. Find t_1, t_2, and v.
(See Appendix A for hints on solving quadratic equations.)

44. At the 5800 m mark, the sled in the previous question begins to accelerate at −7.0 m/s^2. Use your answers from item 43 to answer the following questions.

a. What is the final position of the sled when it comes to rest?

b. How long does it take for the sled to come to rest?

45. A tennis ball with a velocity of +10.0 m/s to the right is thrown perpendicularly at a wall. After striking the wall, the ball rebounds in the opposite direction with a velocity of −8.0 m/s to the left. If the ball is in contact with the wall for 0.012 s, what is the average acceleration of the ball while it is in contact with the wall?

46. A parachutist descending at a speed of 10.0 m/s loses a shoe at an altitude of 50.0 m.

a. When does the shoe reach the ground?

b. What is the velocity of the shoe just before it hits the ground?

47. A mountain climber stands at the top of a 50.0 m cliff hanging over a calm pool of water. The climber throws two stones vertically 1.0 s apart and observes that they cause a single splash when they hit the water. The first stone has an initial velocity of +2.0 m/s.

a. How long after release of the first stone will the two stones hit the water?

b. What is the initial velocity of the second stone when it is thrown?

c. What will the velocity of each stone be at the instant both stones hit the water?

48. A model rocket is launched straight upward with an initial speed of 50.0 m/s. It accelerates with a constant upward acceleration of 2.00 m/s^2 until its engines stop at an altitude of 150 m.

a. What is the maximum height reached by the rocket?

b. When does the rocket reach maximum height?

c. How long is the rocket in the air?

49. A professional race-car driver buys a car that can accelerate at +5.9 m/s^2. The racer decides to race against another driver in a souped-up stock car. Both start from rest, but the stock-car driver leaves 1.0 s before the driver of the race car. The stock car moves with a constant acceleration of +3.6 m/s^2.

a. Find the time it takes the race-car driver to overtake the stock-car driver.

b. Find the distance the two drivers travel before they are side by side.

c. Find the velocities of both cars at the instant they are side by side.

50. Two cars are traveling along a straight line in the same direction, the lead car at 25 m/s and the other car at 35 m/s. At the moment the cars are 45 m apart, the lead driver applies the brakes, causing the car to have an acceleration of –2.0 m/s^2.

a. How long does it take for the lead car to stop?

b. Assume that the driver of the chasing car applies the brakes at the same time as the driver of the lead car. What must the chasing car's minimum negative acceleration be to avoid hitting the lead car?

c. How long does it take the chasing car to stop?

51. One swimmer in a relay race has a 0.50 s lead and is swimming at a constant speed of 4.00 m/s. The swimmer has 20.0 m to swim before reaching the end of the pool. A second swimmer moves in the same direction as the leader. What constant speed must the second swimmer have in order to catch up to the leader at the end of the pool?