2 REVIEW

19. 110 m

20. +8.6 m/s

21. **a.** −15 m/s
b. −38 m

22. +1.5 m/s; +32 m

23. 17.5 m

24. **a.** 11 m/s
b. 52 s

25. 0.99 m/s

26. **a.** The ball's velocity decreases, becomes zero at its maximum altitude, then increases in the negative direction.
b. At maximum altitude, the ball's velocity is zero.
c. $-9.81\ m/s^2$
d. $-9.81\ m/s^2$
e. The ball's acceleration remains constant.

27. For each ball, the velocity can be analyzed as the distance between images, and the acceleration can be seen by comparing the distances. Both balls are accelerating; they start with approximately the same acceleration, but the smaller ball's acceleration gradually decreases because of air resistance.

28. The two pins have the same acceleration ($-9.81\ m/s^2$).

29. **a.** yes
b. yes
c. yes

30. −39.6 m/s

31. 3.94 s

32. 0.60 s

33. 1.51 h

19. A car accelerates uniformly from rest to a speed of 65 km/h (18 m/s) in 12 s. Find the distance the car travels during this time.

For problems 20–23, see Sample Problem D.

20. A car traveling at +7.0 m/s accelerates at the rate of $+0.80\ m/s^2$ for an interval of 2.0 s. Find v_f.

21. A car accelerates from rest at $-3.00\ m/s^2$.
a. What is the velocity at the end of 5.0 s?
b. What is the displacement after 5.0 s?

22. A car starts from rest and travels for 5.0 s with a uniform acceleration of $+1.5\ m/s^2$. The driver then applies the brakes, causing a uniform acceleration of $-2.0\ m/s^2$. If the brakes are applied for 3.0 s, how fast is the car going at the end of the braking period, and how far has it gone from its start?

23. A boy sledding down a hill accelerates at $1.40\ m/s^2$. If he started from rest, in what distance would he reach a speed of 7.00 m/s?

For problems 24–25, see Sample Problem E.

24. A sailboat starts from rest and accelerates at a rate of $0.21\ m/s^2$ over a distance of 280 m.
a. Find the magnitude of the boat's final velocity.
b. Find the time it takes the boat to travel this distance.

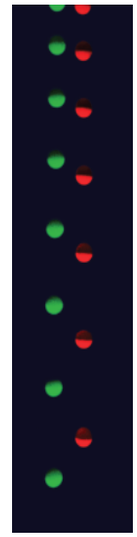
25. An elevator is moving upward at 1.20 m/s when it experiences an acceleration of $0.31\ m/s^2$ downward, over a distance of 0.75 m. What will its final velocity be?

FALLING OBJECTS

Conceptual Questions

26. A ball is thrown vertically upward.
a. What happens to the ball's velocity while the ball is in the air?
b. What is its velocity when it reaches its maximum altitude?
c. What is its acceleration when it reaches its maximum altitude?
d. What is its acceleration just before it hits the ground?
e. Does its acceleration increase, decrease, or remain constant?

27. The image at right is a strobe photograph of two falling balls released simultaneously. (This motion does not take place in a vacuum.) The ball on the left side is solid, and the ball on the right side is a hollow table-tennis ball. Analyze the motion of both balls in terms of velocity and acceleration.



28. A juggler throws a bowling pin into the air with an initial velocity v_i. Another juggler drops a pin at the same instant. Compare the accelerations of the two pins while they are in the air.

29. A bouquet is thrown upward.
a. Will the value for the bouquet's displacement be the same no matter where you place the origin of the coordinate system?
b. Will the value for the bouquet's velocity be the same?
c. Will the value for the bouquet's acceleration be the same?

Practice Problems

For problems 30–32, see Sample Problem F.

30. A worker drops a wrench from the top of a tower 80.0 m tall. What is the velocity when the wrench strikes the ground?

31. A peregrine falcon dives at a pigeon. The falcon starts downward from rest with free-fall acceleration. If the pigeon is 76.0 m below the initial position of the falcon, how long does the falcon take to reach the pigeon? Assume that the pigeon remains at rest.

32. A ball is thrown upward from the ground with an initial speed of 25 m/s; at the same instant, a ball is dropped from rest from a building 15 m high. After how long will the balls be at the same height?

MIXED REVIEW

33. If the average speed of an orbiting space shuttle is 27 800 km/h, determine the time required for it to circle Earth. Assume that the shuttle is orbiting about 320.0 km above Earth's surface, and that Earth's radius is 6380 km.