Ch 2 (5th ed)

30. Describe the motion of the ball shown in each of the strobe drawings. (Assume that the ball moves from left to right.)

a. ● ● ● ● ● ● ●

b. ●● ● ● ● ● ● ● ●

c. ● ● ● ● ● ● ● ●●

31. Assume that an airplane accelerates from 550 mph to 555 mph, a car accelerates from 60 mph to 67 mph, and a bicycle accelerates from 0 to 10 mph. If all three vehicles accomplish these changes in the same length of time, which one (if any) has the largest acceleration?

32. If a jaguar accelerates from 0 to 30 mph in 2 seconds and a cheetah accelerates from 20 mph to 45 mph in 2 seconds, which one has the larger acceleration?

33. A sports car accelerates from 65 mph to 75 mph in 2 seconds while a minivan accelerates from 20 mph to 35 mph in 2 seconds. Which one has the larger acceleration?

34. A Dodge Caravan has a speed of 50 mph and an acceleration of 2 (mph) per second. A Ford Taurus has a speed of 55 mph and an acceleration of 1 (mph) per second. Which car has the higher speed after 10 seconds have elapsed?

35. When we say that light objects and heavy objects fall at the same rate, what assumption(s) are we making?

36. Free fall near the surface of the Moon can be described as motion with a constant _____.

37. You are standing on a high cliff above the ocean. You drop a pebble, and it strikes the water 4 seconds later. Ignoring the effects of air resistance, how fast was the pebble traveling just before striking the water?

38. You throw a ball straight up in the air. The instant after leaving your hand the ball's speed is 30 meters per second. Ignoring the effects of air resistance, predict how fast the ball will be traveling 2 seconds later.

39. What happens to the acceleration of a ball in free fall if the ball's mass is cut in half?

40. Two balls have the same size but are made from different materials: one from rubber and the other from steel. How do their accelerations compare after they are dropped?

41. You are bouncing on a trampoline while holding a bowling ball. As your feet leave the trampoline, you let go of the bowling ball. Do you rise to a higher, the same, or a lower height than if you had held onto the bowling ball?

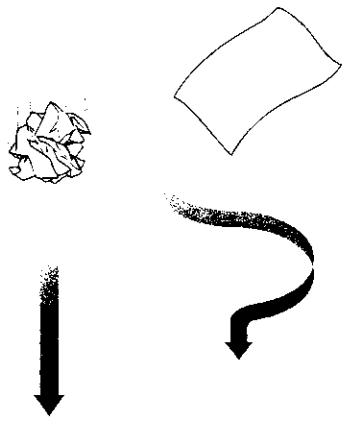
42. You are bouncing on a trampoline while holding a bowling ball. As your feet leave the trampoline, you let go of the bowling ball. When you reach your maximum height, is the bowling ball above, beside, or below you?

43. A penny and a feather are placed inside a long cylinder, and the air is pumped out. When the cylinder is inverted, which hits the bottom first—the penny or the feather?

44. The Moon is a good place to study free fall because it has no atmosphere. An astronaut on the Moon simultaneously dropped a hammer and a feather from the same height, which one hit the ground first?

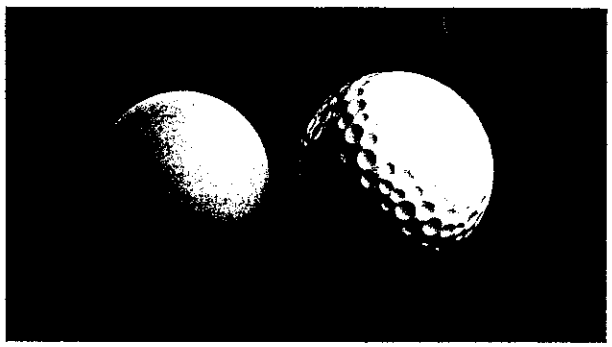
45. How did the ideas of Galileo and Aristotle differ concerning the motion of a freely falling object?

46. A sheet of paper and a book fall at different rates unless the paper is wadded up into a ball, as shown in the figure. How would Galileo and Aristotle account for this?



47. A student decides to test Aristotle's and Galileo's ideas about free fall by simultaneously dropping a 20-pound ball and a 1-pound ball from the top of a grain elevator. The two balls have the same size and shape. What actually happens?

48. A Ping-Pong ball and a golf ball have approximately the same size but very different masses. Which hits the ground first if you drop them simultaneously from a tall building? Do not neglect the effects of air resistance.



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49. A Ping-Pong ball and a marble are dropped side by side from the top of the biology building. Which ball has the greater acceleration? Do not ignore the effects of air resistance.

50. A Ping-Pong ball and a marble are both thrown straight up in the air at the same initial speed. Which ball has the greater acceleration? Do not ignore the effects of air resistance.

51. A hard rubber ball is bounced on the floor. Compare the ball's acceleration on the way down to its acceleration on its way back up.

52. How (if at all) does the acceleration of a cylinder rolling up a ramp differ from that of one that is rolling down the ramp?

***53.** If we ignore air resistance, the acceleration of an object that is falling downward is constant. How do you suppose the acceleration would change if we do *not* ignore air resistance? Explain your reasoning.

54. If we do not neglect air resistance, during which of the first 5 seconds of free fall does a ball's speed change the most?

EXERCISES

1. The top speed of the Concorde is 1450 mph. Given that 1 mile = 1.61 km, what is this speed in km/h?

2. Top professional pitchers can throw fastballs at speeds of 100 mph. Given that 1 mph = 0.447 m/s, what is this speed in meters per second?

3. At exactly noon, you pass mile marker 50 in your car. At 2:30 P.M. you pull into a rest stop at mile marker 215. What was your average speed during this time?

4. To be eligible to enter the Boston Marathon, a race that covers a distance of 26.2 miles, a runner must be able to finish in less than 3 h. What minimum average speed must be maintained to accomplish this?

5. In 1989 Ann Trason broke the U.S. women's record for a 24-h run by covering a distance of 143 miles. What was her average speed?

6. The 10,000-m run world record is 26 min 22.75 s. What was the runner's average speed in m/s?

7. How far can a bus travel in 8 h at an average speed of 60 mph?

8. At an average speed of 10 m/s, how many kilometers can a cyclist travel in an 8-h day?

***9.** Starting at 9 A.M., you hike for 3 h at an average speed of 4 mph. You stop for lunch from noon until 2 P.M. What is your average speed over the interval from 9 A.M. to 2 P.M.?

***10.** Your plan was to be on the road by 9 A.M., but you did not leave the garage until 10 A.M. You then drove with the cruise control set at 75 mph until stopping at noon. What was your average speed over the time interval from 9 A.M. to noon?

11. If a cheetah runs at 25 m/s, how long will it take a cheetah to run a 100-m dash? How does this compare with human times?

12. How many hours would be required to make a 4400-km trip across the United States if you average 80 km/h?

13. If a runner can average 4 mph, can he complete a 100-mile supermarathon in less than 24 h?

14. At an average speed of 125 mph, how long would it take a race car to complete a 500-mile race?

15. A Chevrolet Corvette can accelerate from 0 to 60 mph in 5.2 s. What is the car's average acceleration in mph/s?

16. If a Cessna 172 requires 20 s to reach its liftoff speed of 120 km/h, what is its average acceleration?

17. A car speeds up from 40 mph to 70 mph to pass a truck. If this requires 6 s, what is the average acceleration of the car?

18. In 1999 the world's record for top fuel dragsters was 4.48 s to travel $\frac{1}{4}$ mile from a standing start. The dragster was traveling 326.44 mph at the end of the quarter mile. What was the dragster's average acceleration? What was its average speed?

19. A child traveling 5 m/s on a sled passes her younger brother. If her average acceleration on the sledding hill is 2 m/s^2, how fast is she traveling when she passes her older brother 4 s later?

20. You throw a ball straight up at 30 m/s. How many seconds elapse before it is traveling downward at 10 m/s?

21. You are trying to decide whether to jump off a cliff into the water below, but you cannot judge the height of the cliff. You drop a pebble and note that it takes 2 s to hit the water. How high is the cliff?