College Physics, 2e **(Knight)**
Chapter 2 Motion in One Dimension

2.1 Quantitative

1) A car accelerates from 5.0 m/s to 21 m/s at a rate of 3.0 m/s^2. How far does it travel while accelerating?
A) 69 m
B) 207 m
C) 41 m
D) 117 m
Answer: A
Var: 50+

2) An airplane needs to reach a velocity of 203.0 km/h to take off. On a 2000 m runway, what is the minimum acceleration necessary for the plane to take flight?
A) 0.79 m/s^2
B) 0.87 m/s^2
C) 0.95 m/s^2
D) 1.0 m/s^2
Answer: A
Var: 50+

3) Assuming equal rates of acceleration in both cases, how much further would you travel if braking from 56 mi/h to rest than from 28 mi/h?
A) 4 times farther
B) 3.2 times farther
C) 4.8 times farther
D) 5.2 times farther
Answer: A
Var: 50+

4) A 8.7 hour trip is made at an average speed of 73.0 km/hr. If the first third of the trip (chronologically) was driven at 96.5 km/hr, what was the average speed for the rest of the journey?
A) 61 km/hr
B) 51 km/hr
C) 67 km/hr
D) 85 km/hr
Answer: A
Var: 50+

5) If the fastest you can safely drive is 65 mi/h, what is the longest time you can stop for dinner if you must travel 541 mi in 9.6 h total?
A) 1.3 h
B) 1.4 h
C) 1.0 h
D) You can't stop at all.
Answer: A
Var: 50+

6) A car travels 95 km to the north at 70.0 km/h, then turns around and travels 21.9 km at 80.0 km/h. What is the difference between the average speed and the average velocity on this trip?
A) 27 km/h
B) 19 km/h
C) 32 km/h
D) 24 km/h
Answer: A
Var: 50+

7) A baseball is hit with a bat and, as a result, its direction is completely reversed and its speed is doubled. If the actual contact with the bat lasts 0.45 s, what is the ratio of the acceleration to the original velocity?
A) -6.7 s^{-1}
B) -4.4 s^{-1}
C) -2.2 s^{-1}
D) -0.15 s^{-1}
Answer: A
Var: 50+

8) A sports car has an average acceleration of 13.1 $\frac{\text{miles}}{\text{hour} \cdot \text{sec}}$. How long does it take for the car to reach 60.0 mi/h, if it starts from rest?
A) 4.6 s
B) 5.5 s
C) 3.1 s
D) 8.8 s
Answer: A
Var: 50+

9) A car is travelling north at 17.7 m/s. After 12 s its velocity is 14.1 m/s in the same direction. Find the magnitude and direction of the car's average acceleration.
A) 0.30 m/s^2, South
B) 2.7 m/s^2, South
C) 0.30 m/s^2, North
D) 2.7 m/s^2, North
Answer: A
Var: 50+

10) Acceleration is sometimes expressed in multiples of g, where g = 9.8 m/s^2 is the acceleration due to the earth's gravity. In a car crash, the car's velocity may go from 26 m/s to 0 m/s in 0.15 s. How many g's are experienced, on average, by the driver?
A) 18 g
B) 13 g
C) 22 g
D) 23 g
Answer: A
Var: 11

11) A train starts from rest and accelerates uniformly, until it has traveled 5.6 km and acquired a velocity of 42 m/s. The train then moves at a constant velocity of 42 m/s for 420 s. The train then slows down uniformly at 0.065 m/s^2, until it is brought to a halt. The acceleration during the first 5.6 km of travel is closest to:
A) 0.16 m/s^2
B) 0.14 m/s^2
C) 0.17 m/s^2
D) 0.19 m/s^2
E) 0.20 m/s^2
Answer: A
Var: 50+

12) A train starts from rest and accelerates uniformly, until it has traveled 2.1 km and acquired a velocity of 24 m/s. The train then moves at a constant velocity of 24 m/s for 400 s. The train then slows down uniformly at 0.065 m/s^2, until it is brought to a halt. The distance traveled by the train while slowing down, in km, is closest to:
A) 4.4
B) 4.2
C) 4.0
D) 3.8
E) 3.6
Answer: A
Var: 50+

13) A car moving at a velocity of 20 m/s is behind a truck moving at a constant velocity of 18 m/s. When the car is 50 m behind the front of the truck, the car accelerates uniformly at 1.8 m/s^2. The car continues at the same acceleration until it reaches a velocity of 25 m/s, which is the legal speed limit. The car then continues at a constant velocity of 25 m/s, until it passes the front of the truck. The distance the car travels while accelerating, in meters, is closest to:
A) 50
B) 54
C) 58
D) 62
E) 66
Answer: D
Var: 1

14) A motorist makes a trip of 180 miles. For the first 90 miles she drives at a constant speed of 30 mph. At what constant speed must she drive the remaining distance if her average speed for the total trip is to be 40 mph?
A) 45 mph
B) 50 mph
C) 52.5 mph
D) 55 mph
E) 60 mph
Answer: E
Var: 1

15) A dragster travels 1/4 mi in 6.7 s. Assuming that acceleration is constant and the dragster is initially at rest, what is its velocity when it crosses the finish line?
A) 269 mi/h
B) 188 mi/h
C) 296 mi/h
D) 135 mi/h
Answer: A
Var: 40

16) The average velocity of a car over a certain time interval is 37 mi/h. If the velocity of the car was 65 mi/h at the end of this interval, what was its initial velocity? Assume that acceleration was constant.
A) 9 mi/h
B) 13 mi/h
C) 4.0 mi/h
D) 57 mi/h
Answer: A
Var: 25

17) A racquetball strikes a wall with a speed of 30 m/s and rebounds with a speed of 26 m/s. The collision takes 20 ms. What is the average acceleration of the ball during the collision?
A) zero
B) 200 m/s^2
C) 2800 m/s^2
D) 1500 m/s^2
E) 1300 m/s^2
Answer: C
Var: 1

18) Human reaction times are worsened by alcohol. How much farther would a drunk driver's car travel before he hits the brakes than a sober driver's car? Assume both cars are initially traveling at 49.0 mi/h, the sober driver takes .33 s, and the drunk driver takes 1.0 s to hit the brakes in a crisis.
A) 48 ft
B) 34 ft
C) 53 ft
D) 58 ft
Answer: A
Var: 30

19) A bicyclist starts a timed race at 6.0 mi/h. In order to win, he must average 21 mi/h. Assuming constant acceleration from the start, how fast must he be traveling at the end of the race?
A) 36 mi/h
B) 30 mi/h
C) 24 mi/h
D) 42 mi/h
Answer: A
Var: 21

20) A toy rocket is launched vertically from ground level (y = 0 m), at time t = 0.0 s. The rocket engine provides constant upward acceleration during the burn phase. At the instant of engine burnout, the rocket has risen to 64 m and acquired a velocity of 60 m/s. The rocket continues to rise in unpowered flight, reaches maximum height, and falls back to the ground. The time interval, during which the rocket engine provides upward acceleration, is closest to:
A) 2.1 s
B) 2.3 s
C) 1.9 s
D) 1.7 s
E) 1.5 s
Answer: A
Var: 50+

21) A toy rocket is launched vertically from ground level (y = 0 m), at time t = 0.0 s. The rocket engine provides constant upward acceleration during the burn phase. At the instant of engine burnout, the rocket has risen to 81 m and acquired a velocity of 40 m/s. The rocket continues to rise in unpowered flight, reaches maximum height, and falls back to the ground. The upward acceleration of the rocket during the burn phase is closest to:
A) 9.9 m/s^2
B) 9.6 m/s^2
C) 9.3 m/s^2
D) 9.0 m/s^2
E) 8.7 m/s^2
Answer: A
Var: 50+

22) A toy rocket is launched vertically from ground level (y = 0 m), at time t = 0.0 s. The rocket engine provides constant upward acceleration during the burn phase. At the instant of engine burnout, the rocket has risen to 49 m and acquired a velocity of 60 m/s. The rocket continues to rise in unpowered flight, reaches maximum height, and falls back to the ground. The maximum height reached by the rocket is closest to:
A) 233 m
B) 221 m
C) 209 m
D) 244 m
E) 256 m
Answer: A
Var: 50+

23) A ball is thrown straight upward with a velocity of 39 m/s. How much time passes before the ball strikes the ground? (Disregard air resistance.)
A) 8.0 s
B) 4.0 s
C) 2.4 s
D) 1.2 s
Answer: A
Var: 31

24) A package is dropped from a helicopter moving upward at 15 m/s. If it takes 16.0 s before the package strikes the ground, how high above the ground was the package when it was released? (Disregard air resistance.)
A) 1000 m
B) 1500 m
C) 810 m
D) 1200 m
Answer: A
Var: 25

25) At the same moment, one rock is dropped and one is thrown downward with an initial velocity of 10 m/s from the top of a 300 m building. How much earlier does the thrown rock strike the ground? (Disregard air resistance.)
A) 0.95 s
B) 0.66 s
C) 0.85 s
D) They land at exactly the same time.
Answer: A
Var: 21

26) A ball is projected upward at time t = 0.0 s, from a point on a roof 60 m above the ground. The ball rises, then falls and strikes the ground. The initial velocity of the ball is 28.4 m/s. Consider all quantities as positive in the upward direction. At time t = 4.3 s, the acceleration of the ball is closest to:
A) zero
B) +5 m/s^2
C) +10 m/s^2
D) -5 m/s^2
E) -10 m/s^2
Answer: E
Var: 50+

27) A ball is projected upward at time t = 0.0 s, from a point on a roof 90 m above the ground. The ball rises, then falls and strikes the ground. The initial velocity of the ball is 80.5 m/s. Consider all quantities as positive in the upward direction. The velocity of the ball when it is 89 m above the ground is closest to:
A) - 81 m/s
B) - 64 m/s
C) - 48 m/s
D) - 32 m/s
E) - 97 m/s
Answer: A
Var: 50+

28) A test rocket is fired straight up from rest with a net acceleration of 20 m/s^2. After 4 seconds the motor turns off, but the rocket continues to coast upward. What maximum elevation does the rocket reach?
A) 487 m
B) 327 m
C) 320 m
D) 408 m
E) 160 m
Answer: A
Var: 1

29) A sports car can go from rest to 32 m/s in 3.88 s. The same car can come to a full stop from that speed in 3.96 s. What is the ratio of starting to stopping accelerations?
A) -1.0
B) 1.0
C) -0.98
D) 0.98
Answer: A
Var: 50+

2.2 True/False

1) The acceleration is always the slope of the "velocity versus time" graph and the velocity is always the slope of the "position versus time" graph.
Answer: TRUE
Var: 1

2) It is not physically possible for the "position versus time" graph of a moving animal to be either perfectly vertical or perfectly horizontal.
Answer: TRUE
Var: 1

3) The equation $s_f = s_i + v_{is}\,\Delta t + \frac{1}{2} a_s (\Delta t)^2$ is valid for all types of motion because it is a fundamental equation of physics.
Answer: FALSE
Var: 1

4) Negative acceleration is called deceleration because an object is slowing down.
Answer: FALSE
Var: 1

5) The equation $v_{fs}^2 = v_{is}^2 + 2a_s\,\Delta x$ applies to motion for which the "velocity versus time" graph is a straight line.
Answer: TRUE
Var: 1

6) If an object stops moving at a point, then its acceleration must be zero at that point.
Answer: FALSE
Var: 1

7) It is physically impossible for an object to have a negative acceleration and yet be speeding up.
Answer: FALSE
Var: 1

8) If the "velocity versus time" graph of an object is a horizontal line, that object cannot be accelerating.
Answer: TRUE
Var: 1

2.3 Conceptual

1) What quantity is measured by your speedometer (be as specific as possible)?
Answer: Your speedometer tells you the instantaneous speed of your car.
Var: 1

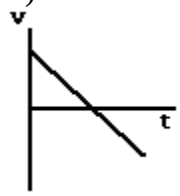
2) You go on a long trip and try to determine your average velocity by using the miles on your car's tripometer and the time the trip required. Why would the answer using this information most likely not be correct?
Answer: Unless the trip was along a perfect straight line, the distance on the tripometer would not be your displacement. The quantity calculated would thus be your average speed, not your average velocity.
Var: 1

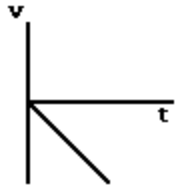
3) Is there any situation in which the average velocity of an object can be greater than the object's average speed? Support your answer.
Answer: The average velocity can never be greater than the average speed. The two averages will be equal for motion along a single straight path; otherwise the average speed is always greater.
Var: 1

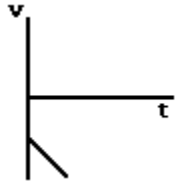
4) It is possible to have a negative average velocity, depending on the choice of coordinate system. Is it possible for an object to have a negative average speed?
Answer: No. An object's average speed must always be greater than or equal to zero, regardless of coordinate system.
Var: 1

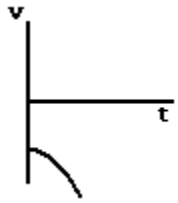
5) A skier begins skiing straight down a hill having a constant slope, starting from rest. If friction is negligible, as the skier goes down the hill, his/her
A) acceleration is constant, with a value less than 10 m/s/s.
B) acceleration is constant, with a value of roughly 10 m/s/s.
C) acceleration increases with time.
D) acceleration is zero.
Answer: A
Var: 1

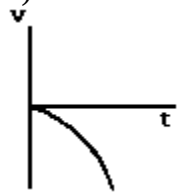
6) A person in a car is driving down a straight road. The instantaneous acceleration is decreasing with time, but is directed in the direction of the car's motion. The speed of the car is
A) increasing with time.
B) decreasing with time.
C) constant.
Answer: A
Var: 1

7) A child standing on a bridge throws a rock straight down. The rock leaves the child's hand at t = 0. Which of the graphs shown here best represents the velocity of the stone as a function of time?
A)


B)


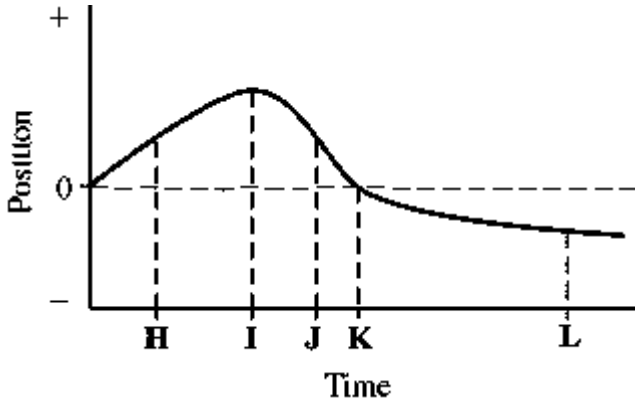
C)


D)


E)


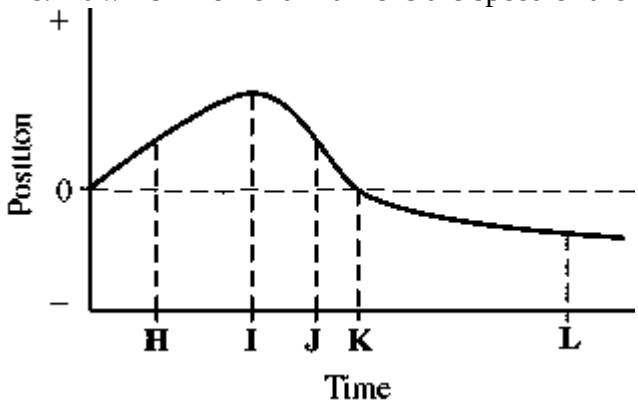
Answer: C
Var: 1

8) The plot below shows the position of an object as a function of time. The letters H-L represent particular moments of time. At which moment in time is the speed of the object the highest?



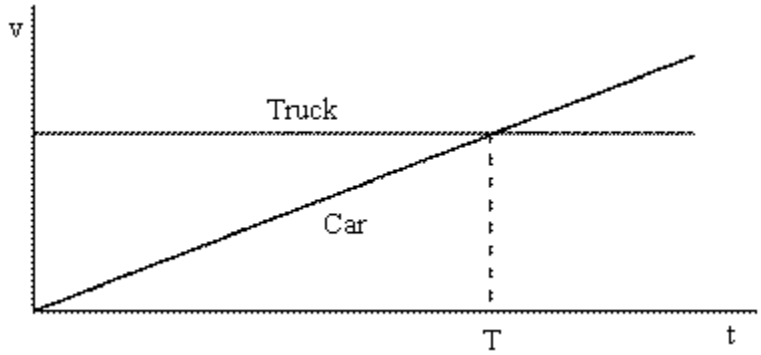
A) J
B) H
C) I
D) K
E) L
Answer: A
Var: 1

9) The plot below shows the position of an object as a function of time. The letters H-L represent particular moments of time. At which moment in time is the speed of the object equal to zero?



A) I
B) H
C) J
D) K
E) L
Answer: A
Var: 1

10) The motions of a car and a truck along a straight road are represented by the velocity-time graphs below. The two vehicles are initially alongside each other at time t = 0.



At time T, what is true of the distances traveled by the vehicles since time t = 0?
A) They will have traveled the same distance.
B) The truck will not have moved.
C) The car will have traveled farther than the truck.
D) The truck will have traveled farther than the car.
Answer: D
Var: 1

11) Two identical objects A and B fall from rest from different heights to the ground. If object B takes *twice* as long as A to reach the ground, what is the ratio of the heights from which A and B fell? Neglect air resistance.
A) 1 : $\sqrt{2}$
B) 1 : 2
C) 1 : 4
D) 1 : 8
Answer: C
Var: 1

12) A ball is thrown vertically upward and then comes back down. During the ball's flight up and down, its **velocity** and **acceleration** vectors are
A) always in opposite directions.
B) always in the same direction.
C) first in opposite directions and then in the same direction.
D) first in the same direction and then in opposite directions.
Answer: C
Var: 1

13) A racing car accelerates uniformly from rest along a straight track. This track has markers spaced at equal distances along it from the start, as shown below. The car reaches a speed of 140 km/h as it passes marker 2.

Whereabouts on the track was the car when it was travelling at half this speed, i.e. at 70 km/h?
A) before marker 1
B) at marker 1
C) between marker 1 and marker 2
Answer: A
Var: 1

14) A stone is thrown vertically upwards, reaches a highest point, and returns to the ground. When the stone is at the **top** of its path, its acceleration
A) is zero.
B) is directed upwards.
C) is directed downwards.
D) changes direction from upwards to downwards.
Answer: C
Var: 1

15) Two identical stones are dropped from a tall building, *one after the other*. Assume air resistance is negligible. While both stones are falling, what will happen to the vertical distance between them?
A) It will increase.
B) It will decrease.
C) It will remain the same.
D) It will first increase and then remain constant.
Answer: A
Var: 1

16) An object is dropped from rest into a pit, and accelerates due to gravity at roughly 10 m/s^2. It hits the ground in 5 seconds. A rock is then dropped from rest into a second pit, and hits the ground in 10 seconds. How much deeper is the second pit, compared to the first pit? Neglect air resistance.
A) four times deeper
B) two times deeper
C) three times deeper
D) five times deeper
Answer: A
Var: 1

17) Which of the following situations is impossible?
A) An object has velocity directed east and acceleration directed west.
B) An object has velocity directed east and acceleration directed east.
C) An object has zero velocity but non-zero acceleration.
D) An object has constant non-zero acceleration and changing velocity.
E) An object has constant non-zero velocity and changing acceleration.
Answer: E
Var: 1