***College Physics* 7e (Wilson/Buffa/Lou/Gatch)**
Chapter 2 Kinematics: Description of Motion

2.1 Conceptual Exercises

1) Give examples of four quantities which are scalars.
Answer: distance, speed, time, mass
Diff: 1 Var: 1 Page Ref: Sec. 2.1-2.3

2) Give examples of four quantities which are vectors.
Answer: displacement, velocity, acceleration, force
Diff: 1 Var: 1 Page Ref: Sec. 2.1-2.3

3) Explain the relationship between velocity and acceleration.
Answer: Acceleration is the time rate of change of velocity.
Diff: 1 Var: 1 Page Ref: Sec. 2.1-2.3

4) Discuss the differences between distance and displacement.
Answer: Distance is the total path length traversed in moving from one location to another. Displacement is the straight-line distance between two points, along with the direction from the starting point to the final point.
Diff: 2 Var: 1 Page Ref: Sec. 2.1-2.3

5) Discuss whether a car speedometer measures instantaneous speed or an average speed.
Answer: One desires it to display instantaneous speed, but it actually records an average speed. It is designed so that the average is over a very short time so that it closely approximates the instantaneous speed.
Diff: 3 Var: 1 Page Ref: Sec. 2.1-2.3

6) Explain how a POSITIVE acceleration could produce a DECELERATION.
Answer: An object which was moving in the negative direction would slow down if its acceleration were positive (a negative acceleration would mean the velocity was getting more negative: it would be speeding up in the negative direction).
Diff: 3 Var: 1 Page Ref: Sec. 2.1-2.3

7) In the formula $v^2 = v_o^2 + 2\,a\,x$, what does x represent?
Answer: The CHANGE in POSITION, which is NOT necessarily the distance gone.
Diff: 2 Var: 1 Page Ref: Sec. 2.4

8) Contrast Aristotle's predictions concerning free-falling bodies with Galileo's predictions.
Answer: Aristotle said heavier bodies fall faster than light bodies; so if the two were dropped at the same time, the heavier body would strike the ground sooner. Galileo observed that the motion was independent of the body's mass provided air friction was not significant.
Diff: 2 Var: 1 Page Ref: Sec. 2.5

9) Consider a heavy object which is thrown straight up, reaches its highest point, and then falls back down to the ground. During what parts of the trajectory was it in "FREE FALL"? (assume here that air friction is negligible)
Answer: During its entire travel during which gravity was the only significant influence on it (it "freely fell" moving up, moving down, and at its motionless highest point).
Diff: 2 Var: 1 Page Ref: Sec. 2.5

10) "Big Mike" throws a baseball straight up and it eventually falls back to him. When the ball was at its highest point, what was its velocity and what was its acceleration? (remember to include magnitude and direction)
Answer: Velocity was zero, acceleration was 9.8 m/s^2 downward.
Diff: 2 Var: 1 Page Ref: Sec. 2.5

11) A scalar quantity is described by both a magnitude and a direction.
Answer: FALSE
Diff: 1 Var: 1 Page Ref: Sec. 2.1-2.2

12) A vector quantity is described by both a magnitude and a direction.
Answer: TRUE
Diff: 1 Var: 1 Page Ref: Sec. 2.1-2.2

13) Is it possible for the magnitude of displacement to be greater than the distance traveled.
Answer: FALSE
Diff: 1 Var: 1 Page Ref: Sec. 2.1-2.2

14) Speed indicates how fast something is moving and in which direction it is moving.
Answer: FALSE
Diff: 1 Var: 1 Page Ref: Sec. 2.1-2.2

15) It is possible to have constant speed, but still be accelerating.
Answer: TRUE
Diff: 2 Var: 1 Page Ref: Sec. 2.3

16) It is possible to have a zero acceleration, and still be moving.
Answer: TRUE
Diff: 2 Var: 1 Page Ref: Sec. 2.3

17) A negative velocity, approaching zero, represents a negative acceleration.
Answer: FALSE
Diff: 2 Var: 1 Page Ref: Sec. 2.3

18) The "acceleration of gravity" is 9.8 m/s^2 everywhere on the surface of the Earth.
Answer: FALSE
Diff: 1 Var: 1 Page Ref: Sec. 2.5

19) Free fall is the motion of an object subject only to the influence of gravity.
Answer: TRUE

Diff: 1 Var: 1 Page Ref: Sec. 2.5

20) An object thrown downward does not experience free fall.
Answer: FALSE
Diff: 1 Var: 1 Page Ref: Sec. 2.5

21) The acceleration due to gravity has the same value for all free-falling objects, regardless of their mass or weight.
Answer: TRUE
Diff: 1 Var: 1 Page Ref: Sec. 2.5

22) An object thrown upward experiences free fall.
Answer: TRUE
Diff: 1 Var: 1 Page Ref: Sec. 2.5

23) All of the following are scalars, except
A) mass.
B) force.
C) temperature.
D) distance.
E) time.
Answer: B
Diff: 1 Var: 1 Page Ref: Sec. 2.1-2.3

24) All of the following are vectors, except
A) mass.
B) acceleration.
C) displacement.
D) velocity.
E) force.
Answer: A
Diff: 1 Var: 1 Page Ref: Sec. 2.1-2.3

25) Speed is to velocity as distance is to
A) magnitude.
B) acceleration.
C) displacement.
D) direction.
E) temperature.
Answer: C
Diff: 1 Var: 1 Page Ref: Sec. 2.1-2.3

26) The slope of a line connecting two points on a position versus time graph gives
A) instantaneous velocity.
B) average velocity.
C) instantaneous acceleration.
D) average acceleration
E) none of the given answers.
Answer: B
Diff: 1 Var: 1 Page Ref: Sec. 2.1-2.3

27) The slope of a tangent line at a given time value on a position versus time graph gives
A) instantaneous velocity.
B) average velocity.
C) instantaneous acceleration.
D) average acceleration
E) none of the given answers.
Answer: A
Diff: 1 Var: 1 Page Ref: Sec. 2.1-2.3

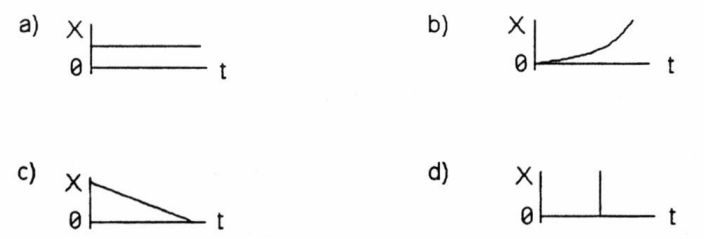
28) The slope of a line connecting two points on a velocity versus time graph gives
A) instantaneous velocity.
B) average velocity.
C) instantaneous acceleration.
D) average acceleration
E) none of the given answers.
Answer: D
Diff: 1 Var: 1 Page Ref: Sec. 2.1-2.3

29) The slope of a tangent line at a given time value on a velocity versus time graph gives
A) instantaneous velocity.
B) average velocity.
C) instantaneous acceleration.
D) average acceleration
E) none of the given answers.
Answer: C
Diff: 1 Var: 1 Page Ref: Sec. 2.1-2.3

30) A new car manufacturer advertises that their car can go "from zero to sixty in 8 s." This is a description of
A) instantaneous speed.
B) average speed.
C) instantaneous acceleration.
D) average acceleration.
E) none of the given answers.
Answer: D
Diff: 1 Var: 1 Page Ref: Sec. 2.1-2.3

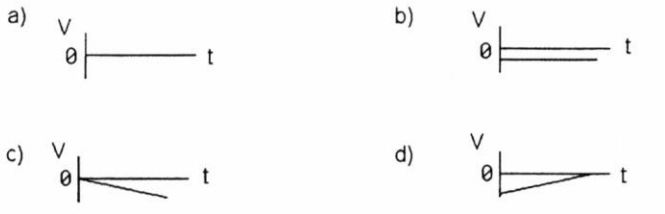
31) Suppose that an object travels from one point in space to another. Make a comparison between the displacement and the distance traveled.
A) The displacement is either greater than or equal to the distance traveled.
B) The displacement is always equal to the distance traveled.
C) The displacement is either less than or equal to the distance traveled.
D) The displacement can be either greater than, smaller than, or equal to the distance traveled.
Answer: C
Diff: 2 Var: 1 Page Ref: Sec. 2.1-2.3

FIGURE 2-1



32) Which graph in Fig. 2-1 represents an object at rest?
A) graph a
B) graph b
C) graph c
D) graph d
E) both graphs a and d
Answer: A
Diff: 2 Var: 1 Page Ref: Sec. 2.1-2.3

FIGURE 2-2



33) Which graph in Fig. 2-2 represents a constant non-zero velocity?
A) graph a
B) graph b
C) graph c
D) graph d
E) both graphs c and d
Answer: B
Diff: 2 Var: 1 Page Ref: Sec. 2.1-2.3

34) Which graph(s) in Fig. 2-2 represent(s) zero acceleration?
A) only a
B) only b
C) a and b
D) b and c
E) c and d
Answer: C
Diff: 2 Var: 1 Page Ref: Sec. 2.1-2.3

35) Which graph(s) in Fig. 2-2 represent(s) constant positive acceleration?
A) graph a
B) graph b
C) graph c
D) graph d
E) both graphs c and d
Answer: D
Diff: 2 Var: 1 Page Ref: Sec. 2.1-2.3

36) When is the average velocity of an object equal to the instantaneous velocity?
A) always
B) never
C) only when the velocity is constant
D) only when the velocity is increasing at a constant rate
E) only when the velocity is decreasing at a constant rate
Answer: C
Diff: 2 Var: 1 Page Ref: Sec. 2.1-2.3

37) If an object is accelerating, it must therefore undergo
A) a change in velocity.
B) a change in direction.
C) a change in speed.
Answer: A
Diff: 2 Var: 1 Page Ref: Sec. 2.1-2.3

38) For constant linear acceleration, the position versus time graph is a
A) horizontal line.
B) vertical line.
C) sloped line.
D) curve.
E) none of the given answers.
Answer: D
Diff: 2 Var: 1 Page Ref: Sec. 2.1-2.3

39) For constant linear acceleration, the velocity versus time graph is a
A) horizontal line.
B) vertical line.
C) sloped line.
D) curve.
E) none of the given answers.
Answer: C
Diff: 2 Var: 1 Page Ref: Sec. 2.1-2.3

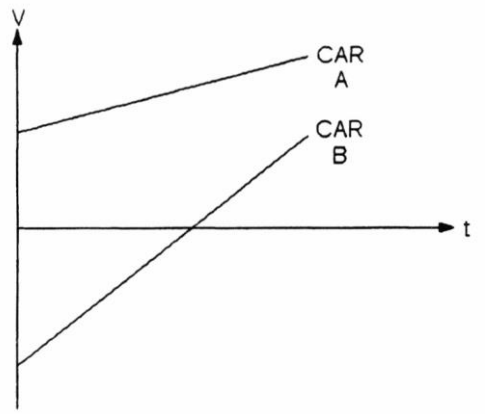
40) Under what condition is average velocity equal to the average of the object's initial and final velocity?
A) This can only occur if there is no acceleration.
B) The acceleration must be constant.
C) The acceleration must be constantly increasing.
D) The acceleration must be constantly decreasing.
E) This can occur only when they are zero.
Answer: B
Diff: 2 Var: 1 Page Ref: Sec. 2.1-2.3

41) Suppose that an object is moving with constant acceleration. Which of the following is an accurate statement concerning its motion?
A) In equal times its speed increases by equal amounts.
B) In equal times its velocity changes by equal amounts.
C) In equal times it moves equal distances.
Answer: B
Diff: 2 Var: 1 Page Ref: Sec. 2.1-2.3

42) Can an object's velocity change direction when its acceleration is constant?
A) Yes, this is possible, and a rock thrown straight up is an example.
B) No, this is not possible because it is always speeding up.
C) No, this is not possible because it is always slowing up.
D) Yes, this is possible, and a car that starts from rest, speeds up, slows to a stop, and then backs up is an example.
E) No, this is not possible because it is always speeding up or always slowing down, but it can never turn around.
Answer: A
Diff: 2 Var: 1 Page Ref: Sec. 2.1-2.3

43) Which of the following can never be negative?
A) acceleration of gravity
B) displacement
C) instantaneous speed
D) average velocity
E) instantaneous velocity
Answer: C
Diff: 2 Var: 1 Page Ref: Sec. 2.1-2.3

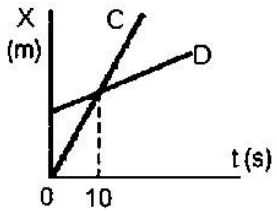
FIGURE 2-3



44) The graph in Fig. 2-3 plots the velocity of two cars (A and B) along the same straight road. During the time interval shown, which car is AHEAD?
A) Car A
B) Car B
C) insufficient information
Answer: C
Diff: 2 Var: 1 Page Ref: Sec. 2.4

45) The graph in Fig. 2-3 plots the velocity of two cars (A and B) along the same straight road. Which car reverses direction?
A) Car A
B) Car B
C) insufficient information
D) both cars A & B
E) neither car A nor B
Answer: B
Diff: 2 Var: 1 Page Ref: Sec. 2.4

FIGURE 2-4



46) During the first 8 s in Fig. 2-4,
A) the magnitude of the acceleration of D is greater than the magnitude of the acceleration of C.
B) the magnitude of the acceleration of C is greater than the magnitude of the acceleration of D.
C) their accelerations are equal in magnitude, but opposite in sign.
D) their accelerations are equal in magnitude, and equal in sign.
E) D is speeding up while C is slowing down
Answer: C
Diff: 2 Var: 1 Page Ref: Sec. 2.4

47) A car is able to stop in a distance d. Assuming the same braking force, what distance does this car require to stop when it is traveling twice as fast?
A) d
B) 2 d
C) $\sqrt{2}$ d
D) 4 d
E) $2\sqrt{2}$ d
Answer: D
Diff: 2 Var: 1 Page Ref: Sec. 2.4

48) A can, after having been given a kick, moves up along a smooth hill of ice. It will
A) have a varying acceleration along the hill.
B) have the same acceleration, both up the hill and down the hill.
C) have a constant acceleration up the hill, but a larger constant acceleration when it comes back down the hill.
D) have a constant acceleration up the hill, but a smaller constant acceleration when it comes back down the hill.
E) travel at constant velocity.
Answer: B
Diff: 2 Var: 1 Page Ref: Sec. 2.4

49) Which physical unit is the SI acceleration of gravity?
A) 40 km, SW
B) 32 ft/s^2
C) 9.8 m/s^2
D) 186,000 mi
E) -120 mi/s
Answer: C
Diff: 1 Var: 1 Page Ref: Sec. 2.5

50) Which physical unit represents acceleration in the British system?
A) -120 mi/s
B) 40 km, SW
C) 9.8 m/s^2
D) 186,000 mi
E) 32 ft/s^2
Answer: E
Diff: 1 Var: 1 Page Ref: Sec. 2.5

51) When an object is released from rest and falls in the absence of friction, which of the following is true concerning its motion?
A) Its velocity is constant.
B) Both its acceleration and its velocity are constant.
C) Neither its acceleration nor its velocity is constant.
D) Its acceleration is constant.
Answer: D

Diff: 1 Var: 1 Page Ref: Sec. 2.5

52) When a ball is thrown straight up, which of the following is zero at its highest point?
A) acceleration
B) displacement
C) velocity
Answer: C
Diff: 2 Var: 1 Page Ref: Sec. 2.5

53) When a ball is thrown straight up, the acceleration at its highest point is
A) upward.
B) downward.
C) zero.
D) horizontal.
E) minimum.
Answer: B
Diff: 2 Var: 1 Page Ref: Sec. 2.5

54) A ball is thrown straight up and returns to its starting point under an acceleration due to gravity. Which of the following is true?
A) It took less time to rise than to fall.
B) To compare rise and fall times we need to know the mass of the ball.
C) It took the same time to rise as it took to fall.
D) It took longer to rise than to fall.
Answer: C
Diff: 2 Var: 1 Page Ref: Sec. 2.5

2.2 Quantitative Exercises

1) A race car circles 10 times around an 8-km track in 20 min. What is its average speed per lap?
Answer: Average lap speed is 70 m/s.
Diff: 2 Var: 1 Page Ref: Sec. 2.1

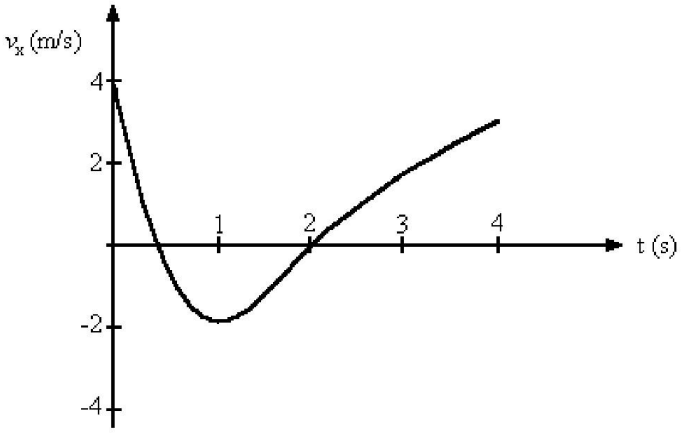
2) Denis swims the length of a 40. meter pool in 10. seconds and immediately swims back to the starting position in another 15. seconds. What was his average speed?
Answer: Avg speed 3.2 m/s.
Diff: 2 Var: 1 Page Ref: Sec. 2.1

3) Jane swims the length of a 40. meter pool in 10. seconds and immediately swims back to the starting position in another 15. seconds. What was her average velocity?
Answer: Zero
Diff: 2 Var: 1 Page Ref: Sec. 2.2

4) A race car circles 10 times around an 8-km track in 20 min. What is its average velocity per lap?
Answer: Average lap velocity is 0.
Diff: 2 Var: 1 Page Ref: Sec. 2.2

5) Jane walks 31 steps eastward and 16 steps southward. What is her displacement if each step averages 0.82 meters?
Answer: 29. m at 27. degrees S of E
Diff: 3 Var: 5 Page Ref: Sec. 2.2
Skill: Algorithmic

FIGURE 2-5



6) Fig. 2-5 represents the velocity of a particle as it travels along the *x*-axis. In what direction is the acceleration at t = 0.5 s?
Answer: in the negative *x* direction
Diff: 1 Var: 1 Page Ref: Sec. 2.3

7) Fig. 2-5 represents the velocity of a particle as it travels along the *x*-axis. In what direction is the acceleration at t = 3.0 s?
Answer: in the positive *x* direction
Diff: 1 Var: 1 Page Ref: Sec. 2.3

8) Fig. 2-5 represents the velocity of a particle as it travels along the *x*-axis. What is the average acceleration of the particle between t = 2 s and t = 4 s?
Answer: 1.5 m/s^2
Diff: 1 Var: 1 Page Ref: Sec. 2.3

9) Fig. 2-5 represents the velocity of a particle as it travels along the *x*-axis. At what value of t is the instantaneous acceleration equal to zero m/s^2?
Answer: At t = 1 s
Diff: 1 Var: 1 Page Ref: Sec. 2.3

10) Eric watches a jet powered truck during an "air-show." It accelerates from rest to 300. mph in 8.0 seconds. The acceleration was equivalent to how many "g's"?
Answer: 1.7 g's
Diff: 2 Var: 1 Page Ref: Sec. 2.3

11) A car traveling 60 km/h accelerates at the rate of 4.0 m/s^2. How much time is required for the car to reach a speed of 90 km/h?
Answer: 2.1 s
Diff: 2 Var: 1 Page Ref: Sec. 2.3

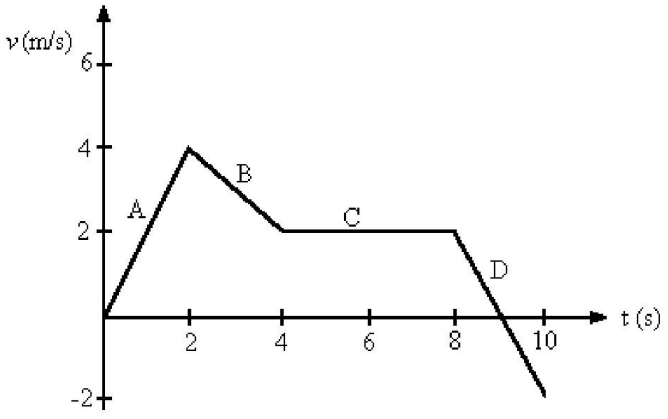
12) Captain Rickard orders his starship to accelerate from rest at a rate of "1g" (accel = 9.8 m/s^2). How long does it take the starship to reach one-tenth the speed of light if light travels 300. megameters/s?
Answer: 35. days
Diff: 2 Var: 1 Page Ref: Sec. 2.3

13) A bat, flying due east at 2 m/s, emits a shriek that is reflected back to it from an oncoming insect flying directly toward the bat at 4 m/s. The insect is 20 m from the bat at the instant the shriek is emitted. Sound travels 340 m/s in air. After what elapsed time does the bat hear the reflected echo?
Answer: 57 milliseconds
Diff: 2 Var: 1 Page Ref: Sec. 2.4

14) A bullet moving at 244. m/s strikes a tree and penetrates a distance of 8.34 mm before stopping. What was the average acceleration of the bullet as it slowed?
Answer: -3.57×10^6 m/s
Diff: 2 Var: 1 Page Ref: Sec. 2.4

15) A bullet moving at 244. m/s strikes a tree and penetrates a distance of 8.34 mm before stopping. Assuming a constant acceleration, how long did it take the bullet to stop?
Answer: 68.4 microseconds
Diff: 2 Var: 1 Page Ref: Sec. 2.4

FIGURE 2-6



16) Fig. 2-6 shows the velocity-versus-time graph for a basketball player traveling up and down the court in a straight-line path. Find the displacement of the player for each of the segments A, B, C and D.
Answer: A, 4 m; B, 6 m; C, 8 m; D, 0 m
Diff: 2 Var: 1 Page Ref: Sec. 2.4

17) A car was moving 110. km/hour.
(a) How long did it take to go 25.5 miles?
(b) If it stopped in 35. s, what was its average acceleration (m/s^2) as it slowed down?
Answer:
(a) 22.4 min
(b) $-0.87\ m/s^2$
Diff: 3 Var: 7 Page Ref: Sec. 2.4
Skill: Algorithmic

18) Consider a mass initially moving at 7.50 m/s.
(a) How long does it take to move 3.5 km if it accelerates at $0.550\ m/s^2$?
(b) How fast is it moving after this acceleration?
Answer:
(a) 100. seconds
(b) 62.5 m/s
Diff: 3 Var: 6 Page Ref: Sec. 2.4
Skill: Algorithmic

19) An auto accelerates from 7.0 m/s at $0.71\ m/s^2$. It travels a distance of 1.033 km while accelerating.
(a) What is the final speed at the end of that displacement?
(b) How many seconds did it take to accelerate from 7.0 m/s?
Answer:
(a) 39. m/s
(b) 45. s
Diff: 3 Var: 5 Page Ref: Sec. 2.4
Skill: Algorithmic

20) A bullet moving horizontally with a speed of 500 m/s strikes a sandbag and penetrates a distance of 10 cm.
(a) What is the average acceleration of the bullet?
(b) How long does it take to come to rest?
Answer:
(a) $-1.25 \times 10^6\ m/s^2$
(b) 0.4 ms
Diff: 3 Var: 1 Page Ref: Sec. 2.4

21) A car with good tires on a dry road can decelerate at about $5\ m/s^2$ when braking. If the car is traveling at 89. km/h:
(a) how long does it take the car to stop under these conditions?
(b) how far does the car travel during this time?
Answer:
(a) 4.9 s
(b) 61.0 m
Diff: 3 Var: 1 Page Ref: Sec. 2.4

22) Suppose that a Ferrari and a Porsche begin a race with a moving start, and each moves with constant speed. One lap of the track is 2 km. The Ferrari laps the Porsche after the Porsche has completed 9 laps. If the speed of the Ferrari had been 10 km/h less, the Porsche would have traveled 18 laps before being overtaken. What were the speeds of the two cars?
Answer: Porsche speed = 180 km/h; Ferrari speed = 200 km/h
Diff: 3 Var: 1 Page Ref: Sec. 2.4

23) In a 400-m relay race the anchorman (the person who runs the last 100 m) for the Trojans can run 100 m in 9.8 s. His rival, the anchorman for the Bruins, can cover 100 m in 10.1 s. What is the largest lead the Bruin runner can have when the Trojan runner starts the final leg of the race, in order for the Trojan runner not to lose the race?
Answer: 3. m
Diff: 3 Var: 1 Page Ref: Sec. 2.4

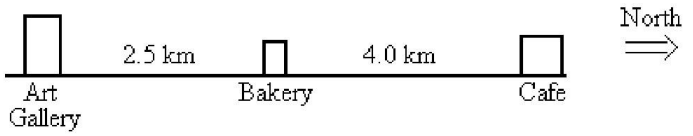
24) An astronaut on a strange new planet finds that she can jump up to a maximum height of 27. meters when her initial upward speed is 6.0 m/s. What is the magnitude of the acceleration of gravity on the planet?
Answer: 0.67 m/s^2
Diff: 2 Var: 1 Page Ref: Sec. 2.5

25) A ball is thrown straight up with a speed of 30 m/s.
(a.) How long does it take the ball to reach the maximum height?
(b.) What is the maximum height reached by the ball?
(c.) What is its speed after 4.2 s?
Answer:
(a.) 3.1 s
(b.) 46 m
(c.) 11 m/s
Diff: 2 Var: 1 Page Ref: Sec. 2.5

26) A foul ball is hit straight up into the air with a speed of 30.0 m/s.
(a.) Calculate the time required for the ball to rise to its maximum height.
(b.) Calculate the maximum height reached by the ball.
(c.) Determine the time at which the ball pass a point 25.0 m above the point of contact between the bat and ball.
(d.) Explain why there are two answers to part c.
Answer:
(a.) 3.06 s
(b.) 45.9 m
(c.) 0.995 s and 5.13 s
(d.) One value for the ball traveling upward; one value for the ball traveling downward.
Diff: 3 Var: 1 Page Ref: Sec. 2.5

27) An object is thrown vertically and accelerates downward at +9.80 m/s2 (downward is positive and upward is negative).
(a) What is its displacement after 5.00 s if it starts at 2.50 m/s?
(b) How fast is it moving after that 5.00 s?
Answer:
(a) 135. meters
(b) 46.5 m/s
Diff: 3 Var: 5 Page Ref: Sec. 2.5
Skill: Algorithmic

FIGURE 2-7



28) Refer to Fig. 2-7. If you start from the Bakery, travel to the Cafe, and then to the Art Gallery, what is the distance you have traveled?

A) 6.5 km
B) 2.5 km
C) 4.0 km
D) 10.5 km
E) 0 km
Answer: D
Diff: 1 Var: 1 Page Ref: Sec. 2.1

29) Refer to Fig. 2-7. If you start from the Bakery, travel to the Art Gallery, and then to the Cafe, in 1.0 hour, what is your average speed?
A) 6.5 km/hr
B) 2.5 km/hr
C) 4.0 km/hr
D) 9.0 km/hr
E) 10.5 km/hr
Answer: D
Diff: 1 Var: 1 Page Ref: Sec. 2.1

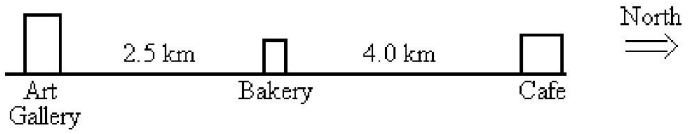
30) If you run a complete loop around an outdoor track (400 m) in 100 s, your average speed is
A) 40000. m/s.
B) 4.0 m/s.
C) 4.0 km/h.
D) 4.0 mph.
E) 0.40 m/s.
Answer: B
Diff: 2 Var: 1 Page Ref: Sec. 2.1

31) A motorist travels for 3.0 h at 80 km/h and 4.0 h at 60 km/h. What is her average speed for the trip?
A) 74 km/h
B) 140 km/h
C) 70 km/h
D) 73 km/h
E) 69 km/h
Answer: E
Diff: 2 Var: 1 Page Ref: Sec. 2.1

32) A motorist travels 160 km at 80 km/h and 160 km at 100 km/h. What is the average speed of the motorist for this trip?

A) 90 km/h
B) 89 km/h
C) 60 km/h
D) 91 km/h
E) 84 km/h
Answer: B
Diff: 2 Var: 1 Page Ref: Sec. 2.1

FIGURE 2-7

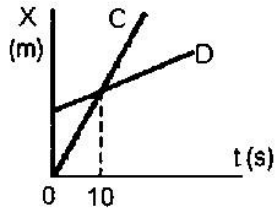


33) Refer to Fig. 2-7. If you start from the Bakery, travel to the Cafe, and then to the Art Gallery, what is your displacement?
A) 4.0 km South
B) 6.5 km South
C) 2.5 km South
D) 10.5 km North
E) 9.0 km North
Answer: C
Diff: 2 Var: 1 Page Ref: Sec. 2.2

34) Barbara travels 20. km Northward, then travels 40. km Eastward, then continues for 50. km in a Southward direction. What displacement will now take her back to her initial position?
A) 30. km Westward + 40. km Northward
B) 50. km Northwest
C) 40. km Westward + 30. km Northward
D) 30. km Northward + 30. km Westward
E) 40. km Eastward + 30. km Southward
Answer: C
Diff: 2 Var: 1 Page Ref: Sec. 2.2

35) If you run a complete loop around an outdoor track (400 m) in 100 s, your average velocity is
A) 0.25 m/s.
B) 4.0 m/s.
C) 40,000 m/s.
D) zero.
E) 4.00 km/s.
Answer: D
Diff: 2 Var: 1 Page Ref: Sec. 2.2

FIGURE 2-4



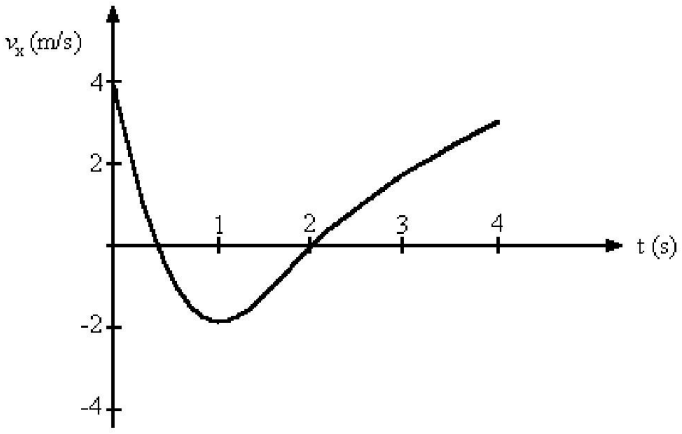
36) (Refer to Fig. 2-4.) At t = 0 s
A) rider D is ahead of rider C.
B) rider C is ahead of rider D.
C) riders C and D are at the same position.
D) rider D is moving faster than rider C.
E) rider D is moving slower than rider C.
Answer: A
Diff: 2 Var: 1 Page Ref: Sec. 2.2

37) (Refer to Fig. 2-4.) At t = 1 s
A) C is moving, and D is at rest.
B) D is moving, and C is at rest.
C) C and D are both moving.
D) C and D are both at rest.
E) C is ahead of D
Answer: C
Diff: 2 Var: 1 Page Ref: Sec. 2.2

38) (Refer to Fig. 2-4.) At t = 1 s
A) C has a greater velocity than D.
B) D has a greater velocity than C.
C) C and D have the same velocity.
D) C is accelerating.
E) D is accelerating.
Answer: A
Diff: 2 Var: 1 Page Ref: Sec. 2.2

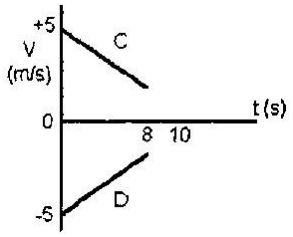
39) (Refer to Fig. 2-4.) At t = 10 s
A) C and D are at the same position.
B) C and D have the same velocity.
C) the velocity of D is greater than the velocity of C.
D) D is in front of C.
E) C is in front of D.
Answer: A
Diff: 2 Var: 1 Page Ref: Sec. 2.2

FIGURE 2-5



40) Fig. 2-5 represents the velocity of a particle as it travels along the *x*-axis. What is the average acceleration of the particle between t = 1 second and t = 4 seconds?
A) 0.33 m/s^2
B) 1.7 m/s^2
C) 2.0 m/s^2
D) 2.5 m/s^2
E) 3.5 m/s^2
Answer: B
Diff: 1 Var: 1 Page Ref: Sec. 2.3

FIGURE 2-8



41) (Refer to Fig. 2-8.) Based on all the graphical information
A) C and D meet at the same position at t = 8 s.
B) C and D will meet at the same position at t = 10 s.
C) C and D will never meet at the same position.
D) not enough information is given to decide if C and D meet.
E) the acceleration of D is negative.
Answer: D
Diff: 2 Var: 1 Page Ref: Sec. 2.3

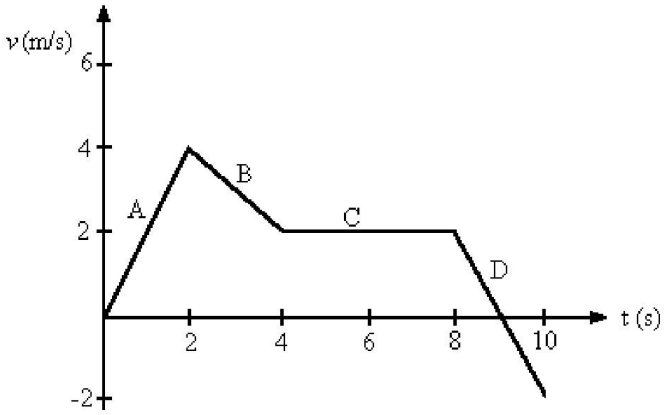
42) (Refer to Fig. 2-8.) During the first 8 s
A) C and D are both slowing down.
B) C and D have constant velocities.
C) C has the same average velocity as D.
D) C is slowing down, and D is speeding up.
E) the acceleration of D is negative.
Answer: A
Diff: 2 Var: 1 Page Ref: Sec. 2.3

43) An airplane increases its speed from 100 m/s to 160 m/s, at the average rate of 15 m/s^2. How much time does it take for the complete increase in speed?
A) 0.25 s
B) 4.0 s
C) 0.0577 s
D) 17.3 s
E) 8.0 s
Answer: B
Diff: 2 Var: 1 Page Ref: Sec. 2.3

44) A jet fighter plane is launched from a catapult on an aircraft carrier. It reaches a speed of 42 m/s at the end of the catapult, and this requires 2 s. Assuming the acceleration is constant, what is the length of the catapult?
A) 16 m
B) 42 m
C) 24 m
D) 66 m
E) 84 m
Answer: B
Diff: 2 Var: 1 Page Ref: Sec. 2.4

45) A car starting from rest moves with constant acceleration of 2 m/s^2 for 10 s, then travels with constant speed for another 10 s, and then finally slows to a stop with constant acceleration of -2 m/s^2. How far does it travel?
A) 400 m
B) 100 m
C) 500 m
D) 300 m
E) 200 m
Answer: A
Diff: 2 Var: 1 Page Ref: Sec. 2.4

FIGURE 2-6



46) Fig. 2-6 shows the velocity-versus-time graph for a basketball player traveling up and down the court in a straight-line path. Find the net displacement of the player for the 10 s shown on the graph.
A) 20 m
B) 18 m
C) 16 m
D) 14 m
E) 12 m
Answer: B
Diff: 2 Var: 1 Page Ref: Sec. 2.4

47) Fig. 2-6 shows the velocity-versus-time graph for a basketball player traveling up and down the court in a straight-line path. Find the total distance run by the player in the 10 s shown in the graph.
A) 20 m
B) 18 m
C) 16 m
D) 14 m
E) 12 m
Answer: A
Diff: 2 Var: 1 Page Ref: Sec. 2.4

48) A car starts from rest and accelerates uniformly at 3 m/s^2. A second car starts from rest 6 s later at the same point and accelerates uniformly at 5 m/s^2. How long does it take the second car to overtake the first car?
A) 24.0 s
B) 12.2 s
C) 35.0 s
D) 18.9 s
E) 22.7 s
Answer: E
Diff: 3 Var: 1 Page Ref: Sec. 2.4

49) A car decelerates uniformly and comes to a stop after 10 s. The car's average velocity during deceleration was 50 km/h. What was the car's deceleration while slowing down?
A) 10 km/h-s
B) 5 km/h-s
C) 9.8 m/s^2
D) 8 km/h-s
E) 4 km/h-s
Answer: A
Diff: 3 Var: 1 Page Ref: Sec. 2.4

50) An object is thrown upwards with a speed of 14 m/s. How high above the projection point does it reach?
A) 5.0 m
B) 10 m
C) 15 m
D) 20 m
E) 25 m
Answer: B
Diff: 1 Var: 1 Page Ref: Sec. 2.5

51) An object is thrown upwards with a speed of 14 .0 m/s. How long does it take it to reach its maximum height?
A) 1.22 s
B) 1.43 s
C) 2.86 s
D) 3.14 s
E) 4.15 s
Answer: B
Diff: 1 Var: 1 Page Ref: Sec. 2.5

52) An object is thrown upwards with a speed of 14 m/s. How high above the projection point is it after 0.50 s?
A) 0 m
B) 5.8 m
C) 7.0 m
D) 8.2 m
E) 10 m
Answer: B
Diff: 1 Var: 1 Page Ref: Sec. 2.5

53) A ball is released moving straight up at 15. m/s. At some time later it is falling downward at 15. m/s. What was the magnitude of its average velocity over this time period?
A) 0. m/s
B) 30. m/s
C) 15. m/s
D) 7.5 m/s
E) 22. m/s
Answer: A
Diff: 2 Var: 1 Page Ref: Sec. 2.5

54) For this problem, assume that the acceleration of gravity is 10 m/s^2 downward, and that all friction effects can be neglected. A ball is thrown upward at a velocity of 20 m/s. What is its velocity after 3 s?
A) zero
B) 10 m/s upward
C) 10 m/s downward
D) 20 m/s downward
E) 20 m/s upward
Answer: C
Diff: 2 Var: 1 Page Ref: Sec. 2.5

55) A bullet shot straight up returns to its starting point in 10 s. Its initial speed was
A) 98 m/s.
B) 49 m/s.
C) 9.8 m/s.
D) 24.5 m/s.
E) 32. ft/s.
Answer: B
Diff: 2 Var: 1 Page Ref: Sec. 2.5

56) An object is thrown upwards with a speed of 13 m/s. How long does it take to reach a height of 4.0 m above the projection point while descending?
A) 0.42 s
B) 1.2 s
C) 2.3 s
D) 3.1 s
E) 4.2 s
Answer: C
Diff: 3 Var: 5 Page Ref: Sec. 2-5
Skill: Algorithmic

57) To determine the height of a flagpole, Abby throws a ball straight up and times it. She sees that the ball goes by the top of the pole after 0.5 s and then reaches the top of the pole again after a total elapsed time of 4.1 s. How high is the pole above the point where the ball was launched?
A) 10 m
B) 13 m
C) 16 m
D) 18 m
E) 26 m
Answer: A
Diff: 3 Var: 1 Page Ref: Sec. 2-5

58) Abby throws a ball straight up and times it. She sees that the ball goes by the top of a flagpole after 0.50 s and reaches the level of the top of the pole after a total elapsed time of 4.10 s. What was the speed of the ball at as it passed the top of the flagpole?
A) 6.40 m/s
B) 16.2 m/s
C) 17.6 m/s
D) 29.0 m/s
E) 33 m/s
Answer: C
Diff: 3 Var: 1 Page Ref: Sec. 2-5