Directions (1–35): For *each* statement or question, choose the word or expression that, of those given, best completes the statement or answers the question. Some questions may require the use of the *2006 Edition Reference Tables for Physical Setting/Physics*. Record your answers on your separate answer sheet.

Base your answers to questions 1 and 2 on the information below.

In a drill during basketball practice, a player runs the length of the 30.-meter court and back. The player does this three times in 60. seconds.

|← 30. m →|
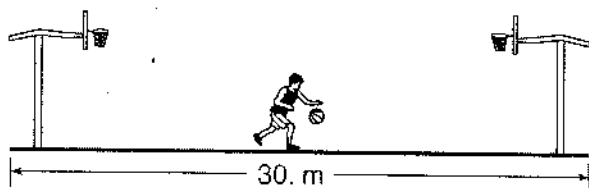
(Not drawn to scale)

1 The magnitude of the player's total displacement after running the drill is

(1) 0.0 m　　　　　(3) 60. m
(2) 30. m　　　　　(4) 180 m

2 The average speed of the player during the drill is

(1) 0.0 m/s　　　　(3) 3.0 m/s
(2) 0.50 m/s　　　　(4) 30. m/s

3 A baseball is thrown at an angle of 40.0° above the horizontal. The horizontal component of the baseball's initial velocity is 12.0 meters per second. What is the magnitude of the ball's initial velocity?

(1) 7.71 m/s　　　　(3) 15.7 m/s
(2) 9.20 m/s　　　　(4) 18.7 m/s

2 Two 20.-newton forces act concurrently on an object. What angle between these forces will produce a resultant force with the greatest magnitude?

(1) 0°　　　　　　(3) 90.°
(2) 45°　　　　　　(4) 180.°

3 A car traveling west in a straight line on a highway decreases its speed from 30.0 meters per second to 23.0 meters per second in 2.00 seconds. The car's average acceleration during this time interval is

(1) 3.5 m/s² east　　(3) 13 m/s² east
(2) 3.5 m/s² west　　(4) 13 m/s² west

6 A car, initially traveling east with a speed of 5.0 meters per second, is accelerated uniformly at 2.0 meters per second² east for 10. seconds along a straight line. During this 10.-second interval the car travels a total distance of

(1) 50. m　　　　　(3) 1.0×10^2 m
(2) 60. m　　　　　(4) 1.5×10^2 m

1 Scalar is to vector as

(1) speed is to velocity
(2) displacement is to distance
(3) displacement is to velocity
(4) speed is to distance

1 Which term identifies a scalar quantity?

(1) displacement　　(3) velocity
(2) momentum　　　(4) time

8 A child riding a bicycle at 15 meters per second accelerates at –3.0 meters per second² for 4.0 seconds. What is the child's speed at the end of this 4.0-second interval?

(1) 12 m/s　　　　(3) 3.0 m/s
(2) 27 m/s　　　　(4) 7.0 m/s

4 In a race, a runner traveled 12 meters in 4.0 seconds as she accelerated uniformly from rest. The magnitude of the acceleration of the runner was

(1) 0.25 m/s²　　　(3) 3.0 m/s²
(2) 1.5 m/s²　　　　(4) 48 m/s²

2 If a car accelerates uniformly from rest to 15 meters per second over a distance of 100. meters, the magnitude of the car's acceleration is

(1) 0.15 m/s²　　　(3) 2.3 m/s²
(2) 1.1 m/s²　　　　(4) 6.7 m/s²

3 An object accelerates uniformly from 3.0 meters per second east to 8.0 meters per second east in 2.0 seconds. What is the magnitude of the acceleration of the object?

(1) 2.5 m/s²　　　(3) 5.5 m/s²
(2) 5.0 m/s²　　　(4) 11 m/s²

62 Regardless of the method used to generate electrical energy, the amount of energy provided by the source is always greater than the amount of electrical energy produced. Explain why there is a difference between the amount of energy provided by the source and the amount of electrical energy produced. [1]

Base your answers to questions 63 through 65 on the graph below, which represents the relationship between velocity and time for a car moving along a straight line, and your knowledge of physics.

Velocity vs. Time
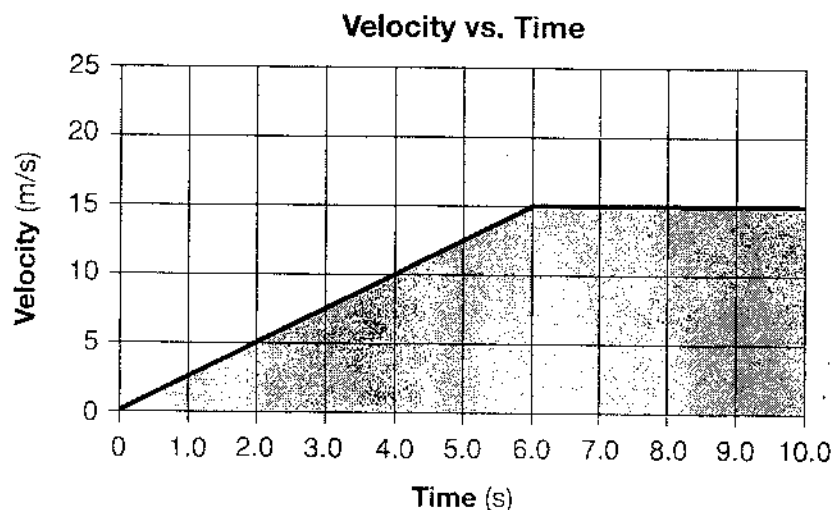
63 Determine the magnitude of the average velocity of the car from $t = 6.0$ seconds to $t = 10.$ seconds. [1]

64 Determine the magnitude of the car's acceleration during the first 6.0 seconds. [1]

65 Identify the physical quantity represented by the shaded area on the graph. [1]

A girl rides her bicycle 1.40 kilometers west, 0.70 kilometer south, and 0.30 kilometer east in 12 minutes. The vector diagram in your answer booklet represents the girl's first two displacements in sequence from point P. The scale used in the diagram is 1.0 centimeter = 0.20 kilometer.

70-71 On the vector diagram *in your answer booklet*, using a ruler and a protractor, construct the following vectors:

- Starting at the arrowhead of the second displacement vector, draw a vector to represent the 0.30 kilometer east displacement. Label the vector with its magnitude. [1]

- Draw the vector representing the resultant displacement of the girl for the entire bicycle trip *and* label the vector R. [1]

72-73 Calculate the girl's average speed for the entire bicycle trip. [Show all work, including the equation and substitution with units.] [2]

74 Determine the magnitude of the girl's resultant displacement for the entire bicycle trip, in kilometers. [1]

75 Determine the measure of the angle, in degrees, between the resultant and the 1.40-kilometer displacement vector. [1]

Answer all questions in this part.

Directions (36–50): For *each* statement or question, choose the word or expression that, of those given, best completes the statement or answers the question. Some questions may require the use of the *2006 Edition Reference Tables for Physical Setting/Physics*. Record your answers on your separate answer sheet.

36 The diameter of an automobile tire is closest to

(1) 10^{-2} m   (3) 10^1 m

(2) 10^0 m   (4) 10^2 m

37 The vector diagram below represents the velocity of a car traveling 24 meters per second 35° east of north.
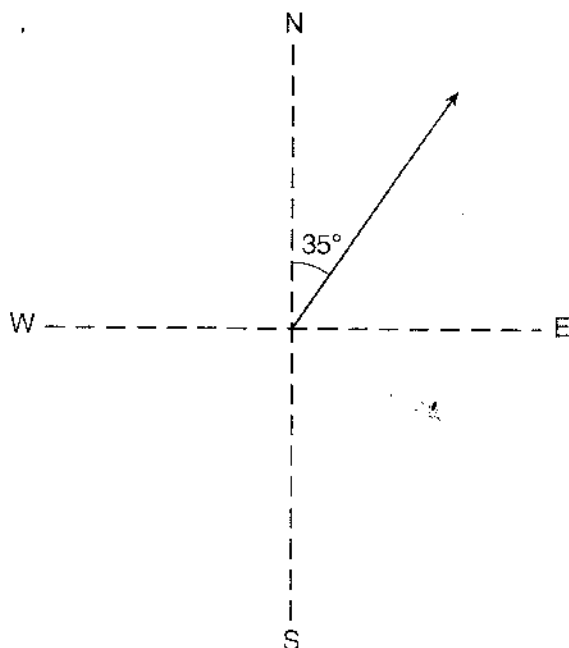
What is the magnitude of the component of the car's velocity that is directed eastward?

(1) 14 m/s   (3) 29 m/s

(2) 20. m/s   (4) 42 m/s

1 Which quantities are scalar?

(1) speed and work
(2) velocity and force
(3) distance and acceleration
(4) momentum and power

2 A 3.00-kilogram mass is thrown vertically upward with an initial speed of 9.80 meters per second. What is the maximum height this object will reach? [Neglect friction.]

(1) 1.00 m   (3) 9.80 m

(2) 4.90 m   (4) 19.6 m

39 A car is moving with a constant speed of 20. meters per second. What total distance does the car travel in 2.0 minutes?

(1) 10. m   (3) 1200 m

(2) 40. m   (4) 2400 m

40 A car, initially traveling at 15 meters per second north, accelerates to 25 meters per second north in 4.0 seconds. The magnitude of the average acceleration is

(1) 2.5 m/s²   (3) 10. m/s²

(2) 6.3 m/s²   (4) 20. m/s²

1 Which quantity is scalar?

(1) mass   (3) momentum

(2) force   (4) acceleration

2 What is the final speed of an object that starts from rest and accelerates uniformly at 4.0 meters per second² over a distance of 8.0 meters?

(1) 8.0 m/s   (3) 32 m/s

(2) 16 m/s   (4) 64 m/s

3 The components of a 15-meters-per-second velocity at an angle of 60.° above the horizontal are

(1) 7.5 m/s vertical and 13 m/s horizontal
(2) 13 m/s vertical and 7.5 m/s horizontal
(3) 6.0 m/s vertical and 9.0 m/s horizontal
(4) 9.0 m/s vertical and 6.0 m/s horizontal

4 What is the time required for an object starting from rest to fall freely 500. meters near Earth's surface?

(1) 51.0 s   (3) 10.1 s

(2) 25.5 s   (4) 7.14 s

7 A truck, initially traveling at a speed of 22 meters per second, increases speed at a constant rate of 2.4 meters per second² for 3.2 seconds. What is the total distance traveled by the truck during this 3.2-second time interval?

(1) 12 m   (3) 70. m

(2) 58 m   (4) 83 m

Part A

Answer all questions in this part.

Directions (1–35): For *each* statement or question, write in your answer booklet the *number* of the word or expression that, of those given, best completes the statement or answers the question.

1 A baseball player runs 27.4 meters from the batter's box to first base, overruns first base by 3.0 meters, and then returns to first base. Compared to the total distance traveled by the player, the magnitude of the player's total displacement from the batter's box is

(1) 3.0 m shorter (3) 3.0 m longer
(2) 6.0 m shorter (4) 6.0 m longer

4 A rock is dropped from a bridge. What happens to the magnitude of the acceleration and the speed of the rock as it falls? [Neglect friction.]

(1) Both acceleration and speed increase.
(2) Both acceleration and speed remain the same.
(3) Acceleration increases and speed decreases.
(4) Acceleration remains the same and speed increases.

3 A car traveling on a straight road at 15.0 meters per second accelerates uniformly to a speed of 21.0 meters per second in 12.0 seconds. The total distance traveled by the car in this 12.0-second time interval is

(1) 36.0 m (3) 216 m
(2) 180. m (4) 252 m

4 A 0.149-kilogram baseball, initially moving at 15 meters per second, is brought to rest in 0.040 second by a baseball glove on a catcher's hand. The magnitude of the average force exerted on the ball by the glove is

(1) 2.2 N (3) 17 N
(2) 2.9 N (4) 56 N

5 Which body is in equilibrium?

(1) a satellite moving around Earth in a circular orbit
(2) a cart rolling down a frictionless incline
(3) an apple falling freely toward the surface of Earth
(4) a block sliding at constant velocity across a tabletop

6 As shown in the diagram below, a student standing on the roof of a 50.0-meter-high building kicks a stone at a horizontal speed of 4.00 meters per second.

Level ground
(Not drawn to scale)
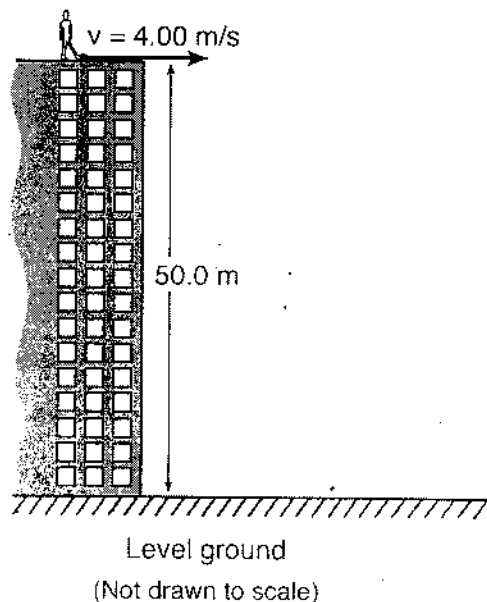
How much time is required for the stone to reach the level ground below? [Neglect friction.]

(1) 3.19 s (3) 10.2 s
(2) 5.10 s (4) 12.5 s

37 The graph below shows the relationship between the speed and elapsed time for an object falling freely from rest near the surface of a planet.
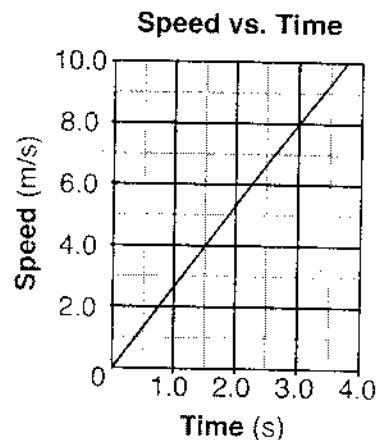
What is the total distance the object falls during the first 3.0 seconds?

(1) 12 m (3) 44 m
(2) 24 m (4) 72 m

42 A student throws a baseball vertically upward and then catches it. If vertically upward is considered to be the positive direction, which graph best represents the relationship between velocity and time for the baseball? [Neglect friction.]

(1)

(3)

(2)

(4)
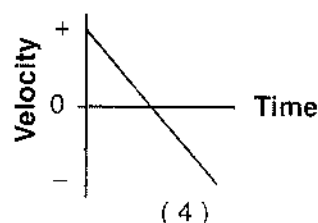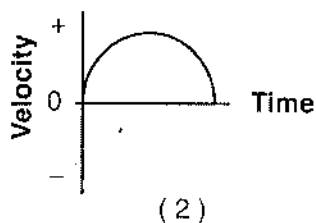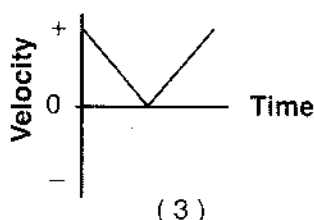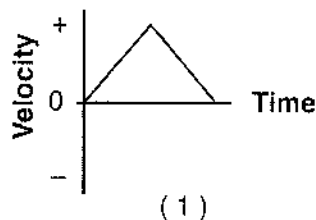
43 A 5.0-kilogram sphere, starting from rest, falls freely 22 meters in 3.0 seconds near the surface of a planet. Compared to the acceleration due to gravity near Earth's surface, the acceleration due to gravity near the surface of the planet is approximately

(1) the same
(2) twice as great

(3) one-half as great
(4) four times as great

A machine fired several projectiles at the same angle, θ, above the horizontal. Each projectile was fired with a different initial velocity, v_i. The graph below represents the relationship between the magnitude of the initial vertical velocity, v_{iy}, and the magnitude of the corresponding initial velocity, v_i, of these projectiles.

Initial Vertical Velocity vs. Initial Velocity
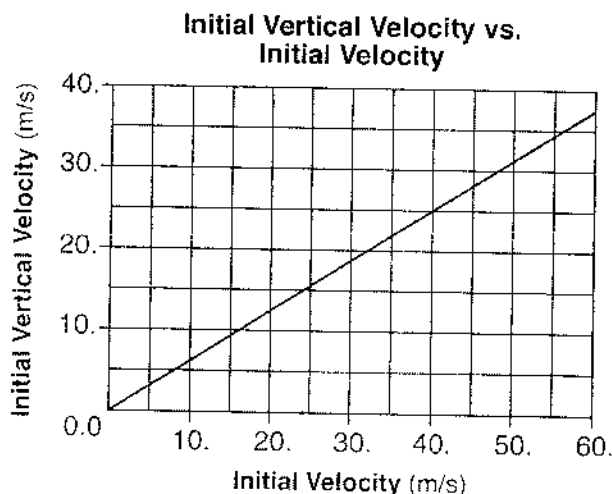
51 Determine the magnitude of the initial vertical velocity of the projectile, v_{iy}, when the magnitude of its initial velocity, v_i, was 40. meters per second. [1]

52 Determine the angle, θ, above the horizontal at which the projectiles were fired. [1]

53 Calculate the magnitude of the initial horizontal velocity of the projectile, v_{ix}, when the magnitude of its initial velocity, v_i, was 40. meters per second. [Show all work, including the equation and substitution with units.] [2]