1. The diagram below shows two carts on a horizontal, frictionless surface being pushed apart when a compressed spring attached to one of the carts is released. Cart A has a mass of 3.0 kilograms and cart B has a mass of 5.0 kilograms. The speed of cart A is 0.33 meter per second after the spring is released.

If the carts are initially at rest, what is the approximate speed of cart B after the spring is released?

1. 0.12 m/s   3. 0.33 m/s
2. 0.20 m/s   4. 0.55 m/s

2. The displacement-time graph below represents the motion of a cart initially moving forward along a straight line.
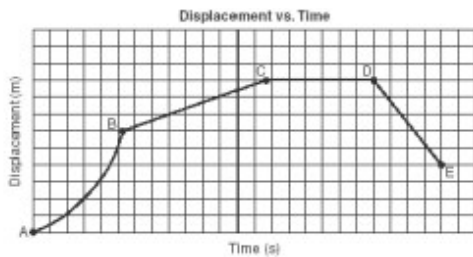
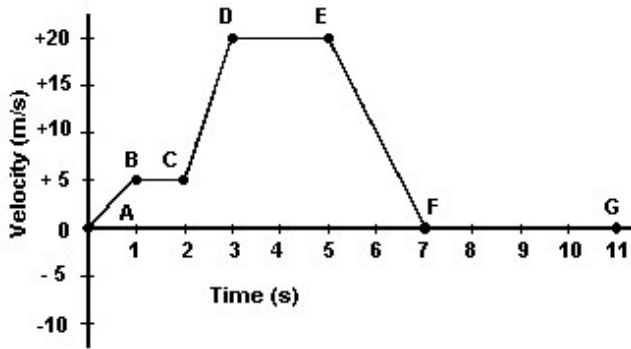During which interval is the cart moving forward at constant speed?

1. AB 3. CD
2. BC 4. DE

3. A student walks 1.0 kilometer due east and 1.0 kilometer due south. Then she runs 2.0 kilometers due west. The magnitude of the student's resultant displacement is closest to

1. 0 km   3. 3.4 km
2. 1.4 km   4. 4.0 km

Figure 1

The graph represents the linear motion of a car.

4. **[Refer to figure 1]**
The average velocity of the car during interval *DE* is
1. 0 m/s   3. 20. m/s
2. 10. m/s   4. 40. m/s

5. A runner completed the 100.-meter dash in 10.0 seconds. Her average speed was
1. 0.100 m/s   3. 100. m/s
2. 10.0 m/s   4. 1,000 m/s

6. A 25-kilogram mass travels east with a constant velocity of 40. meters per second. The momentum of this mass is

1. 1.0×10^3 kg•m/s east
2. 9.8×10^3 kg•m/s east
3. 1.0×10^3 kg•m/s west
4. 9.8×10^3 kg•m/s west

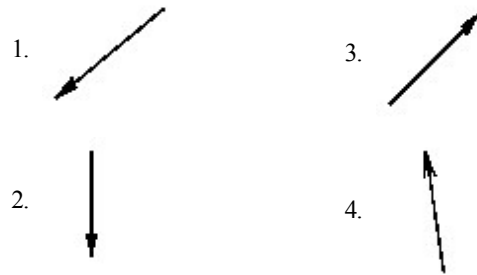7. The diagram shows a graph of distance as a function of time for an object in straight-line motion.
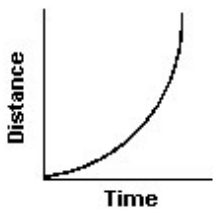
According to the graph, the object most likely has

1. a constant momentum
2. a decreasing acceleration
3. a decreasing mass
4. an increasing speed
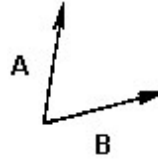
8.

Which vector below represents the resultant of the concurrent vectors *A* and *B* in the diagram above?

9. What is the magnitude of the velocity of a 25-kilogram mass that is moving with a momentum of 100 kilogram-meters per second?
1. 0.25 m/s   3. 40 m/s
2. 2,500 m/s   4. 4.0 m/s

10. A boat initially traveling at 10. meters per second accelerates uniformly at the rate of 5.0 meters per second squared for 10. seconds. How far does the boat travel during this time?
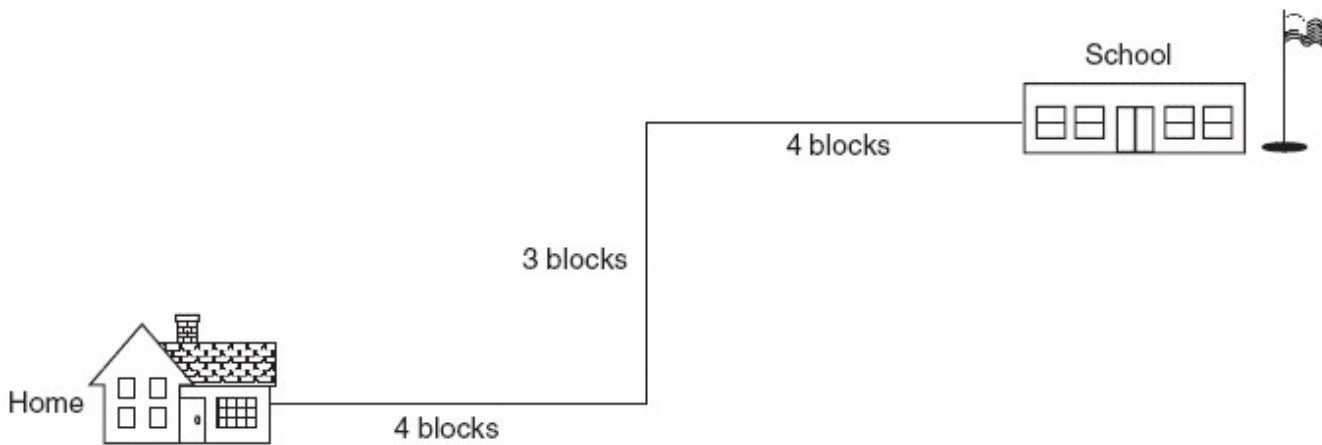1. 50. m   3. 350 m
2. 250 m   4. 500 m

11. The graph represents the relationship between distance and time for an object in motion.
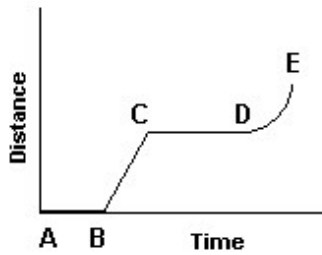
During which interval is the speed of the object changing?

1. *AB*   3. *CD*
2. *BC*   4. *DE*

12. A student on her way to school walks four blocks east, three blocks north, and another four blocks east, as shown in the diagram.

Compared to the distance she walks, the magnitude of her displacement from home to school is

  1. less
  2. greater
  3. the same

13. What is the total displacement of a student who walks 3 blocks east, 2 blocks north, 1 block west, and then 2 blocks south?
1. 0   3. 2 blocks west
2. 2 blocks east   4. 8 blocks

14. A boat heads directly eastward across a river at 12 meters per second. If the current in the river is flowing at 5.0 meters per second due south, what is the magnitude of the boat's resultant velocity?
1. 7.0 m/s   3. 13 m/s
2. 8.5 m/s   4. 17 m/s

15. Which two terms represent a vector quantity and the scalar quantity of the vector's magnitude, respectively?
  1. acceleration and velocity
  2. weight and force
  3. speed and time
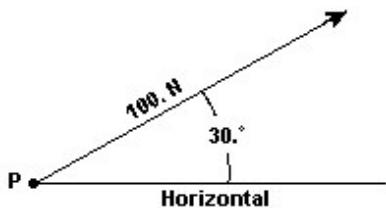 4. displacement and distance

16. The diagram below shows a worker using a rope to pull a cart.

The worker's pull on the handle of the cart can best be described as a force having

    1. magnitude, only
    2. direction, only
    3. both magnitude and direction
    4. neither magnitude nor direction

17. A 100.-newton force acts on point P, as shown in the diagram below.


The magnitude of the vertical component of this force is approximately

1. 30. N   3. 71 N
2. 50. N   4. 87 N

18. A baseball pitcher throws a fastball at 42 meters per second. If the batter is 18 meters from the pitcher, approximately how much time does it take for the ball to reach the batter?
1. 1.9 s   3. 0.86 s
2. 2.3 s   4. 0.43 s

19. A river flows due east at 1.5 meters per second. A motorboat leaves the north shore of the river and heads due south at 2.0 meters per second, as shown in the diagram below.
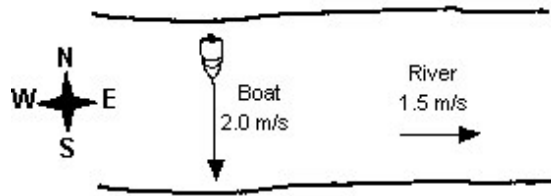
Which vector below best represents the resultant of the velocity of the boat relative to the riverbank?
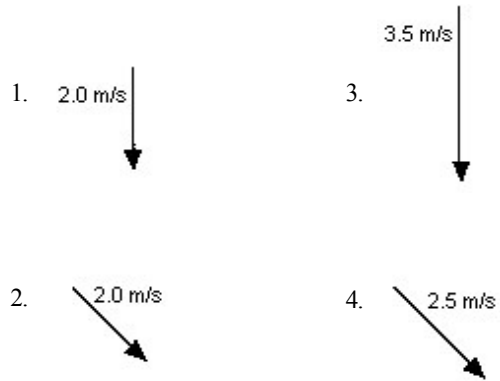
20. What is the average velocity of a car that travels 30. kilometers due west in 0.50 hour?
1. 15 km/hr   3. 15 km/hr west
2. 60. km/hr   4. 60. km/hr west

21. A student walks 3 blocks south, 4 blocks west, and 3 blocks north. What is the displacement of the student?
1. 10 blocks east   3. 4 blocks east
2. 10 blocks west   4. 4 blocks west

22. A force of 6.0 newtons north and a force of 8.0 newtons east act concurrently on an object. The magnitude of the resultant of the two forces is
1. 1.3 N   3. 10. N
2. 2.0 N   4. 14 N

23. The vector in the diagram below represents the resultant of two forces acting concurrently on an object at point *P*.
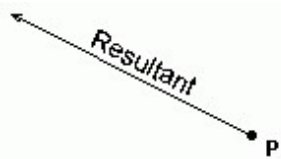

Which pair of vectors below best represents two concurrent forces that combine to produce this resultant force vector?
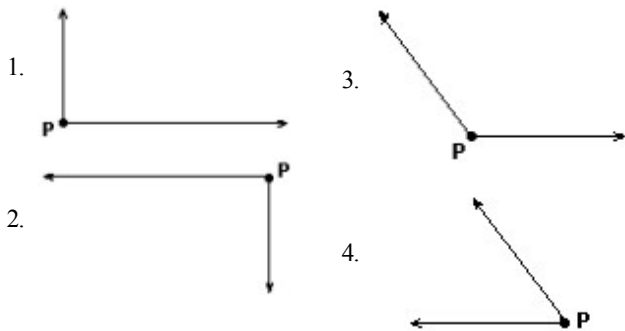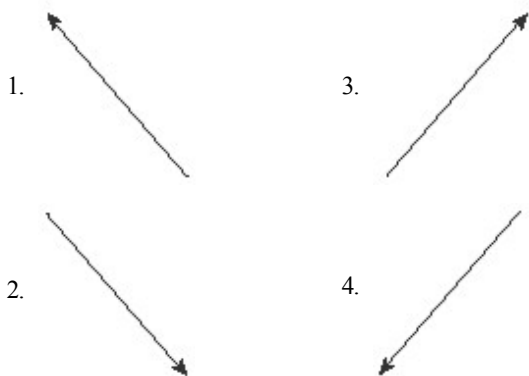

24. A car travels between the 100. meter and 250. meter highway markers in 10. seconds. The average speed of the car during this interval is
1. 10. m/s   3. 25 m/s
2. 15 m/s   4. 35 m/s

25. A force vector was resolved into two perpendicular components, F_1 and F_2, as shown in the diagram below.
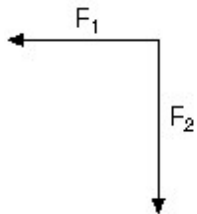
Which vector best represents the original force?

26. As the angle between a force and level ground decreases from 60° to 30°, the vertical component of the force
    1. decreases
    2. increases
    3. remains the same

27. An airplane flies with a velocity of 750. kilometers per hour, 30.0° south of east. What is the magnitude of the eastward component of the plane's velocity?
1. 866 km/h   3. 433 km/h
2. 650. km/h   4. 375 km/h

28. A rocket with a mass of 1,000 kilograms is moving at a speed of 20 meters per second. The magnitude of the momentum is
1. 50 kg•m/s   3. 20,000 kg•m/s
2. 200 kg•m/s   4. 40,000 kg•m/s

29. A car travels a distance of 98 meters in 10. seconds. What is the average speed of the car during this 10.-second interval?
1. 4.9 m/s   3. 49 m/s
2. 9.8 m/s   4. 98 m/s

30. Which is the most likely mass of a high school student?
1. 1 kg   3. 60 kg
2. 5 kg   4. 250 kg

31. If the speed of a moving object is doubled, which quantity associated with the object must also double?
    1. its momentum
    2. its kinetic energy
    3. its acceleration
    4. its gravitational potential energy

32. A student walks 40. meters along a hallway that heads due north, then turns and walks 30. meters along another hallway that heads due east. What is the magnitude of the student's resultant displacement?
1. 10. m   3. 50. m
2. 35 m   4. 70. m

33. A girl leaves a history classroom and walks 10. meters north to a drinking fountain. Then she turns and walks 30. meters south to an art classroom. What is the girl's total displacement from the history classroom to the art classroom?
1. 20. m south   3. 40. m south
2. 20. m north   4. 40. m north

34. Velocity is not the same as speed. Which piece of information is included in velocity, but not in speed?
    1. The amount of time something takes
    2. The direction of the motion
    3. The gravity behind something
    4. The forces of acceleration

35. Which of the following is a scalar quantity?
1. displacement   3. force
2. distance   4. acceleration

36. A cart starting from rest travels a distance of 3.6 meters in 1.8 seconds. The average speed of the cart is
1. 0.20 m/s   3. 0.50 m/s
2. 2.0 m/s   4. 5.0 m/s

37. A 25 kilogram mass travels east with a constant velocity of 40 meters per second. The momentum of this mass is
    1. 1,000 kg·m/s east
    2. 9,800 kg·m/s east
    3. 1,000 kg·m/s west
    4. 9,800 kg·m/s west

38. A person travels 6 meters north, 4 meters east, and 6 meters south. What is the total displacement?
1. 16 m east   3. 6 m south
2. 6 m north   4. 4 m east

39. A woman drives a car from Buffalo to Albany and then to New York City, as shown in the diagram.

Compared to the size of the car's total displacement (overall change in position), the distance driven is

    1. shorter
    2. longer
    3. the same

40. As shown in the diagrams, a lump of clay travels horizontally to the right toward a block at rest on a frictionless surface. Upon collision, the clay and the block stick together and move to the right.
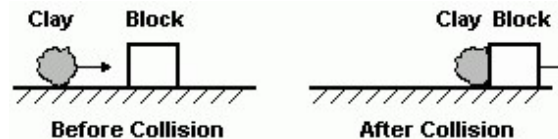
Compared to the total momentum of the clay and the block before the collision, the momentum of the clay-block system after the collision is
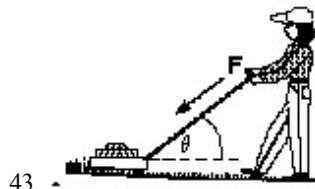
    1. less
    2. greater
    3. the same

41. What is the momentum of a 1,500-kilogram car as it travels at 30 meters per second due east for 60 seconds?
    1. 45,000 kg·m/s, east
    2. 45,000 kg·m/s, west
    3. 2,700,000 kg·m, east
    4. 2,700,000 kg·m, west

42. Which is the most likely mass of a student?
1. 1 kg   3. 60 kg
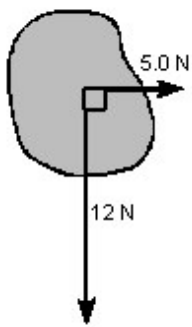2. 5 kg   4. 250 kg

43.

In the diagram, as angle θ between the lawnmower handle and the horizontal increases, the horizontal component of F

    1. decreases
    2. increases
    3. remains the same

44. Two perpendicular forces act on an object as shown in the diagram.

What is the magnitude of the resultant force on the object?

1. 17 N   3. 7.0 N
2. 13 N   4. 5.0 N

45. A 2.0-kilogram ball traveling north at 4.0 meters per second collides head-on with a 1.0 kilogram ball traveling south at 8.0 meters per second. What is the magnitude of the total momentum of the two balls after collision?
1. 0 kg·m/s   3. 16 kg·m/s
2. 8.0 kg·m/s   4. 32 kg·m/s

46. A person travels 6 meters north, 4 meters east, and 6 meters south. What is the total displacement?
1. 16 m east   3. 6 m south
2. 6 m north   4. 4 m east

47. A 2-kilogram rifle initially at rest fires a 0.002-kilogram bullet. As the bullet leaves the rifle with a velocity of 500 meters per second, what is the momentum of the rifle-bullet system?
1. 2.5 kg•m/s   3. 0.5 kg•m/s
2. 2.0 kg•m/s   4. 0 kg•m/s

48. A 3.0-newton force and a 4.0-newton force act concurrently on a point. In which diagram below would the orientation of these forces produce the greatest net force on the point?
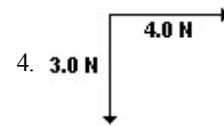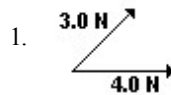
49. A 2.0-kilogram toy cannon is at rest on a frictionless surface. A remote triggering device causes a 0.005-kilogram projectile to be fired from the cannon. Which equation describes this system after the cannon is fired?
1. mass of cannon + mass of projectile = 0
2. speed of cannon + speed of projectile = 0
3. momentum of cannon + momentum of projectile = 0
4. velocity of cannon + velocity of projectile = 0

50. Which pair of concurrent forces could produce a resultant force having a magnitude of 10. newtons?
1. 10. N, 10. N   3. 4.7 N, 4.7 N
2. 10. N, 30. N   4. 4.7 N, 50. N