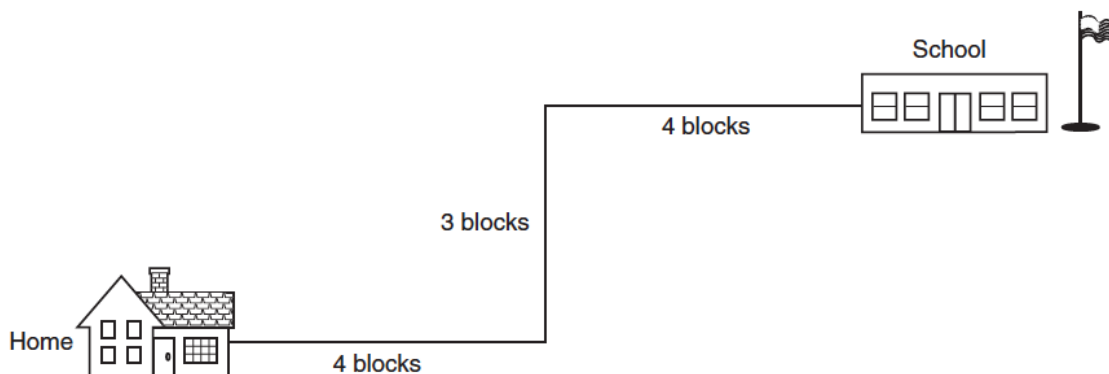Name: _____   Period: _____

Kinematics-Defining Motion

1. 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

2. A motorboat, which has a speed of 5 meters per second in still water, is headed east as it crosses a river flowing south at 3.3 meters per second. What is the magnitude of the boat's resultant velocity with respect to the starting point?
   1. 3.3 m/s
   2. 5.0 m/s
   3. 6.0 m/s
   4. 8.3 m/s

3. A speedometer in a car does *not* measure the car's velocity because velocity is a
   1. vector quantity and has a direction associated with it
   2. vector quantity and does not have a direction associated with it
   3. scalar quantity and has a direction associated with it
   4. scalar quantity and does not have a direction associated with it

4. A person observes a fireworks display from a safe distance of 0.750 kilometer. Assuming that sound travels at 340 meters per second in air, what is the time between the person seeing and hearing a fireworks explosion?
   1. 0.453 s
   2. 2.21 s
   3. 410 s
   4. 2.55×10^5 s

5. On the surface of Earth, a spacecraft has a mass of 2.00×10^4 kilograms. What is the mass of the spacecraft at a distance of one Earth radius above Earth's surface?
   1. 5.00×10^3 kg
   2. 2.00×10^4 kg
   3. 4.90×10^4 kg
   4. 1.96×10^5 kg

6. 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
   2. 650 km/h
   3. 433 km/h
   4. 375 km/h

7. One car travels 40 meters due east in 5 seconds, and a second car travels 64 meters due west in 8 seconds. During their periods of travel, the cars definitely had the same
   1. average velocity
   2. total displacement
   3. change in momentum
   4. average speed

8. State the *two* general characteristics that are used to define a vector quantity.

Kinematics-Defining Motion

Base your answers to questions 9 through 12 on the information and diagram below.

A model airplane heads due east at 1.50 meters per second, while the wind blows due north at 0.70 meter per second. The scaled diagram below represents these vector quantities.
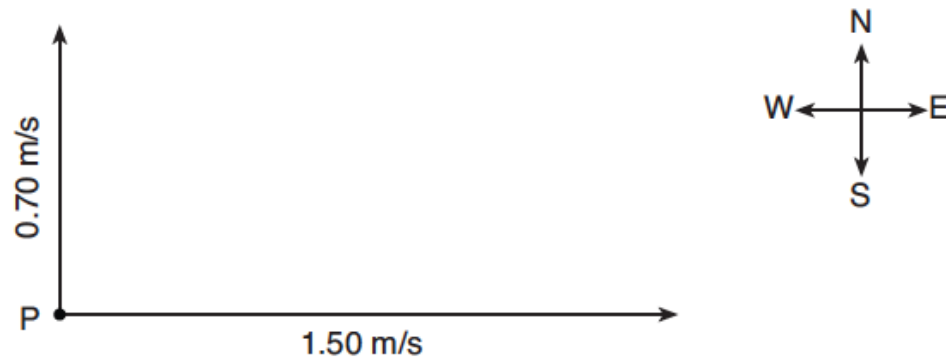
9. Using a ruler, determine the scale used in the vector diagram.   **1 cm = _____ m/s**

10. On the diagram above, use a protractor and a ruler to construct a vector to represent the resultant velocity of the airplane. Label the vector R.

11. Determine the magnitude of the resultant velocity.

12. Determine the angle between north and the resultant velocity.

13. 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 m shorter
2. 6 m shorter
3. 3 m longer
4. 6 m longer

14. In a 4-kilometer race, a runner completes the first kilometer in 5.9 minutes, the second kilometer in 6.2 minutes, the third kilometer in 6.3 minutes, and the final kilometer in 6 minutes. The average speed of the runner for the race is approximately
1. 0.16 km/min
2. 0.33 km/min
3. 12 km/min
4. 24 km/min

15. 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
2. 20 m north
3. 40 m south
4. 40 m north

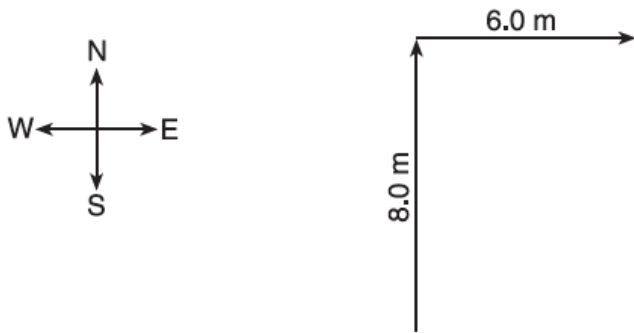16. Which is a vector quantity?
1. speed
2. work
3. mass
4. displacement

17. A cart travels 4 meters east and then 4 meters north. Determine the magnitude of the cart's resultant displacement.

Kinematics-Defining Motion

Base your answers to questions 18 through 20 on the information and vector diagram below.

A dog walks 8 meters due north and then 6 meters due east.

18. Using a metric ruler and the vector diagram, determine the scale used in the diagram.

    1 cm = _____ **m**

19. On the diagram above, construct the resultant vector that represents the dog's total displacement.

20. Determine the magnitude of the dog's total displacement.

21. On a highway, a car is driven 80 kilometers during the first hour of travel, 50 kilometers during the next 0.50 hour, and 40 kilometers in the final 0.50 hour. What is the car's average speed for the entire trip?
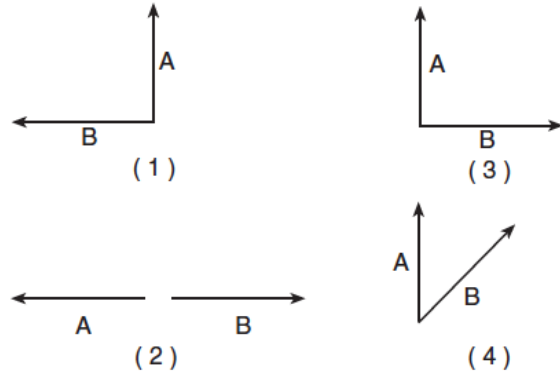   1. 45 km/h
    2. 60 km/h
    3. 85 km/h
    4. 170 km/h

22. Explain the difference between a scalar and a vector quantity.

23. The diagram below shows a resultant vector, R.
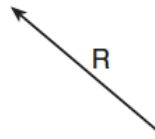
    Which diagram below best represents a pair of component vectors, A and B, that would combine to form resultant vector R?

Base your answers to questions 24 and 25 on the information below.

A stream is 30 meters wide and its current flows southward at 1.5 meters per second. A toy boat is launched with a velocity of 2.0 meters per second eastward from the west bank of the stream.

24. What is the magnitude of the boat's resultant velocity as it crosses the stream?
    1. 0.5 m/s
    2. 2.5 m/s
    3. 3.0 m/s
    4. 3.5 m/s

25. How much time is required for the boat to reach the opposite bank of the stream?
    1. 8.6 s
    2. 12 s
    3. 15 s
    4. 60 s

26. A person walks 150 meters due east and then walks 30 meters due west. The entire trip takes the person 10 minutes. Determine the magnitude and direction of the person's total displacement.

Kinematics-Defining Motion

27. A high-speed train in Japan travels a distance of 300 kilometers in 3.60×10^3 seconds. What is the average speed of this train?
    1. 1.20×10^{-2} m/s
    2. 8.33×10^{-2} m/s
    3. 12.0 m/s
    4. 83.3 m/s

28. A child walks 5 meters north, then 4 meters east, and finally 2 meters south. What is the magnitude of the resultant displacement of the child after the entire walk?
    1. 1.0 m
    2. 5.0 m
    3. 3.0 m
    4. 11.0 m

29. 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

30. A car travels 90 meters due north in 15 seconds. Then the car turns around and travels 40 meters due south in 5 seconds. What is the magnitude of the average velocity of the car during this 20-second interval?
    1. 2.5 m/s
    2. 5.0 m/s
    3. 6.5 m/s
    4. 7.0 m/s

31. Velocity is to speed as displacement is to
    1. acceleration
    2. time
    3. momentum
    4. distance

Base your answers to questions 32 and 33 on the following information.

A hiker walks 5 kilometers due north and then 7 kilometers due east.

32. What is the magnitude of her resultant displacement?

33. What total distance has she traveled?

Base your answers to questions 34 and 35 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
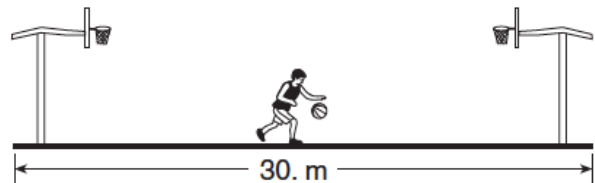
(Not drawn to scale)

34. The magnitude of the player's total displacement after running the drill is
    1. 0.0 m
    2. 30 m
    3. 60 m
   4. 180 m

35. The average speed of the player during the drill is
    1. 0.0 m/s
    2. 0.50 m/s
    3. 3.0 m/s
    4. 30 m/s

Kinematics-Defining Motion

Base your answers to questions 36 through 38 on the information below.

A river has a current flowing with a velocity of 2 meters per second due east. A boat is 75 meters from the north riverbank. It travels at 3 meters per second relative to the river and is headed due north. In the diagram below, the vector starting at point P represents the velocity of the boat relative to the river water.
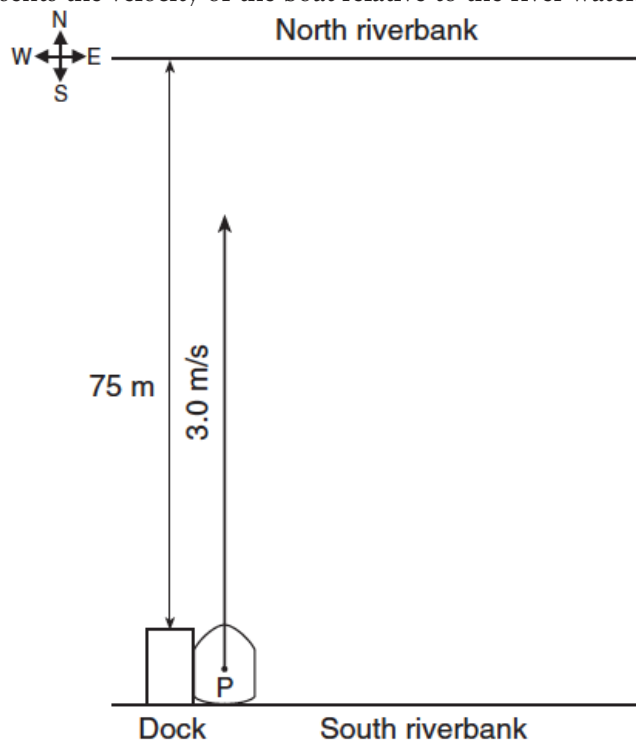
36. Calculate the time required for the boat to cross the river. [Show all work, including the equation and substitution with units.]

37. On the diagram, use a ruler and protractor to construct a vector representing the velocity of the river current. Begin the vector at point P and use a scale of 1 cm = 0.50 meter per second.

38. Calculate or find graphically the magnitude of the resultant velocity of the boat. [Show all work, including the equation and substitution with units or construct the resultant velocity vector on the diagram, using the scale given. The value of the magnitude must be written below.

Kinematics-Defining Motion

Base your answers to questions 39 through 42 on the information below.

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.

39. On the vector diagram below, using a ruler and 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.
    - Draw the vector representing the resultant displacement of the girl for the entire bicycle trip and label the vector R.

N

W ←——→ E

S

Scale
1.0 cm = 0.20 km

1.40 km   P

0.70 km
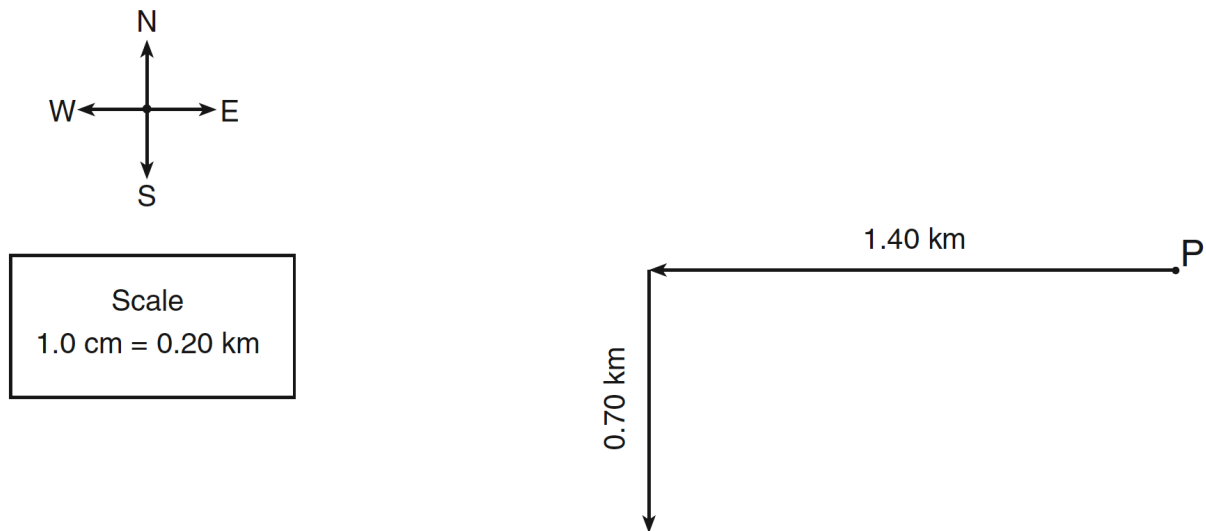
40. Calculate the girl's average speed for the entire bicycle trip. [Show all work, including the equation and substitution with units.]

41. Determine the magnitude of the girl's resultant displacement for the entire bicycle trip, in kilometers.

42. Determine the measure of the angle, in degrees, between the resultant and the 1.40-kilometer displacement vector.

Kinematics-Defining Motion

43. An airplane traveling north at 220 meters per second encounters a 50.0-meters-per-second crosswind from west to east, as represented in the diagram below.

220. m/s

50.0 m/s
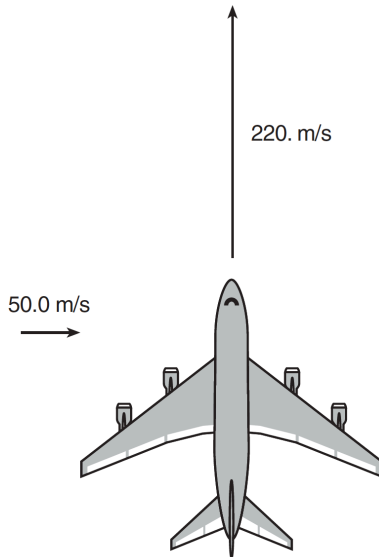
What is the resultant speed of the plane?
1. 170 m/s
2. 214 m/s
3. 226 m/s
4. 270 m/s

44. The vector diagram below represents the velocity of a car traveling 24 meters per second 35° east of north.

N

35°

W ———————————— E

S
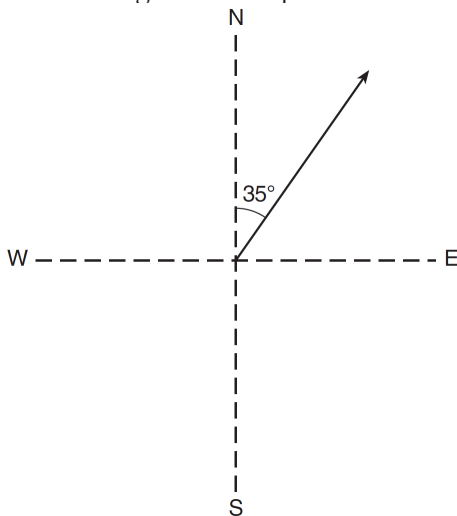
What is the magnitude of the component of the car's velocity that is directed eastward?
1. 14 m/s
2. 20 m/s
3. 29 m/s
4. 42 m/s