

a direction that cannot be determined from the information given.

15. As an apple tree is transported by a truck moving to the right with a constant velocity, one of its apples shakes loose and falls toward the bed of the truck. Of the curves shown in Figure CQ3.15, (i) which best describes the path followed by the apple as seen by a stationary observer on the ground, who observes the truck moving

from his left to his right? (ii) Which best describes the path as seen by an observer sitting in the truck?

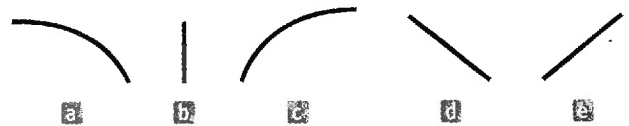


Figure CQ3.15

PROBLEMS

WebAssign The problems in this chapter may be assigned online in Enhanced WebAssign.

1. denotes straightforward problem; 2. denotes intermediate problem; 3. denotes challenging problem
1. denotes full solution available in *Student Solutions Manual/Study Guide*
 1. denotes problems most often assigned in Enhanced WebAssign

BIO denotes biomedical problems

GP denotes guided problems

M denotes Master It tutorial available in Enhanced WebAssign

Q&C denotes asking for quantitative and conceptual reasoning

S denotes symbolic reasoning problem

W denotes Watch It video solution available in Enhanced WebAssign

3.1 Vectors and Their Properties

- Vector \vec{A} has a magnitude of 29 units and points in the positive y -direction. When vector \vec{B} is added to \vec{A} , the resultant vector $\vec{A} + \vec{B}$ points in the negative y -direction with a magnitude of 14 units. Find the magnitude and direction of \vec{B} .
- Vector \vec{A} has a magnitude of 8.00 units and makes an angle of 45.0° with the positive x -axis. Vector \vec{B} also has a magnitude of 8.00 units and is directed along the negative x -axis. Using graphical methods, find (a) the vector sum $\vec{A} + \vec{B}$ and (b) the vector difference $\vec{A} - \vec{B}$.
- 1.** Vector \vec{A} is 3.00 units in length and points along the positive x -axis. Vector \vec{B} is 4.00 units in length and points along the negative y -axis. Use graphical methods to find the magnitude and direction of the vectors (a) $\vec{A} + \vec{B}$ and (b) $\vec{A} - \vec{B}$.
- Q&C** Three displacements are $\vec{A} = 200$ m due south, $\vec{B} = 250$ m due west, and $\vec{C} = 150$ m at 30.0° east of north. (a) Construct a separate diagram for each of the following possible ways of adding these vectors: $\vec{R}_1 = \vec{A} + \vec{B} + \vec{C}$; $\vec{R}_2 = \vec{B} + \vec{C} + \vec{A}$; $\vec{R}_3 = \vec{C} + \vec{B} + \vec{A}$. (b) Explain what you can conclude from comparing the diagrams.
- A roller coaster moves 200 ft horizontally and then rises 135 ft at an angle of 30.0° above the horizontal. Next, it travels 135 ft at an angle of 40.0° below the horizontal. Use graphical techniques to find the roller coaster's displacement from its starting point to the end of this movement.
- Q&C** An airplane flies 200 km due west from city A to city B and then 300 km in the direction of 30.0° north of west from city B to city C. (a) In straight-line distance, how far is city C from city A? (b) Relative to city A, in what direction is city C? (c) Why is the answer only approximately correct?

- A plane flies from base camp to lake A, a distance of 280 km at a direction of 20.0° north of east. After dropping off supplies, the plane flies to lake B, which is 190 km and 30.0° west of north from lake A. Graphically determine the distance and direction from lake B to the base camp.

- A force \vec{F}_1 of magnitude 6.00 units acts on an object at the origin in a direction $\theta = 30.0^\circ$ above the positive x -axis (Fig. P3.8). A second force \vec{F}_2 of magnitude 5.00 units acts on the object in the direction of the positive y -axis. Find graphically the magnitude and direction of the resultant force $\vec{F}_1 + \vec{F}_2$.

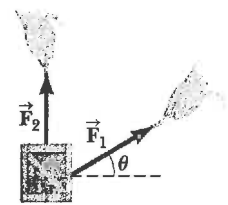


Figure P3.8

- A man in a maze makes three consecutive displacements. His first displacement is 8.00 m westward, and the second is 13.0 m northward. At the end of his third displacement he is back to where he started. Use the graphical method to find the magnitude and direction of his third displacement.

3.2 Components of a Vector

- A person walks 25.0° north of east for 3.10 km. How far due north and how far due east would she have to walk to arrive at the same location?
- The magnitude of vector \vec{A} is 35.0 units and points in the direction 325° counterclockwise from the positive x -axis. Calculate the x - and y -components of this vector.
- A figure skater glides along a circular path of radius 5.00 m. If she coasts around one half of the circle, find (a) the magnitude of the displacement vector and

(b) what distance she skated. (c) What is the magnitude of the displacement if she skates all the way around the circle?

13. A girl delivering newspapers covers her route by traveling 3.00 blocks west, 4.00 blocks north, and then 6.00 blocks east. (a) What is her resultant displacement? (b) What is the total distance she travels?

14. **Q.C** A hiker starts at his camp and moves the following distances while exploring his surroundings: 75.0 m north, 2.50×10^2 m east, 125 m at an angle 30.0° north of east, and 1.50×10^2 m south. (a) Find his resultant displacement from camp. (Take east as the positive x -direction and north as the positive y -direction.) (b) Would changes in the order in which the hiker makes the given displacements alter his final position? Explain.

15. A vector has an x -component of -25.0 units and a y -component of 40.0 units. Find the magnitude and direction of the vector.

16. A quarterback takes the ball from the line of scrimmage, runs backwards for 10.0 yards, then runs sideways parallel to the line of scrimmage for 15.0 yards. At this point, he throws a 50.0-yard forward pass straight downfield, perpendicular to the line of scrimmage. What is the magnitude of the football's resultant displacement?

17. **M** The eye of a hurricane passes over Grand Bahama Island in a direction 60.0° north of west with a speed of 41.0 km/h. Three hours later the course of the hurricane suddenly shifts due north, and its speed slows to 25.0 km/h. How far from Grand Bahama is the hurricane 4.50 h after it passes over the island?

18. A map suggests that Atlanta is 730 miles in a direction 5.00° north of east from Dallas. The same map shows that Chicago is 560 miles in a direction 21.0° west of north from Atlanta. Figure P3.18 shows the location of these three cities. Modeling the Earth as flat, use this information to find the displacement from Dallas to Chicago.

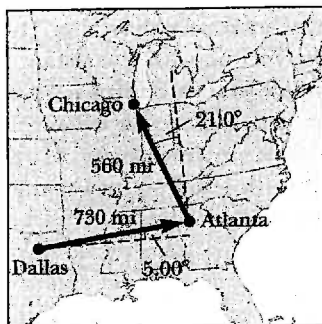


Figure P3.18

19. A commuter airplane starts from an airport and takes the route shown in Figure P3.19. The plane first flies to

city A, located 175 km away in a direction 30.0° north of east. Next, it flies for 150 km 20.0° west of north, to city B. Finally, the plane flies 190 km due west, to city C. Find the location of city C relative to the location of the starting point.

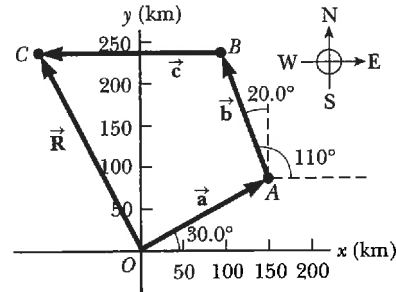


Figure P3.19

20. The helicopter view in Figure P3.20 shows two people pulling on a stubborn mule. Find (a) the single force that is equivalent to the two forces shown and (b) the force a third person would have to exert on the mule to make the net force equal to zero. The forces are measured in units of newtons (N).

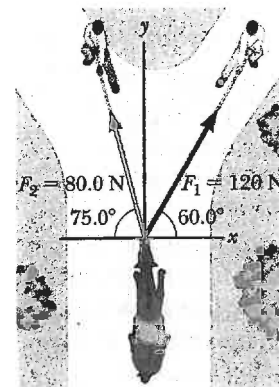


Figure P3.20

21. **W** A novice golfer on the green takes three strokes to sink the ball. The successive displacements of the ball are 4.00 m to the north, 2.00 m northeast, and 1.00 m at 30.0° west of south (Fig. P3.21). Starting at the same initial point, an expert golfer could make the hole in what single displacement?

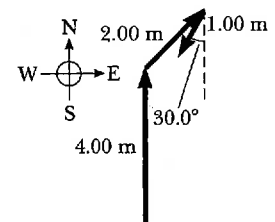


Figure P3.21

3.3 Displacement, Velocity, and Acceleration in Two Dimensions

3.4 Motion in Two Dimensions

22. One of the fastest recorded pitches in major-league baseball, thrown by Tim Lincecum in 2009, was clocked