Physics 201 Examples 3

Jan 16, 2013

1. A highway is to be built between two towns, one of which lies 35.0 km south and 72.0 km west of the other. What is the shortest length of highway that can be built between the two towns, and at what angle would this highway be directed with respect to due west?

80.1 km, 25.9° south of west

2. You are on a treasure hunt and your map says "Walk due west for 52 paces, then walk 30.0° north of west for 42 paces, and finally walk due north for 25 paces." What is the magnitude of the component of your displacement in the direction (a) due north and (b) due west?

(a) 46 paces
(b) 88 paces

3. A 60.0-kg crate rests on a level floor at a shipping dock. The coefficients of static and kinetic friction are 0.760 and 0.410, respectively. What horizontal pushing force is required to (a) just start the crate moving and (b) slide the crate across the dock at a constant speed?

(a) 447 N
(b) 241 N

4. A person is trying to judge whether a picture (mass = 1.10 kilograms) is properly positioned by temporarily pressing it against a wall. The pressing force is perpendicular to the wall. The coefficient of static friction between the picture and the wall is 0.660. What is the minimum amount of pressing force that must be used?

16.3 newtons

5. Two ropes are attached to a heavy box to pull it along the floor. One rope applies a force of 475 newtons in a direction due west; the other applies a force of 315 newtons in a direction due south. As we will see later in the text, force is a vector quantity. (a) How much force should be applied by a single rope, and (b) in what direction (relative to due west), if it is to accomplish the same effect as the two forces together?

(a) 570 newtons
(b) 33.6° south of due west

6. Two bicyclists, starting at the same place, are riding toward the same campground by two different routes. One cyclist rides 1080 meters due east and then turns due north and travels another 1430 meters before reaching the campground. The second cyclist starts out by heading due north for 1950 meters and then turns and heads directly toward the campground. (a) At the turning point, how far is the second cyclist from the campground? (b) What direction (measured relative to due east) must the second cyclist head during the last part of the trip?

(a) 1200 meters
(b) 25.7° south of east

7. Your friend has slipped and fallen. To help her up, you pull with a force $\vec{F}$, as Figure 1 shows. The vertical component of this force is 130 newtons, and the horizontal component is 150 newtons. Find (a) the magnitude of $\vec{F}$ and (b) the angle θ.

(a) 200 newtons
(b) 41°

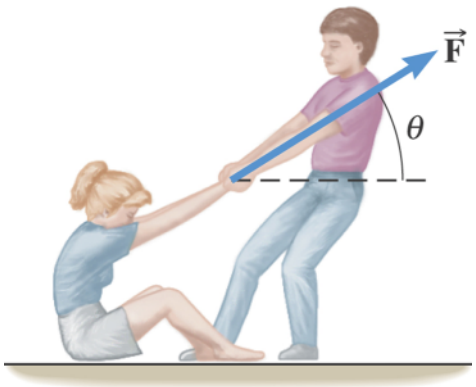

Figure 1: Problem 1.38

8. Vector $\vec{A}$ has a magnitude of 6.00 units and points due east. Vector $\vec{B}$ points

(a) 10.4 units
(b) 12.0 units

due north. (a) What is the magnitude of $\vec{B}$, if the vector $\vec{A} + \vec{B}$ points 60.0° north of east? (b) Find the magnitude of $\vec{A} + \vec{B}$.

9. Figure 2 shows a force vector that has a magnitude of 475 newtons. Find the (a) x, (b) y, and (c) z components of the vector.

(a) 322 newtons
(b) 209 newtons
(c) 279 newtons

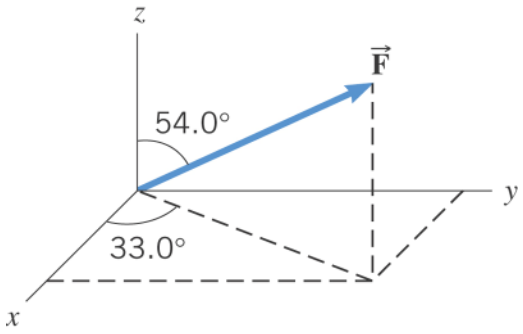

Figure 2: Problem 1.44

10. A football player runs the pattern given in Figure 3 by the three displacement vectors $\vec{A}$, $\vec{B}$, and $\vec{C}$. The magnitudes of these vectors are $A = 5.00$ meters, $B = 15.0$ meters, and $C = 18.0$ meters. Using the component method, find the magnitude and direction of the resultant vector $\vec{A} + \vec{B} + \vec{C}$.

30.1 at $-8.45°$

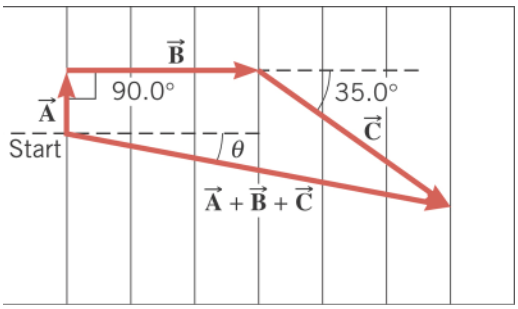

Figure 3: Problem 1.47

11. On a safari, a team of naturalists set out toward a research station located 4.8 km away in a direction 42° north of east. After traveling in a straight line for 2.4 km, they stop and discover that they have been travelling 22° north of east, because their guide misread his compass. What are (a) the magnitude and (b) the direction (relative to due east) of the displacement vector now required to bring the team to the research station?

(a) 2.7 km
(b) 60°

12. The route followed by a hiker consists of three displacement vectors $\vec{A}$, $\vec{B}$, and $\vec{C}$. Vector $\vec{A}$ is along a measured trail and is 1550 meters in a direction 25.0° north of east. Vector $\vec{B}$ is not along a measured trail, but the hiker uses a compass and knows that the direction is 41.0° east of south. Similarly, the direction of vector $\vec{C}$ is 35.0° north of west. The hiker ends up back where she started, so the resultant displacement is zero, or $\vec{A} + \vec{B} + \vec{C} = 0$. Find the magnitudes of (a) vector $\vec{B}$ and (b) vector $\vec{C}$.

(a) 5550 meters
(b) 6160 meters

13. What are the x and y components of the vector that must be added to the three vectors in Table 1, so that the sum of the four vectors is zero? Due east is the $+x$ direction, and due north is the $+y$ direction.

-288 units and 155 units

$\vec{A}$	113 units	60.0° south of west
$\vec{B}$	222 units	35.0° south of east
$\vec{C}$	177 units	23.0° north of east

Table 1: Problem 1.69

14. A Mercedes-Benz 300SL (mass = 1700 kilograms) is parked on a road that rises 15.0° above the horizontal. What are the magnitudes of (a) the normal force and (b) the static friction force that the ground exerts on the tires?

(a) 16100 newtons
(b) 4310 newtons

15. Three forces act on a moving object. One force has a magnitude of 80.0 netwons and is directed due north. Another has a magnitude of 60.0 newtons and is directed due west. What must the magnitude and direction of the third force, such that the object continues to move with a constant velocity?

100.0 at 53.1° south of east

16. Figure 4 shows a wire tooth brace used by orthodontists. The topmost tooth is protruding slightly, and the tension in the wire exerts two forces $\vec{T}$ and $\vec{T}'$ on this tooth in order to bring it back into alignment. If the forces have the same magnitude of 21.0 newtons, what is the magnitude of the net force exerted on the tooth by these forces?

11.6 newtons

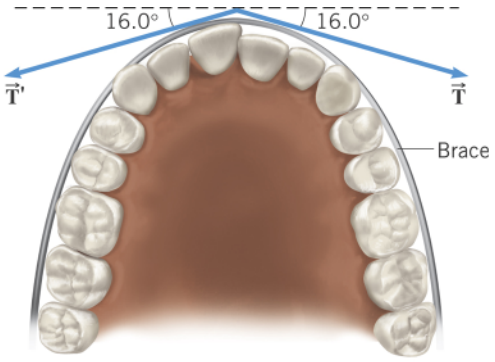

Figure 4: Problem 4.55

17. A bicyclist is coasting straight down a hill at a constant speed. The mass of the rider and bicycle is 80.0 kilograms, and the hill is inclined at 15.0° with respect to the horizontal. Air resistance opposes the motion of the cyclist. Later, the bicyclist climbs the same hill at the same constant speed. How much force (directed parallel to the hill) must be applied to the bicycle in order for the bicyclist to climb the hill?

406 newtons

18. While moving in, a new homeowner is pushing a box across the floor at a constant velocity. The coefficient of kinetic friction between the box and the floor is 0.41. The pushing force is directed downward at an angle θ below the horizontal. When θ is greater than a certain value, it is not possible to move the box, no matter how large the pushing force is. Find that value of θ.

68°

19. Suppose W in Figure 5 is 500 newtons. Find the values of L and R if the system is to hang in equilibrium as shown.

288 and 384 newtons

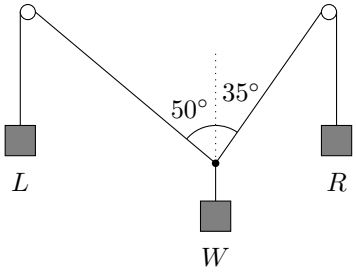

Figure 5: Hanging weights