Lesson 8-3  (Pages 500–504)
Find an ordered triple to represent $\overrightarrow{p}$ in each equation if $\overrightarrow{q} = \langle 1, 2, -1 \rangle$, $\overrightarrow{r} = \langle -2, 2, 4 \rangle$, and $\overrightarrow{s} = \langle -4, -3, 0 \rangle$.

1. $\overrightarrow{p} = 2\overrightarrow{q} + 3\overrightarrow{s}$
2. $\overrightarrow{p} = \overrightarrow{q} - \frac{1}{2}\overrightarrow{r} + \overrightarrow{s}$
3. $\overrightarrow{p} = -2\overrightarrow{r} + \overrightarrow{s}$
4. $\overrightarrow{p} = \frac{3}{4}\overrightarrow{s} + 2\overrightarrow{q}$

Lesson 8-2  (Pages 493–499)
Find the ordered pair that represents $\overrightarrow{AB}$. Then find the magnitude of $\overrightarrow{AB}$.

1. $A(3, 6), B(4, 1)$
2. $A(-1, 3), B(-2, 2)$
3. $A(0, -4), B(-1, -8)$
4. $A(1, 10), B(3, -9)$
5. $A(-6, 0), B(-3, -6)$
6. $A(4, -5), B(0, 7)$

Find the magnitude of each vector and write each vector as the sum of unit vectors.

7. $\langle 5, 6 \rangle$
8. $\langle -2, 4 \rangle$
9. $\langle -10, -5 \rangle$
10. $\langle 2.5, 6 \rangle$
11. $\langle 2, -6 \rangle$
12. $\langle -15, -12 \rangle$

Lesson 8-4  (Pages 505–511)
Find each inner product and state whether the vectors are perpendicular. Write yes or no.

1. $(3, 4) \cdot (2, 5)$ 26; no
2. $(-3, 2) \cdot (4, 6)$ 0; yes
3. $(-5, 3) \cdot (2, -3)$ -19; no
4. $(8, 6) \cdot (-2, -3)$ -34; no
5. $(3, 4, 0) \cdot (4, -3, 6)$ 0; yes
6. $(4, 5, 1) \cdot (-1, -2, 3)$ -11; no

Find each cross product. Then verify that the resulting vector is perpendicular to the given vectors. 7–10. See margin for verification.

7. $(1, 0, 3) \times (1, 1, 2)$ $\langle -3, 1, 1 \rangle$
8. $(3, 0, 4) \times (-1, 5, 2)$ $\langle -20, -10, 15 \rangle$
9. $(-1, 1, 0) \times (2, 1, 3)$ $\langle 3, 3, -3 \rangle$
10. $(1, -3, 2) \times (6, -1, -2)$ $(8, 10, 19)$
1. Harold is pushing his Grandpa in a wheel chair up a ramp. The ramp is 35 feet long and inclines at 12 degrees. Harold’s Grandpa weighs 200 pounds and the wheelchair weighs 40 pounds. What is the work done by gravity as Harold pushes his Grandpa?

2. A pilot flies a plane east for 200 kilometers and 60 degrees south of west for 80 kilometers. Find the plane’s distance and direction from the starting point.

3. Coach Gallant wants to hang a sign outside his classroom. The sign he has purchased is 100 pounds. He has two beams he is using to hang the sign. They make a 36 degree angle with eachother. Find the resultant force of each beam.

4. A person walks 100 yards east then walks 45 yards south. What is the direction and magnitude of the resultant vector? Draw this diagram.

5. Molly and Lindsey are pulling the wishbone after Thanksgiving dinner. Molly is pulling with a force of 75 Newtons due West and Lindsey is pulling with a force of 60 Newtons due North. Determine the resultant force and direction.

6. Vector u has a magnitude of 53 and a direction of 0°. Vector v has a magnitude of 10 and a direction of 295°. Find the magnitude and direction of the resultant to the nearest whole number.

7. Two vectors u and v of magnitude of 33 and 22 respectively are separated by an angle of θ=45°. Find the magnitude of their resultant and the angle φ the sum makes with the first vector.
Lesson 8-3  (Pages 500–504)
Find an ordered triple to represent \( \vec{p} \) in each equation if \( \vec{q} = \langle 1, 2, -1 \rangle \), \( \vec{r} = \langle -2, 2, 4 \rangle \), and \( \vec{s} = \langle -4, -3, 0 \rangle \).
1. \( \vec{p} = 2\vec{q} + 3\vec{s} \) \( \langle -10, -5, -2 \rangle \)
2. \( \vec{p} = \vec{q} - \frac{1}{2} \vec{r} + \vec{s} \) \( \langle -2, -2, -3 \rangle \)
3. \( \vec{p} = -2\vec{r} + \vec{s} \) \( \langle 0, -7, -8 \rangle \)
4. \( \vec{p} = \frac{3}{4}\vec{s} + 2\vec{q} \) \( \langle -1, 1\frac{3}{4}, -2 \rangle \)

Answers

Lesson 8-2  (Pages 493–499)
Find the ordered pair that represents \( \overrightarrow{AB} \). Then find the magnitude of \( \overrightarrow{AB} \).
1. \( A(3, 6), B(4, 1) \) \( \langle 1, -5 \rangle; \sqrt{26} \)
2. \( A(-1, 3), B(-2, 2) \) \( \langle -1, -1 \rangle; \sqrt{2} \)
3. \( A(0, -4), B(-1, -8) \) \( \langle -1, -4 \rangle; \sqrt{17} \)
4. \( A(1, 10), B(3, -9) \) \( \langle 2, -19 \rangle; \sqrt{385} \)
5. \( A(-6, 0), B(-3, -6) \) \( \langle 3, -6 \rangle; 3\sqrt{5} \)
6. \( A(4, -5), B(0, 7) \) \( \langle -4, 12 \rangle; 4\sqrt{10} \)

Find the magnitude of each vector and write each vector as the sum of unit vectors.
7. \( \langle 5, 6 \rangle \sqrt{61}; 5\hat{i} + 6\hat{j} \)
8. \( \langle -2, 4 \rangle \) \( 2\sqrt{5}; -2\hat{i} + 4\hat{j} \)
9. \( \langle -10, -5 \rangle \) \( 5\sqrt{5}; -10\hat{i} - 5\hat{j} \)
10. \( \langle 2.5, 6 \rangle \) \( 6.5; 2.5\hat{i} + 6\hat{j} \)
11. \( \langle 2, -6 \rangle \) \( 2\sqrt{10}; 2\hat{i} - 6\hat{j} \)
12. \( \langle -15, -12 \rangle \) \( 3\sqrt{41}; -15\hat{i} - 12\hat{j} \)

Lesson 8-4  (Pages 505–511)
Find each inner product and state whether the vectors are perpendicular. Write yes or no.
1. \( \langle 3, 4 \rangle \cdot \langle 2, 5 \rangle \) 26; no
2. \( \langle -3, 2 \rangle \cdot \langle 4, 6 \rangle \) 0; yes
3. \( \langle -5, 3 \rangle \cdot \langle 2, -3 \rangle \) -19; no
4. \( \langle 8, 6 \rangle \cdot \langle -2, -3 \rangle \) -34; no
5. \( \langle 3, 4, 0 \rangle \cdot \langle 4, -3, 6 \rangle \) 0; yes
6. \( \langle 4, 5, 1 \rangle \cdot \langle -1, -2, 3 \rangle \) -11; no

Find each cross product. Then verify that the resulting vector is perpendicular to the given vectors. 7–10. See margin for verification.
7. \( \langle 1, 0, 3 \rangle \times \langle 1, 1, 2 \rangle \) \( \langle -3, 1, 1 \rangle \)
8. \( \langle 3, 0, 4 \rangle \times \langle -1, 5, 2 \rangle \) \( \langle -29, -10, 15 \rangle \)
9. \( \langle -1, 1, 0 \rangle \times \langle 2, 1, 3 \rangle \) \( \langle 3, 3, -3 \rangle \)
10. \( \langle -1, -3, 2 \rangle \times \langle 6, -1, -2 \rangle \) \( \langle 8, 18, 19 \rangle \)

to verify, do the dot product between the new vector and each of the cross product vectors.
If dot product is zero, they are perpendicular
\[ \begin{align*}
\text{1} & \quad \text{W: } F_1 = F_2 = \sqrt{240^2 + 385^2} = \sqrt{57600 + 15225} = \sqrt{72825} = 270.13 \\
\text{2} & \quad \text{W: } \langle 0, 240 \rangle \cdot \langle \cos(12^\circ), \sin(12^\circ) \rangle = 240 \cdot 0 + 385 \cdot \sin(12^\circ) = 2.358 \, \text{km} \rightarrow \text{store as x in calc} \\
\text{3} & \quad \text{X: } \tan(36^\circ) = \frac{100}{\sqrt{240^2 + 385^2}} = 0.1376 \\
\text{4} & \quad \theta = \tan^{-1}\left(\frac{45}{100}\right) = 24.2^\circ \rightarrow \text{south of east} \\
\text{5} & \quad \theta = \tan^{-1}\left(\frac{100}{75}\right) = 38.9^\circ \rightarrow \text{North of west} 
\end{align*} \]
6

\[ \sin(\theta) = \frac{\sin(115^\circ)}{10} \]

9,85°

\( \theta = 9.85^\circ \) south of east

OR

350.15°

7

\[ \frac{20}{\sin(\theta)} = \frac{49.2}{\sin(135^\circ)} \]

\( \theta = 16.7^\circ \)

No exact direction, just 16.7° between 1st vector and resultant

\[ ||r|| = \sqrt{33^2 + 20^2 - 2(33 \times 20) \cos(135^\circ)} \]

\( ||r|| = 49.2 \)