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8-2 Practice

Vectors in the Coordinate Plane

Find the component form and magnitude of $\overrightarrow{AB}$ with the given initial and terminal points.

1. $A(2, 4), B(-1, 3)$
   $\langle -3, -1 \rangle$; $\sqrt{10}$

2. $A(4, -2), B(5, -5)$
   $\langle 1, -3 \rangle$; $\sqrt{10}$

3. $A(-3, -6), B(8, -1)$
   $\langle 11, 5 \rangle$; $\sqrt{146}$

Find each of the following for $\mathbf{v} = \langle 2, -1 \rangle$ and $\mathbf{w} = \langle -3, 5 \rangle$.

4. $3\mathbf{v}$
   $\langle 6, -3 \rangle$

5. $\mathbf{w} - 2\mathbf{v}$
   $\langle -7, 7 \rangle$

6. $4\mathbf{v} + 3\mathbf{w}$
   $\langle -1, 11 \rangle$

7. $5\mathbf{w} - 3\mathbf{v}$
   $\langle -21, 28 \rangle$

Find a unit vector u with the same direction as v.

8. $\mathbf{v} = \langle -3, 6 \rangle$ **$\left\langle -\frac{\sqrt{5}}{5}, \frac{2\sqrt{5}}{5} \right\rangle$**

9. $\mathbf{v} = \langle -8, -2 \rangle$ **$\left\langle -\frac{4\sqrt{17}}{17}, -\frac{\sqrt{17}}{17} \right\rangle$**

Let $\overrightarrow{DE}$ be the vector with the given initial and terminal points. Write $\overrightarrow{DE}$ as a linear combination of the vectors i and j.

10. $D(4, -5), E(6, -7)$ **$2\mathbf{i} - 2\mathbf{j}$**

11. $D(-4, 3), E(5, -2)$ **$9\mathbf{i} - 5\mathbf{j}$**

12. $D(4, 6), E(-5, -2)$ **$-9\mathbf{i} - 8\mathbf{j}$**

13. $D(2, 1), E(3, 7)$ **$\mathbf{i} + 6\mathbf{j}$**

Find the component form of v with the given magnitude and direction angle.

14. $|\mathbf{v}| = 12, \theta = 42°$ **$\langle 8.9, 8.0 \rangle$**

15. $|\mathbf{v}| = 8, \theta = 132°$ **$\langle -5.4, 5.9 \rangle$**

16. **GARDENING** Anne and Henry are lifting a stone statue and moving it to a new location in their garden. Anne is pushing the statue with a force of 120 newtons at a 60° angle with the horizontal while Henry is pulling the statue with a force of 180 newtons at a 40° angle with the horizontal. What is the magnitude of the combined force they exert on the statue?

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8-5 Practice

Dot and Cross Products of Vectors in Space

Find the dot product of u and v. Then determine if u and v are orthogonal.

1. $\langle -2, 0, 1\rangle \cdot \langle 3, 2, -3\rangle$
   –9; not orthogonal
2. $\langle -4, -1, 1\rangle \cdot \langle 1, -3, 4\rangle$
   3; not orthogonal
3. $\langle 0, 0, 1\rangle \cdot \langle 1, -2, 0\rangle$
   0; orthogonal

Find the angle θ between vectors u and v to the nearest tenth of a degree.

4. $\mathbf{u} = \langle 1, -2, 1\rangle$, $\mathbf{v} = \langle 0, 3, -2\rangle$
   about 154.9°
5. $\mathbf{u} = \langle 3, -2, 1\rangle$, $\mathbf{v} = \langle -4, -2, 5\rangle$
   about 96.9°
6. $\mathbf{u} = \langle 2, -4, 4\rangle$, $\mathbf{v} = \langle -2, -1, 6\rangle$
   about 51.3°

Find the cross product of u and v. Then show that u × v is orthogonal to both u and v.

7. $\langle 1, 3, 4\rangle \times \langle -1, 0, -1\rangle$
   $\langle -3, -3, 3\rangle$; $\langle -3, -3, 3\rangle \cdot \langle 1, 3, 4\rangle = -3(1) + (-3)(3) + (3)(4) = 0$; $\langle -3, -3, 3\rangle \cdot \langle -1, 0, -1\rangle = (-3)(-1) + (-3)(0) + 3(-1) = 0$
8. $\langle 3, 1, -6\rangle \times \langle -2, 4, 3\rangle$
   $\langle 27, 3, 14\rangle$; $\langle 27, 3, 14\rangle \cdot \langle 3, 1, -6\rangle = (27)(3) + 3(1) + (14)(-6) = 0$; $\langle 27, 3, 14\rangle \cdot \langle -2, 4, 3\rangle = (27)(-2) + (3)(4) + (14)(3) = 0$
9. $\langle 3, 1, 2\rangle \times \langle 2, -3, 1\rangle$
   $\langle 7, 1, -11\rangle$; $\langle 7, 1, -11\rangle \cdot \langle 3, 1, 2\rangle = (7)(3) + (1)(1) + (-11)(2) = 0$; $\langle 7, 1, -11\rangle \cdot \langle 2, -3, 1\rangle = (7)(2) + (1)(-3) + (-11)(1) = 0$
10. $\langle 4, -1, 0\rangle \times \langle 5, -3, -1\rangle$
    $\langle 1, 4, -7\rangle$; $\langle 1, 4, -7\rangle \cdot \langle 4, -1, 0\rangle = (1)(4) + (4)(-1) + (-7)(0) = 0$; $\langle 1, 4, -7\rangle \cdot \langle 5, -3, -1\rangle = (1)(5) + (4)(-3) + (-7)(-1) = 0$

Find the area of the parallelogram with adjacent sides u and v.

11. $\mathbf{u} = \langle 9, 4, 2\rangle$, $\mathbf{v} = \langle 6, -4, 2\rangle$
    62.4 units^2
12. $\mathbf{u} = \langle 2, 0, -8\rangle$, $\mathbf{v} = \langle -3, -8, -5\rangle$
    74.2 units^2

13. Find the volume of the parallelepiped with adjacent edges represented by the vectors $\langle 3, -2, 9\rangle$, $\langle 6, -2, -7\rangle$, and $\langle -8, -5, -2\rangle$.
    643 units^3

14. **TOOLS** A mechanic applies a force of 35 newtons straight down to a ratchet that is 0.25 meter long. What is the magnitude of the torque when the handle

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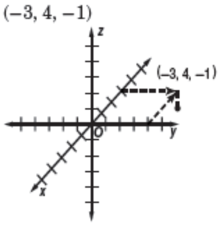
8-4 Practice

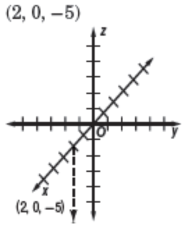
Vectors in Three-Dimensional Space

Plot each point in a three-dimensional coordinate system.

1. (−3, 4, −1)

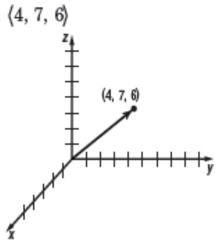


2. (2, 0, −5)

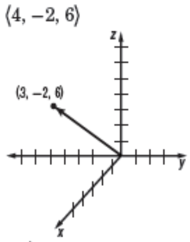


Locate and graph each vector in space.

3. ⟨4, 7, 6⟩



4. ⟨4, −2, 6⟩



Find the component form and magnitude of $\overrightarrow{AB}$ with the given initial and terminal points. Then find a unit vector in the direction of $\overrightarrow{AB}$.

5. $A(2, 1, 3)$, $B(-4, 5, 7)$

$\langle -6, 4, 4\rangle$; $2\sqrt{17}$

$\left\langle -\frac{3\sqrt{17}}{17}, \frac{2\sqrt{17}}{17}, \frac{2\sqrt{17}}{17}\right\rangle$

6. $A(4, 0, 6)$, $B(7, 1, -3)$

$\langle 3, 1, -9\rangle$; $\sqrt{91}$

$\left\langle \frac{3\sqrt{91}}{91}, \frac{\sqrt{91}}{91}, -\frac{9\sqrt{91}}{91}\right\rangle$

7. $A(-4, 5, 8)$, $B(7, 2, -9)$

$\langle 11, -3, -17\rangle$; $\sqrt{419}$

$\left\langle \frac{11\sqrt{419}}{419}, -\frac{3\sqrt{419}}{419}, -\frac{17\sqrt{419}}{419}\right\rangle$

8. $A(6, 8, -5)$, $B(7, -3, 12)$

$\langle 1, -11, 17\rangle$; $\sqrt{411}$

$\left\langle \frac{\sqrt{411}}{411}, -\frac{11\sqrt{411}}{411}, \frac{17\sqrt{411}}{411}\right\rangle$

Find the length and midpoint of the segment with the given endpoints.

9. (3, 4, −9), (−4, 7, 1)

$\sqrt{158}$; $\left(-\frac{1}{2}, \frac{11}{2}, -4\right)$

10. (−17, −3, 2), (3, −9, 5)

$\sqrt{445}$; $\left(-7, -6, \frac{7}{2}\right)$

Find each of the following for v = ⟨2, −4, 5⟩ and w = ⟨6, −8, 9⟩.

11. v + w

⟨8, −12, 14⟩

12. 5v − 2w

⟨−2, −4, 7⟩