**Vectors – The Basics**

1. Explain the difference between \((-2, 4)\) and \((-2, 4)\). Illustrate the difference with a sketch.

**Vector Arithmetic**

For problems 2 & 3 find \(\|\vec{a}\|, 7\vec{b}\) and \(4\vec{b} - 6\vec{a}\).

2. \(\vec{a} = \langle -5, 2 \rangle, \quad \vec{b} = \langle -3, -10 \rangle\)

3. \(\vec{a} = 8\vec{i} - 2\vec{j} + \vec{k}, \quad \vec{b} = 7\vec{j} - 4\vec{k}\)

4. Find a unit vector that is in
   (a) the same direction as \(\vec{w} = \langle 9, 0, -7 \rangle\)
   (b) the opposite direction as \(\vec{v} = 2\vec{i} + 3\vec{j} - 10\vec{k}\)

**Dot Product**

For problems 5 & 6 compute \(\vec{a} \cdot \vec{b}\).

5. \(\vec{a} = \langle -1, 2, 6 \rangle, \quad \vec{b} = 9\vec{i} + 4\vec{j} + 2\vec{k}\)

6. \(\|\vec{a}\| = 14, \quad \|\vec{b}\| = 3\) and the angle between \(\vec{a}\) and \(\vec{b}\) is \(\theta = \frac{\pi}{6}\).

For problems 7 & 8 find the angle between the two vectors and determine if the two vectors are parallel, orthogonal or neither.

7. \(\vec{p} = \langle 4, -2, 1 \rangle, \quad \vec{q} = \langle 15, 7, -3 \rangle\)

8. \(\vec{x} = 2\vec{i} - 2\vec{j} + 3\vec{k}, \quad \vec{y} = -\vec{i} + 5\vec{j} + 4\vec{k}\)

For problems 9 & 10 find the vector projection of \(\vec{b}\) onto \(\vec{a}\).

9. \(\vec{a} = \langle 0, 2, -1 \rangle, \quad \vec{b} = \langle 1, -2, -5 \rangle\)

10. \(\vec{a} = \langle 1, -2, -5 \rangle, \quad \vec{b} = \langle 0, 2, -1 \rangle\)

**Cross Product**

11. Find \(\vec{v} \times \vec{w}\) and \(\vec{w} \times \vec{v}\) for \(\vec{v} = \langle 2, -6, 1 \rangle\) and \(\vec{w} = \langle 0, 1, -1 \rangle\)

12. Find a vector that is orthogonal to the plane containing \((9, 0, 1), (-1, 1, 4)\) and \((7, 0, 4)\).

13. Determine if \(\langle 3, 0, 0 \rangle, \langle 1, -4, 2 \rangle\) and \(\langle 2, -4, 1 \rangle\) all lie in the same plane.