

**Exercises 12.4**

$$\begin{aligned}
5.) \quad \left\langle \frac{1}{2}, \frac{1}{3}, \frac{1}{4} \right\rangle \times \langle 1, 2, -3 \rangle &= \left( -1 - \frac{1}{2} \right) i - \left( -\frac{3}{2} - \frac{1}{4} \right) j + \left( 1 - \frac{1}{3} \right) k = \left\langle -\frac{3}{2}, \frac{7}{4}, \frac{2}{3} \right\rangle \\
\left\langle \frac{1}{2}, \frac{1}{3}, \frac{1}{4} \right\rangle \cdot \left\langle -\frac{3}{2}, \frac{7}{4}, \frac{2}{3} \right\rangle &= -\frac{3}{4} + \frac{7}{12} + \frac{2}{12} = 0 \\
\langle 1, 2, -3 \rangle \cdot \left\langle -\frac{3}{2}, \frac{7}{4}, \frac{2}{3} \right\rangle &= -\frac{3}{2} + \frac{14}{4} - \frac{6}{3} = 0
\end{aligned}$$

$$\begin{aligned}
7.) \quad \left\langle t, 1, \frac{1}{t} \right\rangle \times \langle t^2, t^2, 1 \rangle &= (1-t)i - (t-t^2)j + (t^3-t^2)k = \langle 1-t, 0, t^3-t^2 \rangle \\
\left\langle t, 1, \frac{1}{t} \right\rangle \cdot \langle 1-t, 0, t^3-t^2 \rangle &= (t-t^2) + (t^2-t) = 0 \\
\langle t^2, t^2, 1 \rangle \cdot \langle 1-t, 0, t^3-t^2 \rangle &= (t^2-t^3) + (t^3-t^2) = 0
\end{aligned}$$

$$\begin{aligned}
17.) \quad \langle 2, -1, 3 \rangle \times \langle 4, 2, 1 \rangle &= (-1-6)i - (2-12)j + (4+4)k = \langle -7, 10, 8 \rangle \\
\langle 4, 2, 1 \rangle \times \langle 2, -1, 3 \rangle &= -\langle 2, -1, 3 \rangle \times \langle 4, 2, 1 \rangle = \langle 7, -10, -8 \rangle.
\end{aligned}$$

$$19.) \quad \langle 3, 2, 1 \rangle \times \langle -1, 1, 0 \rangle = \langle -1, -1, 5 \rangle; \frac{\langle -1, -1, 5 \rangle}{\|\langle -1, -1, 5 \rangle\|} = \frac{1}{3\sqrt{3}} \langle -1, -1, 5 \rangle$$

Thus  $\pm \frac{1}{3\sqrt{3}} \langle -1, -1, 5 \rangle$  are orthogonal unit vectors.

$$\begin{aligned}
27.) \quad \vec{AB} &= \langle -1+3, 3-0 \rangle = \langle 2, 3 \rangle; \vec{BC} = \langle 5+1, 2-3 \rangle = \langle 6, -1 \rangle. \\
\begin{vmatrix} 2 & 3 \\ 6 & -1 \end{vmatrix} &= -2-18 = -20, |-20| = 20
\end{aligned}$$

29.) a.) awd

**Exercises 12.5**

3.) awd