**Practice Problems**

1. Find the position vector for the vector that starts at (1,5,1,7) and ends at (9, -3, -1, 11).

2. Find the magnitude of the following vectors: $\overrightarrow{a} = \begin{bmatrix} -1 \\ 3 \end{bmatrix}$, $\overrightarrow{b} = \begin{bmatrix} 2 \\ 4 \\ 1 \end{bmatrix}$, $\overrightarrow{c} = \begin{bmatrix} 0.5 \\ 2.4 \\ 10.2 \\ 8.7 \end{bmatrix}$

3. Let $\overrightarrow{a} = \begin{bmatrix} 2 \\ 3 \end{bmatrix}$, $\overrightarrow{b} = \begin{bmatrix} -6 \\ 4 \end{bmatrix}$, $\overrightarrow{c} = \begin{bmatrix} 1 \\ -8 \end{bmatrix}$. Find $\overrightarrow{v}$ if $\overrightarrow{v} = 2\overrightarrow{a} - 3\overrightarrow{b} + 4\overrightarrow{c}$

4. Find the unit vector of the following vectors: $\overrightarrow{x} = \begin{bmatrix} 1 \\ -8 \end{bmatrix}$, $\overrightarrow{y} = \begin{bmatrix} -3 \\ 6 \\ 7 \end{bmatrix}$, $\overrightarrow{z} = \begin{bmatrix} 10 \\ -2 \\ -8 \\ 2 \end{bmatrix}$

5. Check whether the following pairs of vectors are orthogonal:

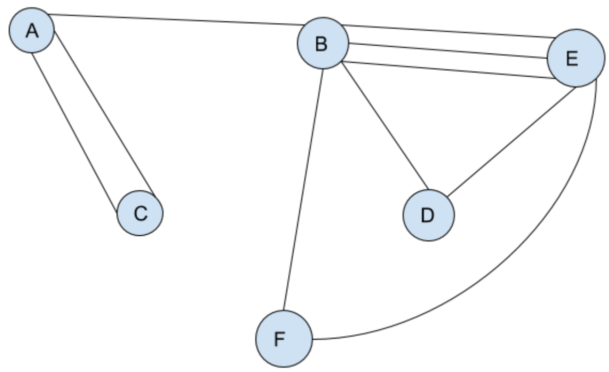
$$\overrightarrow{a} = \begin{bmatrix} 1 \\ 3 \end{bmatrix} \text{ and } \overrightarrow{b} = \begin{bmatrix} -4 \\ -6 \end{bmatrix}$$

$$\overrightarrow{c} = \begin{bmatrix} 12 \\ 4 \\ -2 \end{bmatrix} \text{ and } \overrightarrow{d} = \begin{bmatrix} 1 \\ 1 \\ 8 \end{bmatrix}$$

$$\overrightarrow{e} = \begin{bmatrix} 6 \\ 6 \\ 6 \end{bmatrix} \text{ and } \overrightarrow{f} = \begin{bmatrix} -1 \\ 1 \\ 0 \end{bmatrix}$$

6. Find the transpose and inverse of the following matrix:
$$\mathbf{P} = \begin{pmatrix} 21 & -1 & 43 \\ 91 & -12 & 41 \\ 17 & -26 & -65 \end{pmatrix}$$

7. 6 towns, named A through F, have a series of roads connecting them. If you look at the picture, you can see that there are two roads connecting A and C, for example.




Create a matrix that displays how many roads connect each of the towns. Your matrix should look like

$$\begin{array}{c|cccccc} & A & B & C & D & E & F \\ \hline A & 0 & 1 & 2 & 0 & 0 & 0 \\ B & & & & & & \\ C & & & & & & \\ D & & & & & & \\ E & & & & & & \\ F & & & & & & \end{array}$$

The first row is filled out to demonstrate the solution. Fill in the rest of the spaces.

**Solutions**

1. $\begin{bmatrix} 8 \\ -8 \\ -2 \\ 4 \end{bmatrix}$

2. $|\overrightarrow{a}| = \sqrt{10}$, $|\overrightarrow{a}| = \sqrt{21}$, $|\overrightarrow{a}| = \sqrt{185.74}$

3. $\begin{bmatrix} 26 \\ -38 \end{bmatrix}$

4. $\overrightarrow{x}_u \begin{bmatrix} \frac{1}{3} \\ \frac{-8}{3} \end{bmatrix}$, $\overrightarrow{y}_u \begin{bmatrix} \frac{-3}{\sqrt{94}} \\ \frac{6}{\sqrt{94}} \\ \frac{7}{\sqrt{94}} \end{bmatrix}$, $\overrightarrow{z}_u \begin{bmatrix} \frac{10}{\sqrt{172}} \\ \frac{-2}{\sqrt{172}} \\ \frac{-8}{\sqrt{172}} \\ \frac{2}{\sqrt{172}} \end{bmatrix}$

5. $\overrightarrow{a} \cdot \overrightarrow{b} = -22$, not orthogonal, $\overrightarrow{c} \cdot \overrightarrow{d} = 0$, orthogonal, $\overrightarrow{e} \cdot \overrightarrow{f} = 0$, orthogonal.

6. $\mathbf{P}^T = \begin{pmatrix} 21 & 91 & 17 \\ -1 & -12 & -26 \\ 43 & 41 & -65 \end{pmatrix}$ $\mathbf{P}^{-1} = \begin{pmatrix} -0.0304 & 0.0195 & -0.0078 \\ -0.1087 & 0.0345 & -0.0502 \\ 0.0356 & -0.0087 & 0.0026 \end{pmatrix}$

7.

| | $A$ | $B$ | $C$ | $D$ | $E$ | $F$ |
|---|---|---|---|---|---|---|
| $A$ | 0 | 1 | 2 | 0 | 0 | 0 |
| $B$ | 1 | 0 | 0 | 1 | 3 | 1 |
| $C$ | 2 | 0 | 0 | 0 | 0 | 0 |
| $D$ | 0 | 1 | 0 | 0 | 1 | 0 |
| $E$ | 0 | 3 | 0 | 1 | 0 | 1 |
| $F$ | 0 | 1 | 0 | 0 | 1 | 0 |