Quiz 1, Math. 415, **Wednesday, June 17th, 2009**

Explain your answers carefully. Write complete sentences, not just formulas.

1. (15 points) If $\mathbf{v}+\mathbf{w}=\begin{pmatrix}7\\1\\3\end{pmatrix}$ and $\mathbf{v}-\mathbf{w}=\begin{pmatrix}1\\7\\1\end{pmatrix}$, find $\mathbf{v}$ and $\mathbf{w}$.

2. (15 points) Calculate the matrix product $A\mathbf{x}$ if $A=\begin{pmatrix}1&1&1\\0&1&1\\0&0&1\end{pmatrix}$ and $\mathbf{x}=\begin{pmatrix}3\\4\\5\end{pmatrix}$.

2a. (15 points) Let $\mathbf{v} = \begin{pmatrix} 2 \\ -1 \end{pmatrix}$. Find a unit vector $\mathbf{u}$ in the direction of $\mathbf{v}$.

2b. (15 points) Still $\mathbf{v} = \begin{pmatrix} 2 \\ -1 \end{pmatrix}$. Find all $\mathbf{w} = \begin{pmatrix} w_1 \\ w_2 \end{pmatrix}$ that are perpendicular to $\mathbf{v}$.

3a. (15 points) Find, if possible, a linear combination $x_1\mathbf{w}_1 + x_2\mathbf{w}_2 + x_3\mathbf{w}_3$ that gives the zero vector, if

$$\mathbf{w}_1 = \begin{pmatrix} 1 \\ 2 \\ 3 \end{pmatrix}, \quad \mathbf{w}_2 = \begin{pmatrix} 4 \\ 5 \\ 6 \end{pmatrix}, \quad \mathbf{w}_3 = \begin{pmatrix} -2 \\ -1 \\ 0 \end{pmatrix}.$$

3b. (15 points) Describe the *shape* of the collection of all linear combinations of the above $\mathbf{w}_1, \mathbf{w}_2, \mathbf{w}_3$: is it a line, a plane or 3 dimensional space?