Name : ________________ Math 1C, Lesson 3: In-Class Problems **Class Number**: ______

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1. T F If $\mathbf{x}, \mathbf{y} \in \mathbb{R}^3$, then $|\mathbf{x} \cdot \mathbf{y}| \leq \|\mathbf{x}\|_2 \, \|\mathbf{y}\|_2$

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2. Find values of $b \in \mathbb{R}$ such that the vectors $\langle -11, b, 2 \rangle$ and $\left\langle b,\, b^2,\, b \right\rangle$ are orthogonal.

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3. Given $\mathbf{x} = \langle 4, 0 \rangle$ and $\mathbf{y} = \langle 5, 2 \rangle$, find the projection of vector $\mathbf{x}$ onto the vector $\mathbf{y}$?

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4. Suppose we define the following two vectors:

$$\mathbf{v} = -4\mathbf{i} - \mathbf{j} + 4\mathbf{k}, \qquad \mathbf{w} = \mathbf{i} + 3\mathbf{j} + 2\mathbf{k}$$

   Find the dot product $\mathbf{v} \cdot \mathbf{w}$ and the angle between these vectors

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5. For vectors $\mathbf{u} = \langle -2, -3, -2 \rangle$ and $\mathbf{v} = \langle 2, -1, -2 \rangle$, express the vector $\mathbf{u}$ as a sum of two vectors

$$\mathbf{u} = \mathbf{p} + \mathbf{r}$$

   where $\mathbf{p}$ is parallel to $\mathbf{v}$ and $\mathbf{r}$ is orthogonal to $\mathbf{v}$.

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6. Determine the minimum distance between the point $P(1, -1, -1)$ and the line L that goes through the origin in the direction of vector $\mathbf{v} = \langle 4, 9, -4 \rangle$. Hint: remember that the "line" L in the direction of vector $\mathbf{v}$ is the set of all possible scalar multiples $t \cdot \mathbf{v}$ for any $t \in \mathbb{R}$.