1. Let $\vec{u} = \begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix}$, $\vec{v} = \begin{bmatrix} 4 \\ 5 \\ 6 \end{bmatrix}$, and $\vec{w} = \begin{bmatrix} 7 \\ 8 \\ 9 \end{bmatrix}$. Explain whether the set $A = \{\vec{u}, \vec{v}, \vec{w}\}$ is a basis for $\mathbb{R}^3$. Make sure to include all relevant definitions.

2. Fix $\vec{u}, \vec{v} \in \mathbb{R}^n$. Show that $\operatorname{span}(\operatorname{span}\{\vec{u}, \vec{v}\}) = \operatorname{span}\{\vec{u}, \vec{v}\}$. Make sure to include all relevant definitions.

3. The worksheets define $\operatorname{proj}_{\vec{v}}\vec{u}$ as the vector in the direction $\vec{v}$ such that $\vec{u} - \operatorname{proj}_{\vec{v}}\vec{u}$ is orthogonal to $\vec{v}$. Call this definition (a). Your textbook defined $\operatorname{proj}_{\vec{v}}\vec{u}$ as the vector $\frac{\vec{u}\cdot\vec{v}}{\vec{v}\cdot\vec{v}}\vec{v}$. Call this definition (b). Show that definitions (a) and (b) are equivalent by showing that that the vector arising from definition (b) must be the same as the vector arising from definition (a). In your answer, elaborate on definition (a) by including the definition of *vector in the direction of* $\vec{v}$ and *orthogonal*. (Hint: in the past, a major stumbling block for writeups has been choosing a notation that clearly distinguishes vectors from definition (a) and vectors from definition (b).)