Math 322 - Matrix Algebra SOLUTIONS
Friday, November 20 ** *Quiz 10* Name: ____________________

1. (**1 point each**) Let $\mathbf{u} = \begin{pmatrix} 1 \\ 3 \\ -2 \end{pmatrix}$, $\mathbf{v} = \begin{pmatrix} 2 \\ 4 \\ 1 \end{pmatrix}$, and $\mathbf{w} = \begin{pmatrix} 1 \\ 1 \\ 2 \end{pmatrix}$. Find the following quantities

   (a) $\mathbf{u} \cdot \mathbf{v} =$ $\boxed{12}$

   (b) $\mathbf{u} \cdot \mathbf{w} =$ $\boxed{0}$

   (c) $\mathbf{v} \cdot \mathbf{w} =$ $\boxed{8}$

   (d) $\|\mathbf{u}\| =$ $\boxed{\sqrt{14}}$

2. (**3 points**) Find a basis for the plane in $\mathbb{R}^3$ perpendicular to $\begin{pmatrix} 1 \\ 2 \\ 3 \end{pmatrix}$.

   The plane perpendicular to this vector is the same as the null space of $\begin{pmatrix} 1 & 2 & 3 \end{pmatrix}$, which is already in reduced echelon form. We therefore read off the basis $\boxed{\mathscr{B} = \left\{ \begin{pmatrix} -2 \\ 1 \\ 0 \end{pmatrix}, \begin{pmatrix} -3 \\ 0 \\ 1 \end{pmatrix} \right\}}$

3. (**3 points**) Find a nonzero vector in $\mathbb{R}^3$ perpendicular to the plane $W = \text{Span}\left\{ \begin{pmatrix} 1 \\ 1 \\ -1 \end{pmatrix}, \begin{pmatrix} 2 \\ -3 \\ 2 \end{pmatrix} \right\}$.

   Again, this is just a nonzero vector in the null space of

$$A = \begin{pmatrix} 1 & 1 & 1 \\ 2 & -3 & 2 \end{pmatrix} \sim \begin{pmatrix} 1 & 1 & -1 \\ 0 & -5 & 4 \end{pmatrix} \sim \begin{pmatrix} 1 & 1 & -1 \\ 0 & 1 & \frac{-4}{5} \end{pmatrix} \sim \begin{pmatrix} 1 & 0 & \frac{-1}{5} \\ 0 & 1 & \frac{-4}{5} \end{pmatrix}.$$

$$\boxed{\mathbf{v} = \begin{pmatrix} 1/5 \\ 4/5 \\ 1 \end{pmatrix}}$$