1. (20 points) Let $\vec{u}_1$, $\vec{u}_2$, $\dots$, $\vec{u}_n$ be vectors in $\mathbb{R}^m$. Define each of the following terms

   (a) span $\{\vec{u}_1, \vec{u}_2, \dots, \vec{u}_n\}$

   (b) Vectors $\vec{u}_1$ and $\vec{u}_2$ that are *parallel*

   (c) The standard basis vectors $\vec{\imath}$, $\vec{\jmath}$, and $\vec{k}$ in $\mathbb{R}^3$

   (d) $\vec{v} \times \vec{w}$ for vectors $\vec{v}$, $\vec{w}$ in $\mathbb{R}^3$

2. (25 points) Consider the vectors $\vec{u} = \begin{bmatrix} 2 \\ -1 \\ 6 \end{bmatrix}$, $\vec{v} = \begin{bmatrix} 3 \\ 0 \\ -2 \end{bmatrix}$, and $\vec{w} = \begin{bmatrix} 0 \\ 1 \\ 2 \end{bmatrix}$.

   (a) Compute $\vec{u} \cdot (2\vec{v} + \vec{w})$.

   (b) Is $\vec{w}$ in the plane spanned by $\vec{u}$ and $\vec{v}$?

   (c) Find the equation for the plane spanned by $\vec{v}$ and $\vec{w}$.

3. (15 points) Consider the plane given by $3x + y - 2z = 1$ and the line given by

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 1 \\ 0 \\ 2 \end{bmatrix} + t \begin{bmatrix} 0 \\ 1 \\ 1 \end{bmatrix}.$$

   (a) Find the point of intersection between the line and the plane.

   (b) Find the line through this point in the direction of the normal vector to the plane.

4. (20 points) Consider points $A(0, 1, 0)$, $B(2, 0, 1)$, and $C(1, -1, 0)$, and the parallelogram with sides $\overrightarrow{AB}$ and $\overrightarrow{AC}$.

   (a) What are the coordinates of the fourth vertex of the parallelogram?

   (b) Find the cosine of the angle formed by the sides of the parallelogram at point B.

   (c) Find the area of the parallelogram.

5. (20 points) Let $\vec{u}$ and $\vec{v}$ be vectors in $\mathbb{R}^n$.

   (a) State the Cauchy-Schwarz inequality

   (b) Use the Cauchy-Schwarz inequality to prove the triangle inequality, that

$$\|\vec{u} + \vec{v}\| \le \|\vec{u}\| + \|\vec{v}\|.$$