Problem Set #2
Due: 21 September 2018 at noon

1. Which pairs of the following vectors are parallel:
   \[
   \vec{w} = -\vec{e}_1 - 2\vec{e}_2 + 2\vec{e}_3 \quad \quad \vec{x} = -2\vec{e}_1 + 4\vec{e}_2 + 4\vec{e}_3 \\
   \vec{y} = 3\vec{e}_1 + 6\vec{e}_2 - 6\vec{e}_3 \quad \quad \vec{z} = -4\vec{e}_1 - 8\vec{e}_2 + 8\vec{e}_3
   \]

2. For all \( \vec{u}, \vec{v} \in \mathbb{R}^n \), establish that
   
   (a) \( \| \vec{u} - \vec{v} \| \geq \| \vec{u} \| - \| \vec{v} \| \); \\
   (b) \( \vec{u} \cdot \vec{v} = \frac{1}{4} \| \vec{u} + \vec{v} \|^2 - \frac{1}{4} \| \vec{u} - \vec{v} \|^2 \).

3. An altitude of a triangle is a line segment from a vertex that is perpendicular to the opposite side. (You may want to take a look at Figures 1.47 and 1.48 on p. 33.) Prove that the three altitudes of a triangle are concurrent. The intersection point of the three altitudes in a triangle is called orthocenter of the triangle.

   **Hint:** If \( H \) is the intersection point of the altitudes from \( A \) and \( B \), prove that \( \vec{CH} \) is perpendicular to \( \overrightarrow{AB} \).