Math 226, HW1, Due on Friday, September 15

1. Section 10.1: 8, 9
2. Section 10.2: 2, 13, 14
3. Calculate the scalar and vector projections of \( \mathbf{u} \) onto \( \mathbf{v} \) and \( \mathbf{v} \) onto \( \mathbf{u} \) where \( \mathbf{u} = \left( \frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}, 0 \right) \) and \( \mathbf{v} = (2, 3, -1) \).
4. Explain why the Pythagorean theorem is a special case of the law of cosines.
5. Recall from class the definition: Vectors \( \mathbf{u} \) and \( \mathbf{v} \) are parallel (denoted \( \mathbf{u} \parallel \mathbf{v} \)) if \( \theta = 0 \) or \( \pi \) or \( \mathbf{u} = \mathbf{0} \) or \( \mathbf{v} = \mathbf{0} \) (here, \( \theta \) is the angle between \( \mathbf{u} \) and \( \mathbf{v} \)).
   Show that \( \mathbf{u} \parallel \mathbf{v} \) iff \( |\mathbf{u} \cdot \mathbf{v}| = |\mathbf{u}| |\mathbf{v}| \)
6. Given vectors \( \mathbf{u} \) and \( \mathbf{v} \neq \mathbf{0} \) show that there exists a unique choice of vectors \( \mathbf{x} \) and \( \mathbf{y} \) such that
   - \( \mathbf{u} = \mathbf{x} + \mathbf{y} \)
   - \( \mathbf{x} \perp \mathbf{v} \)
   - \( \mathbf{y} \parallel \mathbf{v} \)