1. Prove Lee Proposition 2.76 (the Jacobi identity and two other basic facts about Lie bracket)

2. Given a unit vector $u$ in $\mathbb{R}^3$, let $X_u$ be the clockwise rotation field for $u$.
   
   Compute $[X_u, X_v]$ for unit vectors $u, v$.
   
   For $x \in S^2 \subset \mathbb{R}^2$, the field is given by the cross product $X_u(x) = u \times x$. Note that in the usual spherical parameterization $(\theta, \phi) \rightarrow (\cos(\theta) \cos(\phi), \sin(\theta) \cos(\phi), \sin(\phi))$, the field $X_k = \frac{\partial}{\partial \theta}$.

3. Let $\sigma(t) = r \cos(t)i + r \sin(t)j + tk$ be a helix with radius $r$. Find the value of $r$ which maximizes the curvature of $\sigma$.

4. Let $\sigma(t) = e^t \cos(t)i + e^t \sin(t)j$ for $t$ any real number. Reparameterize $\sigma$ by the arclength parameter $s$, and compute the length of $\sigma$ for $t$ from $-\infty$ to $0$. This is a curve which spirals infinitely many times around the origin but has only finite length.