1. Find the scale factors for the spherical polar coordinate system \((r, \theta, \phi)\). We will use the convention that \(\theta\) is the polar angle (measured down from the north pole) and \(\phi\) is the azimuthal angle (measured counterclockwise up from the positive x axis). (10)

2. Find expressions for unit vectors \(\hat{r}\), \(\hat{\theta}\), and \(\hat{\phi}\) in terms of the Cartesian unit vectors. (10)

3. a) Use algebraic techniques to express Cartesian unit vectors in terms of \(\hat{r}\), \(\hat{\theta}\), and \(\hat{\phi}\). (10)
   
b) Extra Credit: Verify these results using matrix algebra methods. (5)

4. Use these results to write the position vector completely in spherical polar coordinates.