1. Let $\vec{V}$ be a vector, with coordinates $V_i$ in a chosen coordinate axis.

   (a) Consider a rotation of the coordinate axis around the $z$ axes by an angle $\theta$ in the clockwise sense. What will be the new coordinates in terms of the old coordinates? Write down a 3×3 matrix $\Lambda_z(\theta)$ such that when applied to the column matrix made of the components of $V_i$, it yields a column matrix made of the new coordinates, $V_i'$.

   (b) For very small rotations, expand $\Lambda_z(\theta)$ around $\theta = 0$ and write $\Lambda_z = 1_{3\times3} + i\theta\Sigma_z$. What is $\Sigma_z$?

   (c) Repeat the same derivation for rotations around $x$ and $y$, and find the matrices $\Sigma_x$ and $\Sigma_y$

   (d) Calculate the commutation relations between $\Sigma_i$.

2. Consider two point charges $q$ and $-2q$ placed at the points $(x, y, z) = (0, 0, d)$ and $(x, y, z) = (0, 0, -d)$. (The total charge of the configuration is $-q$). Calculate the electric field created by these two charges at and arbitrary point given by the coordinates $(x, y, z)$. For $r \gg d$ where $r$ is the distance of the point from the origin, obtain an expansion of $\vec{E}$ in terms of $\frac{d}{r}$ and keep only the terms upto the order $\left(\frac{d}{r}\right)^2$.