Problem 1. Magnetic field distribution

Consider a spatial distribution of electric current density $\mathbf{j}(\mathbf{r}) = j_0\hat{e}_r$. Prove that the magnetic field $\mathbf{B}(\mathbf{r}) = 0$. You may prove it from the aspect of the symmetry principle and check it from the Maxwell equations.

.**Problem 2. Log spirals**

Please prove that for a logarithmic spiral, the angle between tangential line and the radial line at any point of the spiral is a fixed value. Under what condition, a logarithmic spiral becomes a circle?

Problem 3. Absence of the 5-fold symmetry in crystals

Please prove that only 2-, 3-, 4-, 6-fold rotational symmetries are allowed in a crystal. For example, 5-fold rotational symmetry may exist in molecule, but cannot exist in a crystal.