1. In the proof of the existence theorem of the scalar potential, show that \( \frac{\partial \psi}{\partial x_2} = F_2 \).

2. Give an example for nonvanishing vector and scalar potentials \( \vec{A}(\vec{r}, t) \) and \( V(\vec{r}, t) \) such that \( \vec{E}(\vec{r}, t) = 0 \) and \( \vec{H}(\vec{r}, t) = 0 \) for all \( \vec{r} \) and \( t \).

3. Consider an infinite plate positioned in the \( y-z \) plane at \( x = 0 \). There is a charge \( q \) placed at the point \( (d, 0, 0) \). Determine the charge distribution \( \sigma(y, z) \) induced on the plate as well as the total force on the plate.

4. Consider the atomic nucleus with \( Z \) protons and atomic weight \( A \) as a uniformly charged sphere of radius \( R = 1.5A^{1/3} \) fm (1 fm=10\(^{-13}\) cm). Find the maximum value of the electric field of the nucleus (express in Volt/m).

5. Let \( q_1 \) and \( q_2 \) be two opposite charges on the \( x \) axis at \( l_1 \) and \( l_2 \). Prove that there is a sphere on which the total potential of the two charges vanishes.
1. A point-like electric dipole $\mathbf{d}$ is oriented in such a way that it has components $(d_x, d_y, 0)$ and placed in vacuum at a distance $x = a$ from an infinite conducting plane $yz$. Calculate the force acting on the dipole.

2. Two coaxial cylinders with radii $R_1$ and $R_2$ and length $L \gg R_{1,2}$ are charged with charges $q_1$ and $q_2$. Determine the electrostatic potential of the system, and observe that $\phi$ is linear in $q_1$ and $q_2$. Determine the capacitance matrix and the capacitance of the system in case $q_1 = -q_2$.

3. A point charge $q$ is placed inside an angle $\alpha_0$ formed by two grounded conducting planes. Find the electric field inside the angle for $\alpha_0 = 45^\circ, 60^\circ$ and $90^\circ$.

4. The centers of three identical small conducting spheres of radius $r$ are forming an equilateral triangle with the side length $l \gg r$. Initially each sphere carries a charge $q$. Then each sphere, in turn, is grounded for a sufficiently long time. Determine the remaining charges $q_1, q_2, q_3$. 