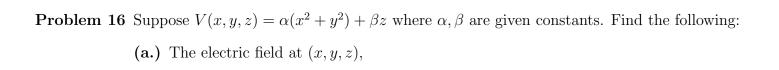Please work each problem in the white space provided. Attach additional sheets if necessary. Print this one-sided and staple in the top left corner with a metal staple once complete. Each team turns in one document.

Problem 13 A charge q is thrown vertically (on Earth) with speed v_o and it reaches a maximum height H (in the absence of any external electric field). Next, a horizontal plane made from an insulator is charged with a positive charge-density σ. The charge q is thrown vertically with speed v_o once again but only reaches a height $H/2$. If the mass of the charge is m then find σ in terms of the given charge, mass and perhaps g.

Problem 14 Suppose a very long line of charge with Q per length L is distributed evenly along the z-axis from inner radius A to outer radius B. Find the potential for this charge distribution as a function of a distance r from the z-axis. Assume the potential is set to zero as $r \to \infty$.

Problem 15 Suppose that 4 particles with a charge 2.0 Coulombs each are assembled in a square pattern. If the side-length of the square is 1.0 meters then what is the energy required to create this charge configuration?

Problem 16 Suppose $V(x, y, z) = \alpha(x^2 + y^2) + \beta z$ where α, β are given constants. Find the following:

(a.) The electric field at (x, y, z),

(b.) The work required to move a charge $Q = 2.0 \ \mu C$ from the origin to $(1, 2, 2)m$.

Problem 17 If a charge of Q is placed at the origin and another charge $-Q$ is placed at $(1, -2)m$ then find the electric potential at (x, y). Assume the potential is set to zero at infinity.

Problem 18 Suppose a ring of radius R and charge Q is set in the xy-plane centered at the origin. Find the electric potential and electric field at $(0, 0, z)$.

Problem 19 Suppose a linear dielectric material has $\epsilon = 3\epsilon_o$. If an air-filled parallel plate capacitor with original capacitance 0.5 μF is modified as to have half of the plate-to-plate volume filled with the material of dielectric ϵ then what is the new capacitance?

Problem 20 Suppose capacitors $C_1 = 1.0 \ \mu F$, $C_2 = 2.0 \ \mu F$ and $C_3 = 3.0 \ \mu F$ are placed in series and then a $4.0 \ \mu F$ capacitor is placed in parallel with the series connection of C_1, C_2, C_3. What is the equivalent capacitance of all four capacitors in the given configuration?

Problem 21 If 20 volts are applied to the capacitor configuration of the last problem then what is the current following through the circuit after a long time and what is the voltage across C_1, C_2, C_3 and C_4 ? Let us denote the voltage drops by V_1, V_2, V_3 and V_4 respective.