An equilateral triangle has a charge $+2Q$ at one corner, and charges of $-Q$ at each of the other corners. Consider the point in the center of the triangle.

a) What is the potential at this point?

b) What is the direction (if any) of the electric field at this point?
Two dimensional polar coordinates are like three-dimensional cylindrical coordinates, but without a $\hat{z}$ axis.

A small hill in a park has a height function given by

$$h(s, \phi) = se^{-s \cos^2 \phi}$$

a) What are the (polar) coordinates of the highest points on this hill?

b) What is the magnitude of the slope of this hill at the point $(1, \pi/4)$?

c) What compass direction corresponds to the direction of steepest descent at the point $(1, \pi/4)$? Assume that $\phi$ is measured relative to the ‘east’ axis, and increases as you turn north.
PROBLEM 3 [25 PTS]

An infinitely long insulating cylindrical shell of inner radius $s_1$ meters and outer radius $s_2$ meters has a uniform charge density of $\rho$ C/m$^3$ smeared throughout it.

a) What is the electric field at every point in space?

Instead, the same amount of charge per meter of the cylinder’s length is deposited onto a conductor with the same dimensions.

b) What is the electric field at every point in space?
PROBLEM 4 [25 PTS]

Over all space, the electrostatic potential has the following form:

\[
\begin{align*}
\frac{A}{\epsilon_0} \left( \frac{d^2}{2} - d(x + d) \right) & \quad x \leq -d \\
\frac{A}{2\epsilon_0} x^2 & \quad -d \leq x \leq d \\
\frac{A}{\epsilon_0} \left( \frac{d^2}{2} + d(x - d) \right) & \quad x \geq d
\end{align*}
\]

What is the charge distribution function \( \rho(x, y, z) \) for all points \((x, y, z)\) in space?