Exercise 6

[1] (50pts) From Schwartz 2-2: A slab of dielectric of thickness $t$, length $L$, and width $W$ is inserted between two plates of the same length and width with separation $d$ (see Fig.1). The plates are connected to a battery, with a potential difference $V$. Find the force on the dielectric when it has been inserted a distance $y$.

[2] (50pts) Consider a Laplace equation in Cartesian coordinates

\[ \nabla^2 \Phi(x, y, z) = \frac{\partial^2 \Phi}{\partial x^2} + \frac{\partial^2 \Phi}{\partial y^2} + \frac{\partial^2 \Phi}{\partial z^2} = 0. \]

Consider a box (see Fig.2) where the plane at $x = 0$, $y = 0$, $z = 0$, $x = a$, and $y = b$ are grounded (meaning $\Phi = 0$) and the potential at the plane at $z = c$ is set $\Phi = \Phi_0$. Find a solution by assuming the form (separation of variables) $\Phi(x, y, z) = X(x)Y(y)Z(z)$. 