Problem 3: Solution [10pts]

Four different dielectrics fill the space between the plates of a parallel-plate capacitor as shown in the figure below. Determine a formula for the capacitance in terms of $K_1, K_2, K_3, K_4$, the area $A$, of the plates, and the separation $d$.

\[
C_1 = \kappa_1 \varepsilon_o \frac{A/2}{d/2} \quad (1)
\]
\[
C_2 = \kappa_2 \varepsilon_o \frac{A/2}{d/2} \quad (2)
\]
\[
C_3 = \kappa_3 \varepsilon_o \frac{A}{d/4} \quad (3)
\]
\[
C_4 = \kappa_4 \varepsilon_o \frac{A}{d/4} \quad (4)
\]
\[
C = \frac{1}{\frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \frac{1}{C_4}} \quad (5)
\]
\[
= \frac{\varepsilon_o A}{d \left( \frac{1}{\kappa_1 + \kappa_2} + \frac{1}{4\kappa_3} + \frac{1}{4\kappa_4} \right)} \quad (6)
\]