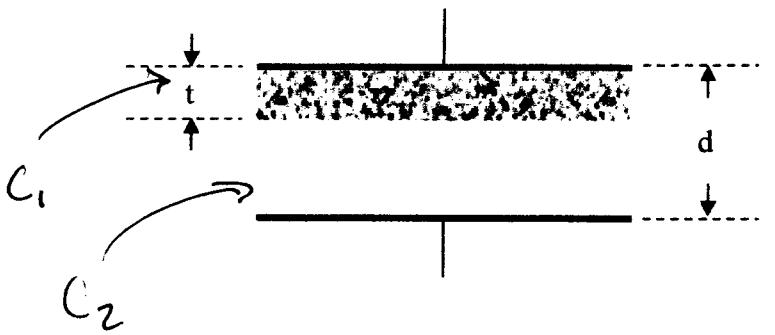
Name _____ SP222 Quiz

A parallel-plate capacitor has a plate separation $d$ has a capacitance equal to $C_0$ where there is only empty space in the space between the plates. A slab of thickness $t$, where $t < d$, that has a dielectric constant $\kappa$ is placed in the space between the plates completely covering one of the plates. What is the capacitance with the slab inserted?

Your answer must be simplified and in terms of the variables specified, i.e $C_o$, $d$, $t$, and $\kappa$.




$$C = \frac{\kappa \varepsilon_0 A}{d} \qquad C_0 = \frac{\epsilon_0 A}{d}$$

$$C_{eq} = C_1 + C_2 + C_3$$

$$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$$

$$C_1 = \frac{K \epsilon_0 A}{t}\left(\frac{d}{d}\right) = \frac{K C_0 d}{t} \qquad C_2 = \frac{\epsilon_0 A}{d-t}\left(\frac{d}{d}\right) = \frac{C_0 d}{d-t}$$

$$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} = \frac{t}{K C_0 d} + \frac{d-t}{C_0 d}\left(\frac{K}{K}\right)$$

$$= \frac{t + (d-t)K}{K \epsilon_0 d}$$

$$C_{eq} = \frac{K \epsilon_0 d}{t + (d-t)K} = \frac{K \epsilon_0 d}{t + dK - tK}$$

Extra Credit: What is the Faraday Constant? What is the numeric value?