Two parallel-plate capacitors are shown below. Both are identical except one has a dielectric slab inserted into the gap between the plates. Both capacitors contain the identical charges on their plates.

\[ E_\kappa = \frac{E}{\kappa}, \quad u = \frac{U}{A \, d}, \quad u_\kappa = \frac{U_\kappa}{A \, d}, \quad U = \frac{Q^2}{2 \, C}, \quad \text{and} \quad U_\kappa = \frac{Q^2}{2 \, C_\kappa}. \]

Find the ratio of the energy densities \( \frac{u_\kappa}{u} \).

A) \( \frac{u_\kappa}{u} = 1 \)

B) \( \frac{u_\kappa}{u} = \kappa \)

C) \( \frac{u_\kappa}{u} = \frac{1}{\kappa} \)
\[ u = \frac{U}{A d'}, \quad \text{and} \quad U = \frac{Q}{2C} = \frac{\varepsilon_0 E^2}{2} \]

\[ u_\kappa = \frac{U_\kappa}{A d'}, \quad \text{and} \quad U_\kappa = \frac{Q}{2\kappa C} = \frac{\varepsilon_0 E^2}{2\kappa} = \frac{\varepsilon_0 \kappa^2 E^2_\kappa}{2\kappa} = \kappa \frac{\varepsilon_0 E^2}{2} \]

\[ \frac{u_\kappa}{u} = \kappa. \]

Answer B.

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