

77. (a) Since  $u = \frac{1}{2}\kappa\epsilon_0 E^2$ , we select the material with the greatest value of  $\kappa E_{\max}^2$ , where  $E_{\max}$  is its dielectric strength. We therefore choose strontium titanate, with the corresponding minimum volume

$$\mathcal{V}_{\min} = \frac{U}{U_{\max}} = \frac{2U}{\kappa\epsilon_0 E_{\max}^2} = \frac{2(250 \text{ kJ})}{(310) \left(8.85 \times 10^{-12} \frac{\text{C}^2}{\text{N}\cdot\text{m}^2}\right) (8 \text{ kV/mm})^2} = 2.85 \text{ m}^3 .$$

- (b) We solve for  $\kappa'$  from  $U = \frac{1}{2}\kappa'\epsilon_0 E_{\max}^2 \mathcal{V}'_{\min}$ :

$$\kappa' = \frac{2U}{\epsilon_0 \mathcal{V}' E_{\max}^2} = \frac{2(250 \text{ kJ})}{\left(8.85 \times 10^{-12} \frac{\text{C}^2}{\text{N}\cdot\text{m}^2}\right) (0.0870 \text{ m}^3) (8 \text{ kV/mm})^2} = 1.01 \times 10^4 .$$