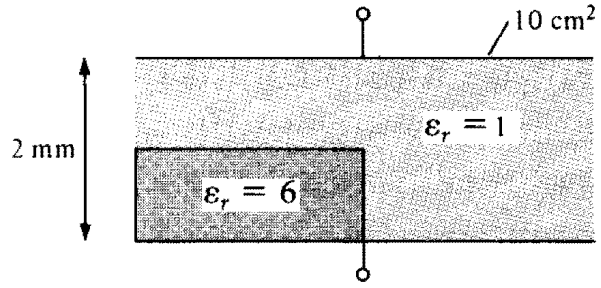
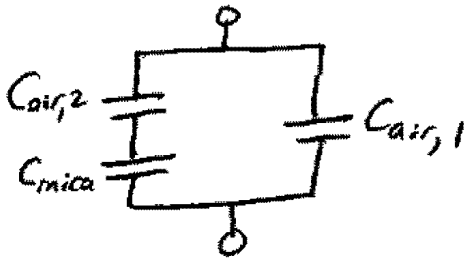
6.39 The parallel-plate capacitor of Figure 6.40 is quarter-filled with mica ($\varepsilon_r = 6$). Find the capacitance of the capacitor.

- Assume remaining dielectric is air.



Model



From (6.22)

$$C = \frac{\epsilon S}{d}$$

$$C_{air,1} = \frac{\epsilon_0 5cm^2}{2mm} = \frac{(8.854\times10^{-12})\,5cm^2\left(\frac{1m^2}{100^2cm^2}\right)}{2\times10^{-3}}$$

$$= 2.2135\,pF$$

$$C_{air,2} = \frac{\epsilon_0 5cm^2}{1mm} = \frac{(8.854\times10^{-12})\,5cm^2\left(\frac{1m^2}{100^2cm^2}\right)}{1\times10^{-3}}$$

$$= 4.427\,pF$$

$$C_{mica} = \frac{6\epsilon_0 5cm^2}{1mm} = 6C_{air,2} = 26.562\,pF$$

apply series + parallel capacitance rules

$$C_{TOT} = C_{air,1} + \left[\frac{1}{C_{air,2}} + \frac{1}{C_{mica}}\right]^{-1}$$

$$C_{TOT} = 6\,pF \text{ or } 6.0081\,pF$$