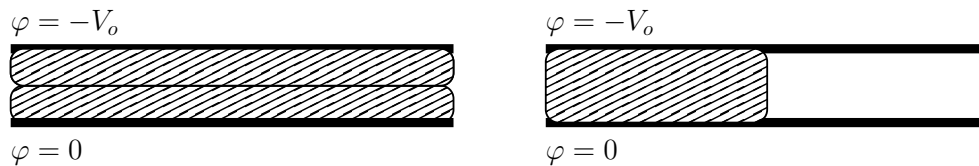


### Problem 1. Forces on a dielectric



- (a) Consider two dielectrics with permittivity  $\epsilon_1$  and  $\epsilon_2$  (with  $\epsilon_2$  above) separated by potential difference of  $-V_o$  as shown above. The between the plates is  $\ell$ , and each dielectric fills exactly half of the vertical space. Compute the force per area on the interface in terms of  $\epsilon_1, \epsilon_2, V$  and  $\ell$  using stress tensor methods.
- (b) Consider a dielectric of permittivity  $\epsilon$  half filling the space of a capacitor as shown in class. Use the stress tensor methods to determine the force on the conductor.
- (c) (Optional) Use energy considerations to calculate the force in part 2. Under a displacement of the dielectric by a distance  $dx$ , at fixed voltage, the change in energy of the system  $W$  is a consequence of the mechanical work  $-Fdx$ , and the work done by the battery maintaining the voltage,  $VdQ$ .

Consider a small displacement, calculate the energy change  $dW$  and  $VdQ$ . You should find that that  $VdQ = 2dW$ , so the force is  $F = +dW/dx$ .