

Massachusetts Institute of Technology  
Department of Physics  
Physics 8.022 - Fall 2002

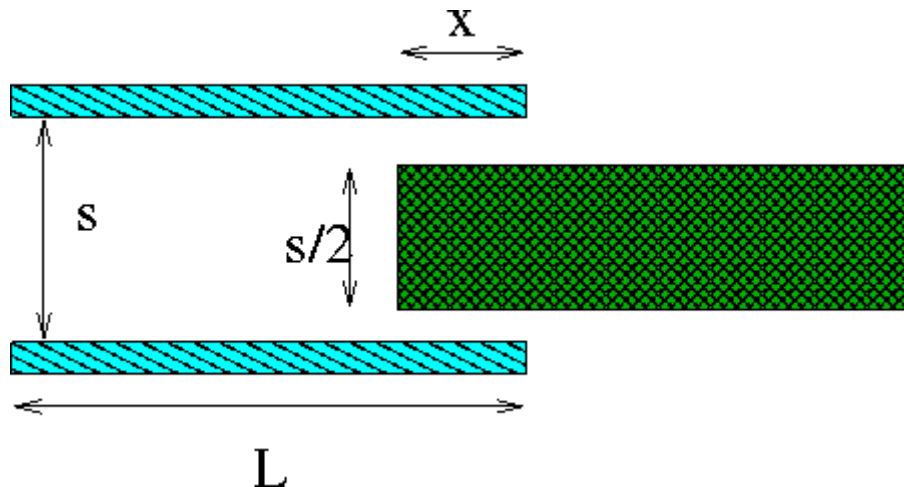
Assignment #4  
Conductors, Capacitance  
Current, Resistance, Ohm's Law

Reading *Purcell* Chapter 3 and 4.

Problem Set #4

Work on **all** problems. Not all problems receive equal points. Total points for this set is 100.

- (20 points) [1] Energy of a conductor in a capacitor.



Two flat square metal plates with sides of length  $L$  are arranged parallel to each other with a separation of  $S$  where  $S \ll L$ . This assumption allows you to neglect the fringing effects due to the finite size of the plates. A charge  $+Q$  is moved from the top plate to the bottom. A third, uncharged, conducting plate of the same size with thickness  $\frac{S}{2}$  is slid between the other two to a depth of  $x$ , maintaining the same spacing of  $\frac{S}{4}$  between its surface and that of the other two.

- What are the surface charge densities  $\sigma_W$  and  $\sigma_N$  on the lower plate adjacent to the wide and narrow gaps?
- What is the electric field in the wide and narrow gaps?
- What is the capacitance of the system?

