Set #7 - for Thursday, November 20

Read

HR&K, Vol. 2	Ch. 31
Purcell	Ch 4
	Ch. 10 Sec. 10.7 – 10.13

Solve

From HR&K

Ch.29 Problem 3

Ch. 31 Exercises 12, 13, 14, 22, 47, Problem 4

From Purcell

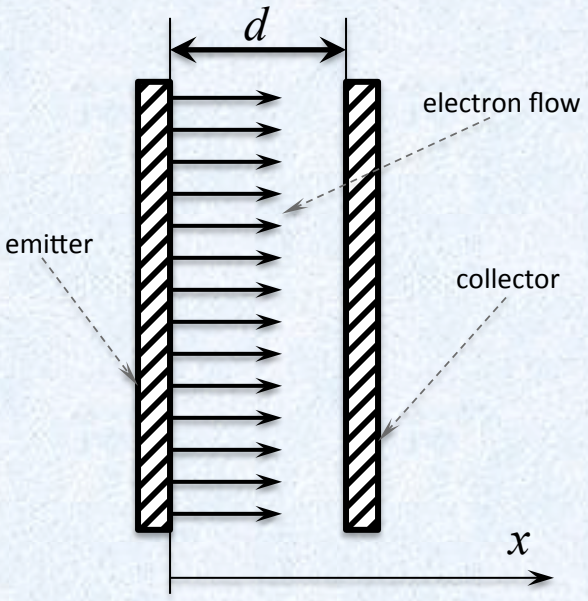
Ch. 4 Problem 4.31, 4.35, 4.36

Problem 1. In a certain old-fashioned electronics tube, electrons are emitted from a hot plane metal plate, and collected by a plane metal plate parallel to the emitter at a distance d away. (The distance d is small compared to the lateral dimensions of the plates.) The electric potential between the plates is given by $V = kx^{4/3}$ where x is the distance from the emitter.

a) What is the surface charge density σ on the emitter?

b) On the collector?

c) What is the volume charge density $\rho(x)$ for $0 < x < d$?



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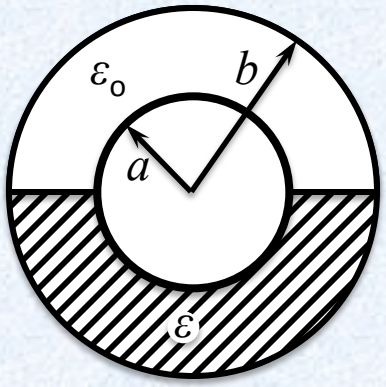
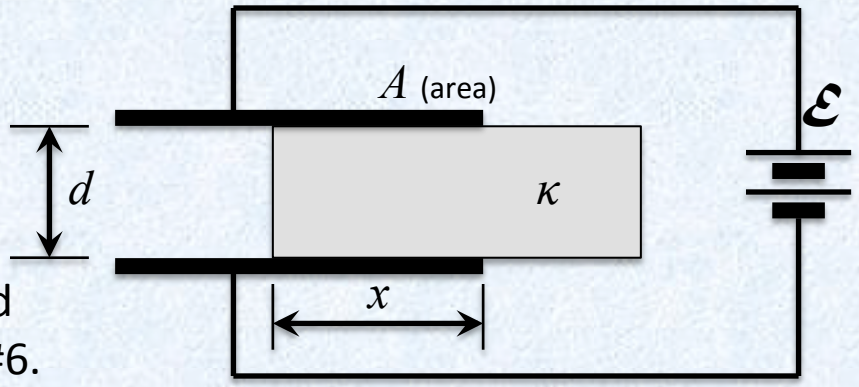
Problem 2. The space between two concentric spherical shells is half-filled with material of dielectric constant ε, as shown. The radii of the shells are a and b respectively. A charge Q is placed on the inner sphere and a charge $-Q$ is placed on the outer sphere.

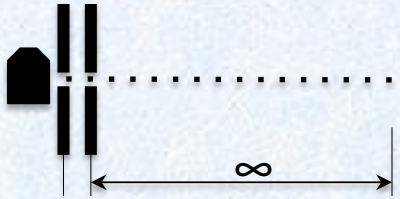


a) Find the fields $\vec{E}$, $\vec{D}$, and $\vec{P}$ at all points between the conductors.
b) What is the capacitance of this arrangement?

Problem 3. A dielectric slab of dielectric constant κ is inserted between the plates of a charged parallel plate capacitor. The plates of the capacitor are connected to constant emf as shown in the figure. Find the magnitude and direction of the force that we need to apply to the slab so that it is inserted slowly and at constant velocity. Discuss similarity and difference of this problem with problem 4 from Set #6.



Problem 4. Consider electron cannon that shoots electrons with the kinetic energy T_i in a plane-parallel capacitor with a small hole in it. The cannon is placed near the hole. The electron gains energy $e \times V$ inside the capacitor and moves far away. Calculate the value of the kinetic energy of electron at infinity.



Good Luck, Dr. B