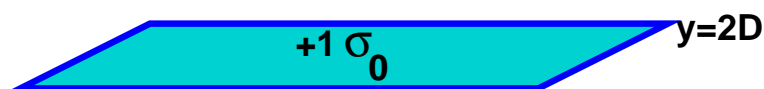


Physics 122: Practice Problem of the Day

Problem #03: Parallel Charged Insulating Sheets

Thursday, 15 Jan 2008

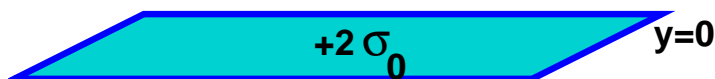
Region IV



Region III



Region II



Region I

Three very thin infinite parallel sheets each made of insulating material are arranged as shown above. Each sheet is embedded with a uniform surface charge density as indicated. The lower-most sheet corresponds to vertical position $y = 0$, the middle sheet has position $y = D$ and the upper-most sheet has position $y = 2D$. The three sheets divide all space into the four regions labeled I, II, III, and IV as shown.

Part (a) – Determine the magnitude and direction of the electric field $\vec{E}(\vec{r})$ in each of the four regions. Give your answer in terms of a *vector expression* as a function of position. Show your work.

Part (b) – A student says:

“When we calculate the field in Region IV, for example, we only need to worry about the surface charge density in the upper-most sheet because the electric field from the lower sheets is blocked by the insulating material.”

Is this student correct? If so, explain? If not, explain.

Part (c) – A student says the following:

“Consider this problem in general. If we have a stack of uniformly charged sheets, then regardless of the number of sheets and regardless of the specific values of surface charge densities placed on the various sheets, it will always be the case that the field in the uppermost region (above all sheets) will have the same magnitude and opposite direction as the field in the lowermost region (below all sheets).”

Is this student correct? If so, explain? If not, can you give a counter-example? Explain.