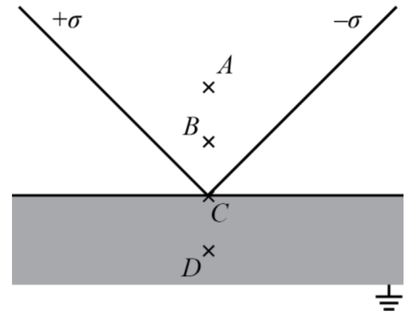
Name ______________________________________ **Student ID** _______________ **Score**________

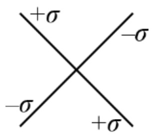
last *first*

IV. [20 points total] Tutorial question.

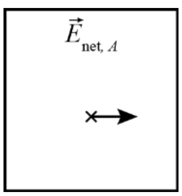
Two insulating semi-infinite sheets of charge $+\sigma$ and $-\sigma$ are placed above a large grounded conducting slab. Points *A*, *B*, *C*, and *D* are aligned vertically and are equally spaced, with point *C* being the point of intersection between the conducting plane and the sheets of charge, as shown at right.



a. [2 pts] Sketch and label the corresponding image-charge distribution that would fulfill the boundary condition of the grounded conducting slab.



b. [6 pts] In the box below, sketch the direction of the net electric field at point *A*. If the net electric field is zero, state so explicitly. Explain your reasoning.



If using the image charge distribution, we have a positive infinite sheet that makes an electric field up and to the right, whereas we have a negative infinite sheet that makes an electric field down at to the right. The vertical components will cancel, so the net electric field will only point to the right.

If not, you can still make the arguments that any positive charge has a negative charge pair that will cancel the vertical component, such that the net electric field must be horizontal. We have the general rule-of-thumb that the electric field points away from positive charge toward negative charge, so the net field should point to the right.

c. [6 pts] Is V_A, the electric potential at point *A greater than, less than,* or *equal to* V_B, that at point *B?* Explain your reasoning.

Equal to.

Superposition: Any positive charge has a paired negative charge from which both points A and B are equidistant. Thus the potential at both A and B is zero.

Line integral: If we take a path directly downward from point A to point B, we notice that $d\vec{l}$ *is perpendicular to the net electric field along each step. Thus by* $\Delta V = -\int \vec{E} \cdot d\vec{l}$*, the change of the potential from A to B must be zero.*

d. [6 pts] Is $|\vec{E}_B|$, the magnitude of the net electric field at point *B greater than, less than,* or *equal to* $|\vec{E}_D|$, that at point *D?* If the net electric field at either point is zero, state so explicitly. Explain your reasoning.

Greater than.

The net electric field is zero inside of a conductor in static equilibrium (at point D) whereas the net electric field at point B is non-zero (see part b.)