PHYS 203A - Winter 2020

Hw 4:

1. This problem is taken from Jackson. It is abit ill worded, but part of the point is to make sense of the wording. The last item is reworded and simplified.

   (a) Show that the Lorentz invariant lagrangian

   $$L = -\frac{m}{2} U_\alpha U^\alpha - \frac{q}{c} U^\alpha A_\alpha$$

   gives the correct relativistic equations of motion for a particle of mass m and charge q interacting with an external field described by the 4-vector potential $A^\alpha(x)$.

   (b) Define the canonical momenta and write the Hamiltonian.

2. (Pollack & Stump, 12.19) An observer measures the electric and magnetic field of a large charged plate, which is at rest in the xy plane with uniform charge density σ, in a region far from the edges of the plate.

   (a) What are her measured field $\vec{E}$ and $\vec{B}$?

   (b) Another observer is moving with speed v in the direction of the x-axis relative the first observer, and also measures the fields. What are these fields, $\vec{E}'$ and $\vec{B}'$ measured by the second observer?

   (c) The second observer attributes the fields to a surface charge density σ' and a current surface density $\vec{K}'$. Relate these quantities to σ.

3. Determine the motion of a particle of mass m and charge q moving in a constant (space and time independent) electric field $\vec{E}$.