Electrodynamics II: Assignment 4
Due February 10 at 11:00 am under instructor's door C503.

1. It's easy to show from Stokes' Theorem that, for a static circuit in a static medium, the experimentally-observed integral form of Faraday's Law (Jackson eq. 5.141) leads to the differential form (Jackson eq. 5.143). Now suppose the loop has relative velocity ***V*** with respect to the medium. Show that in this case the differential form still holds. (In this case the experimentally observed total time derivative has additional terms to account for the velocity; see, e.g., the footnote at the bottom of Jackson p. 210.)

2. (a) Show that retarded sources $[\rho]_{\text{ret}}$ and $[\mathbf{J}]_{\text{ret}}$ satisfy the usual continuity equation with the substitution of the source-gradient with the source- plus field-gradient $\nabla + \nabla'$. (b) As an aside, show that in an appropriate limit the usual continuity equation is recovered. (c) Thereby show the condition Jackson eq. 6.14 is satisfied for potentials Jackson eq.s. 6.48.

3. Two short problems. (a) Consider a spherical shell carrying a uniform surface charge σ. Use the stress tensor formalism to find the surface pressure. (b) Consider the infinitely-long solenoid having *n* turns/length and carrying current *I*. Use the stress tensor formalism to find the "hoop" stress on the solenoid.

4. In establishing momentum conservation Jackson eq. 6.122, finish the argument by showing that a term of the form found on the left-side-of-Jackson eq. 6.119 leads to the tensor divergence of the Maxwell stress tensor.

[ver 06Feb20 11:30]