

Physics 621 Homework Assignment 4

due Tuesday October 6 2009

1. Show that the gauge transformation $\psi \rightarrow \psi' = e^{iqf/\hbar}\psi$ leaves the Schrödinger equation invariant, when the vector and scalar potentials obey the gauge transformation $\vec{A} \rightarrow \vec{A}' = \vec{A} + \nabla f$ and $\phi \rightarrow \phi' = \phi - \frac{\partial f}{\partial t}$
2. A beam of particles, travelling with speed v , enter a region in which some of them are absorbed. The absorption can be modelled by the use of a complex potential $V = V_r - iV_i$ in the Schrödinger equation. Show that the rate that particles are absorbed, per unit volume, is $\frac{2}{\hbar}V_i\psi^*\psi$. Hint: consider the flux...
3. Show that if a particle is in a stationary state at a given time t_0 , then it will always remain in a stationary state.
4. Consider a charged particle moving in some region of electric and/or magnetic fields. Calculate the commutator of two orthogonal components of the mechanical momenta, *i.e.* calculate $[\Pi_i, \Pi_j]$.