

PHY 6645 - Quantum Mechanics I - Fall 2018
Homework #12, due November 14

1. A particle of mass μ and charge q moves in an electromagnetic field $\vec{E}(\vec{x}, t) = -\vec{\nabla}\Phi(\vec{x}, t) - \frac{1}{c}\partial_t\vec{A}(\vec{x}, t)$ and $\vec{B}(\vec{x}, t) = \vec{\nabla} \times \vec{A}(\vec{x}, t)$.

a) Show that the classical motion of the particle extremizes the action

$$S = \int_{t_1}^{t_2} dt \left[\frac{\mu}{2} \vec{v} \cdot \vec{v} - q(\Phi(\vec{x}, t) - \frac{1}{c} \vec{v} \cdot \vec{A}(\vec{x}, t)) \right] . \quad (0.1)$$

b) What is the canonical momentum \vec{p} conjugate to \vec{x} ?

c) Derive the Hamiltonian $H(\vec{x}, \vec{p}, t)$ for the particle's motion.

2. Problems 10.2.3, 10.3.5 and 11.4.3 in Shankar's book.