Phys 410 – Homework #6

All problems from Taylor.

1) 13.5
2) 13.13
3) 13.27
4) 13.28
5) 13.18 part (a) only. A few comments:
    a. For background, read Taylor section 7.9.
    b. **A** is the vector potential; the magnetic field (**B**) is derived from the vector potential by taking its curl: $\boldsymbol{B} = \boldsymbol{\nabla} \times \boldsymbol{A}$.
    c. You should derive the Hamiltonian by applying the definition given in Taylor's equation 13.22. The sum will be over the three spatial dimensions (x,y,z).
    d. To get the quantum mechanical Hamiltonian for a charged particle in a magnetic field, we take inspiration from the classical Hamiltonian that you derive in this problem and substitute $\boldsymbol{p} \rightarrow \frac{\hbar}{i}\boldsymbol{\nabla}$ to find:

$$\widehat{H} = \frac{1}{2m}\left(\frac{h}{i}\boldsymbol{\nabla} - q\boldsymbol{A}\right)^2 + qV$$

    Comparison with experiment demonstrates that this is, in fact, the correct Hamiltonian operator for this quantum system. See also Griffiths *Introduction to Quantum Mechanics*, 2nd edition, Problems 4.59 to 4.61.