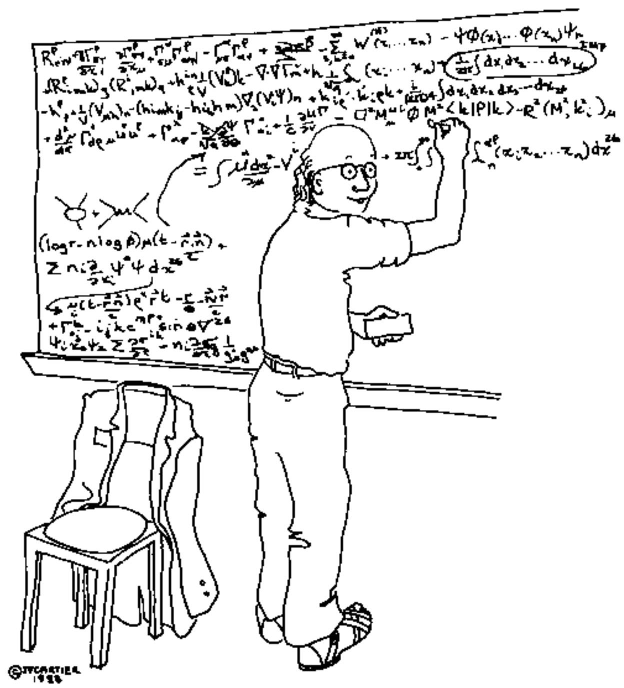
Phys 402
Spring 2009
Homework 6
Due Friday, March 27, 2009 @ 9 AM

1. Griffiths, 2nd Edition, Problem 5.7 **3 particles with overlapping wavefunctions. Remember the Slater determinant!**

2. Griffiths, 2nd Edition, Problem 5.12 **Ground state electron configurations of the first two rows of the periodic table**

3. Griffiths, 2nd Edition, Problem 9.1 **Dipole matrix elements of the Hydrogen atom**



"At this point we notice that this equation is beautifully simplified if we assume that space–time has 92 dimensions."

Physics 402
Spring 2009
Prof. Anlage
Discussion Worksheet for March 25, 2009

1. Quantum 2-body problem. Suppose you have two particles interacting only with each other in one dimension. The Hamiltonian is:

$$H = \frac{p_1^2}{2m_1} + \frac{p_2^2}{2m_2} + V(x_1 - x_2)$$

a) Re-express the Hamiltonian after transforming to center-of-mass and relative coordinates,

$$X = \frac{m_1 x_1 + m_2 x_2}{m_1 + m_2}, \qquad x = x_1 - x_2$$

Hint: use the chain rule *e.g.* $\frac{\partial}{\partial x_1} = \frac{\partial X}{\partial x_1}\frac{\partial}{\partial X} + \frac{\partial x}{\partial x_1}\frac{\partial}{\partial x}$

2. The Hamiltonian is now separable. Write a solution, separate them, and solve the center-of-mass Schrödinger equation.