

Assignment #6

Physics 322

Due by the end of classes (before you get your exam!)

Please answer all questions, and turn in your solutions as a hard copy. If you use Maple, you may turn in your Maple output, so long as it is well-documented (not just Maple code and output). All questions are of equal value.

1. April 15th handout questions!
2. A perturbation $W = \alpha\delta(x - \frac{a}{2})$ is placed in the middle of an infinite potential well that spans $0 \leq x \leq a$.
 - (a) Find the first-order perturbation to the n -th energy level, E_n^1 .
 - (b) Determine the conditions in which this perturbation is non-zero.
 - (c) Calculate the first three terms in the first-order wavefunction correction $\langle x | \psi_1^1 \rangle = \psi_1^1(x)$.
3.
 - (a) Suppose a solution to the KG equation is $\phi = e^{-i(Et - px)}$. Write down the equivalent negative energy solution, and describe what it represents (as we did in class).
 - (b) For your solution in (a), what does ϕ^* represent?
 - (c) Consider again the KG equation for a charged particle interacting with an electromagnetic field:

$$\left[(\partial_\mu + iqA_\mu)(\partial^\mu + iqA^\mu) + m^2 \right] \phi = 0$$

Take the complex-conjugate of this equation, so that you have a new equation for ϕ^* . Use this equation to further describe the difference between ϕ and ϕ^* (that is, what else does this equation tell you about antiparticles?).