

Quantum Mechanics III, FK8007
Autumn, 2011
Fysikum, SU
Lars Bergström

Take-home Problems, set VI – deadline December 19

1. Estimate the ground state energy of a particle of mass m , moving in a linear potential,

$$V(x) = \kappa \cdot |x|, \quad -\infty < x < \infty, \quad \kappa > 0$$

using the variational trial wave function $\Psi(x) = e^{-\lambda|x|}$, where λ is to be varied.

[Hint: $\frac{d}{dx}|x| = \text{sign}(x)$, with $\text{sign}(x) = -1$ for $x < 0$, $\text{sign}(x) = +1$ for $x \geq 0$; $\frac{d}{dx}\text{sign}(x) = 2\delta(x)$.] (0.5p)

2. A two dimensional harmonic oscillator is in the level with degenerate energy

$$E = 2\hbar\omega.$$

Compute the effects of a perturbation of the form $V' = \alpha xy$ to this energy level (α is a real, positive constant).

(0.5p)