

Test 2 (1 June 2014)
ZCT 205 Quantum Mechanics

Name:

Matrix Number:

1. The ground state of a particle bounded to a harmonic potential well

$$V(x) = \frac{1}{2}m\omega^2x^2,$$

with ω a positive constant, is

$$\psi_0(x) = e^{-\xi^2/2}, \quad \xi = x\sqrt{\frac{m\omega}{\hbar}}$$

- (a) Calculate the expectation of the momentum for the particle in the ground state of the harmonic potential, $\langle \hat{p} \rangle$.
- (b) Calculate the expectation of (momentum)² for the particle in the ground state of the harmonic potential, $\langle \hat{p}^2 \rangle$.
- (c) From your answer in 1d, 1e, what is the uncertainty in the momentum, σ_p ?
- (d) Calculate the expectation of the position for the particle in the ground state of the harmonic potential, $\langle \hat{x} \rangle$.
- (e) Calculate the expectation of (position)² for the particle in the ground state of the harmonic potential, $\langle \hat{x}^2 \rangle$.
- (f) What is the uncertainty of the position, σ_x , of the particle in the ground state?
- (g) What is product of $\sigma_x\sigma_p$?
- (h) Comment on your answer in 1g.