

PHYSICS DEPARTMENT

PHYSICS 439: QUANTUM MECHANICS

PROBLEM SET 10

DATE: _____

NAME: _____

PROBLEM 1 (20 points)

Consider a particle in a one-dimensional potential well

defined by $V(x) = 0$ for $0 < x < a$ and $V(x) = \infty$ elsewhere.

(a) Find the energy eigenvalues E_n and the corresponding normalized wave functions $\psi_n(x)$ for $n = 1, 2, 3$.

(b) Calculate the expectation value of the momentum $\langle p \rangle$ for the state $n=1$.

(c) Calculate the expectation value of the kinetic energy $\langle T \rangle$ for the state $n=1$.

(d) Calculate the expectation value of the potential energy $\langle V \rangle$ for the state $n=1$.

(e) Calculate the expectation value of the total energy $\langle E \rangle$ for the state $n=1$.

(f) Calculate the expectation value of the position $\langle x \rangle$ for the state $n=1$.

(g) Calculate the expectation value of the momentum squared $\langle p^2 \rangle$ for the state $n=1$.

(h) Calculate the expectation value of the kinetic energy $\langle T \rangle$ for the state $n=2$.

(i) Calculate the expectation value of the potential energy $\langle V \rangle$ for the state $n=2$.

(j) Calculate the expectation value of the total energy $\langle E \rangle$ for the state $n=2$.

(k) Calculate the expectation value of the position $\langle x \rangle$ for the state $n=2$.

(l) Calculate the expectation value of the momentum squared $\langle p^2 \rangle$ for the state $n=2$.

(m) Calculate the expectation value of the kinetic energy $\langle T \rangle$ for the state $n=3$.

(n) Calculate the expectation value of the potential energy $\langle V \rangle$ for the state $n=3$.

(o) Calculate the expectation value of the total energy $\langle E \rangle$ for the state $n=3$.

(p) Calculate the expectation value of the position $\langle x \rangle$ for the state $n=3$.

(q) Calculate the expectation value of the momentum squared $\langle p^2 \rangle$ for the state $n=3$.

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