5.73

Quiz 21

$[\mathbf{x},\mathbf{p}] = i\hbar$

$\mathbf{H} = \mathbf{p}^2/2m + (1/2)k\mathbf{x}^2$ Harmonic Oscillator

Force $= -\dfrac{dV(x)}{dx}$ (negative gradient of potential energy)

$$F = m\frac{d^2x}{dt^2} = \frac{dp}{dt}$$
$$p = m\frac{dx}{dt}$$

Newton's laws

$$\frac{d\langle \mathbf{A} \rangle}{dt} = \frac{i}{\hbar}\langle [\mathbf{H},\mathbf{A}] \rangle + \left\langle \frac{\partial \mathbf{A}}{\partial t} \right\rangle$$ Heisenberg's Equation of Motion

A. Evaluate $[\mathbf{H},\mathbf{p}]$

B. Relate $\dfrac{d}{dt}\langle \mathbf{p} \rangle$ to $\langle \mathbf{x} \rangle$.

C. Evaluate $[\mathbf{H},\mathbf{x}]$.

D. Relate $\dfrac{d}{dt}\langle \mathbf{x} \rangle$ to $\langle \mathbf{p} \rangle$

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