Postulates of QM

Postulate 1

The state of a quantum-mechanical system is completely specified by a function ψ(x) that depends upon the coordinate of the particle. All possible information about the system can be derived from ψ(x). This function, called the wave function or the state function, has the important property that ψ(x)ψ(x) dx is the probability that the particle lies in the interval dx, located at the position x.*

Recall that wavefunctions that satisfy $\int_{allspace} \psi_n^*(x)\psi_n(x)dx = 1$ are said to be normalized.

Only normalizable functions are acceptable as wavefunctions. So functions must:

1. be single-valued
2. be continuous
3. be finite
4. not diverge as $x \rightarrow \infty$

Postulates of QM 4-2

Postulate 2

To every observable in classical mechanics there corresponds a linear operator in quantum mechanics.

Postulate 3

In any measurement of the observable associated with the operator, $\hat{A}$*, the only values that will ever be observed are the eigenvalues* a_n*, which satisfy the eigenvalue equation:* $\hat{A}\psi_n = a_n\psi_n$.

Postulate 4

If a system is in a state described by a normalized wave function ψ(x), then the average value of the observable corrresponding to $\hat{A}$ is given by:

$$< a >= \int_{allspace} \psi^*(x)\hat{A}\psi(x)dx$$

Postulates of QM

Postulate 5

The wave function, or state function, of a system evolves in time according to the time-dependent Schrödinger equation:

$$\hat{H}\Psi(x,t) = i\hbar \frac{\partial \Psi(x,t)}{\partial t}$$

Separation of Variables: Let $\Psi(x,t) = \psi(x) f(t)$

$$\frac{1}{\psi(x)}\hat{H}\psi(x) = \frac{i\hbar}{f(t)}\frac{df(t)}{dt} = E$$

Time independent Schrödinger Equation: $\hat{H}\psi(x) = E\psi(x)$

Time dependent Schrödinger Equation: $\frac{df(t)}{dt} = -\frac{i}{\hbar}Ef(t)$