Postulates of Quantum Mechanics

1.To every physical observable A there corresponds a linear Hermitian operator **A** that is established by postulate or by extension from other postulates. For example

a. The position operator is $\mathbf{r} = x\mathbf{i} + y\mathbf{j} + z\mathbf{k}$

b. The linear momentum operator is $\mathbf{p} = (\hbar/i)\nabla$

c. The Hamiltonian operator corresponds to the total energy of the system.

d. Etc.

2. Everything measurable that can be known about a system is contained in the wavefunction $\Psi(\mathbf{r},t)$ which is obtained from the Schrodinger Equation

$$\mathbf{H}\Psi = i\hbar\,\partial\Psi/\partial t$$

where **H** is the Hamiltonian operator.

3. A measurement of a physical observable A, whose corresponding operator is **A**, can return only one of the eigenvalues a_n of the eigenvalue equation

$$\mathbf{A}\varphi_n(\mathbf{r}) = a_n\varphi_n$$

4. The probability $c_n{}^*c_n$ of measuring a particular eigenvalue a_n (corresponding to observable A) is obtained by expressing $\Psi(\mathbf{r},t)$ in the orthonormal basis of eigenvectors (eigenfunctions) φ_n where c_n is the n-th component in the expansion

$$\Psi(\mathbf{r},t) = \sum c_n(t)\varphi_n(\mathbf{r})$$

It follows from this that the expectation value (defined as the mean or average value of many measurements) of an observable A is obtained from the wavefunction Ψ through

$$\langle A\rangle = \int \Psi^* \mathbf{A}\Psi d^3x$$

5. If the measurement at time t_o of physical observable A results in eigenvalue a_n, then, regardless of its earlier state, the state of the system immediately after the measurement is φ_n where φ_n is the eigenstate corresponding to eigenvalue a_n. (Another way of saying this is that the act of making a measurement causes the wavefunction to collapse on the eigenstate corresponding to the measurement.)