Quantum mechanics main points II

Quantum mechanics main points I is still important since it contains the most basic foundations of the subject.

Since Chapters Q3-Q6 were on the midterm, I do not have any new comments about those.

As always, the chapter introductions are a good place to start in reviewing and organizing the most important topics.

Chapter Q7: This lays out the basics of bound states and the associated quantization of energy. The details of the Bohr model are not important because they are wrong. Nevertheless, they give the right answers for the energy levels E_n and the radius a_0, which are important.

Chapter Q8: This is essentially a continuation of Chapter 7. The connection between energy levels and spectra is a big deal in quantum mechanics. Also appearing here are the important topics of spin and the exclusion principle.

Chapter Q9: Here you can limit your attention to the hydrogen atom. The things to focus on are the quantum numbers that label the stationary states and the associated energy levels. (But you already know the energies; that was back in Chapter 7.)

Chapters Q10 and Q11: These give a good qualitative and intuitive introduction to the time-independent Schroedinger in the position basis in one dimension. Most of it is summarized in the rules on page 203.

Feynman Chapter 5, Spin One: This is mainly a long discussion to motivate the rules of Eqs. 5.27. Concentrate on how this machinery is used in very simple cases.

QM II, Time dependence of amplitudes: The important results here are

$\langle \varphi, t \mid E \rangle \propto e^{-iEt/\hbar}$ and $\langle j | U(t) | i \rangle = \delta_{ij} e^{-iE_i t/\hbar}$.

for stationary or definite-energy states

QM III, Time dependence of amplitudes: Schroedinger equation: This gives the general view of the Schroedinger equation including time dependence and in any basis

$$i\hbar \frac{\partial \psi(i,t)}{\partial t} = \sum_j \langle i|H|j\rangle \psi(j,t).$$

It is more important to understand what the equation says and does than it is to know the details of how it was derived. Check out how it is used in the simple cases in the *Examples* section.

QM IV, Schroedinger equation in position basis: In this document, the bottom lines are

$$i\hbar \frac{\partial \psi(x,t)}{\partial t} = -\frac{\hbar^2}{2m}\frac{\partial^2 \psi(x,t)}{\partial x^2} + V(x)\psi(x,t)$$

$$\psi_E(x,t) = e^{-iEt/\hbar}\psi_E(x)$$

$$E\psi_E(x) = -\frac{\hbar^2}{2m}\frac{\partial^2 \psi_E(x)}{\partial x^2} + V(x)\psi_E(x).$$

This gives the relation between stationary states, the time-dependent, and time-independent Schroedinger equations.

QM V, Identical particles, statistics, and spin: From this, it is sufficient to grasp what it means to say a particle is a fermion or a boson and what the spin and statistics theorem says. One result from this discussion is the Pauli exclusion principle.

A few words to the wise or at least to those of you who need to use your time wisely: Before getting into the more difficult and sophisticated points, make sure that you have a good grasp of the easier and more fundamental things. Make sure that you have a good understanding of the text by Moore before you attack the handouts. In the handouts, try to keep sight of the general line of the arguments and how the ideas fit together before burrowing into the intricacies of the derivations. When you want more detail or explanation than is in the handouts, then check the relevant readings in Feynman. In this subject, one thing follows from another, so that it is impossible to understand one thing without understanding what preceded it.