Question 1

What does Merzbacher establish in section 15.1 and what formulas do you plan to memorize from this section?

In Section 15.1, Merzbacher establishes a connection between the formal quantum theory of states $|\Psi(t)\rangle$ and the quantum mechanics of wavefunctions $\psi(x,t)$ or $\psi(p,t)$ in 3D. Assuming that one already knows the orthogonality, completeness, commutation relations, and eigen equations, there is probably not much to memorize since all the results can be derived relatively easily if needed. One critical point is that the inner product (overlap) of the state and (say) a coordinate eigenstate, represents the probability amplitude of finding the state at this coordinate as stated in Eq. (15.5).

Question 2

What is the physical meaning of a propagator? For which systems does Merzbacher give analytic expressions of the propagators? And what different methods does he present to find propagators?

The propagator is the conditional probability amplitude, i.e., the probability amplitude that the system is at location $x'$ at time $t'$ given that it was at location $x$ at time $t$. The book gives the propagators for the free particle, the SHO, and the time-dependent (but otherwise constant) force. The methods used are the Green function expansion, solving the quantum Hamilton-Jacobi using symmetry considerations and some guessing.

Question 3

What is a Feynman path integral and how does it relate to the propagator?

It is a new kind of integral with paths as "integration variables" and it forms the basis for a quantization procedure based on the Lagrangian and different from the canonical (Hamiltonian) procedure of Dirac. It was invented by Feynman based on initial work by Dirac. It has an appealing interpretation (see Fig. 15.1), is an extension of classical trajectories, and does not involve the more abstract formalism of noncommuting operators. The propagator can be written exactly as a Feynman path integral as in Eq. (15.77).

Question G

What remarkable (surprising, insightful, powerful, dubious) statement(s) did you find in your reading of Merzbacher’s Chapter 14? What exactly do you find remarkable about the statement(s)?

Question H

Which exercise and which problem from Merzbacher’s Chapter 14 would you like to be in charge of solving? Why?