

Theory Questions 2019 QM III

1. From quantum to classical : The free particle
2. Harmonic oscillator : Definition of coherent states
3. Harmonic oscillator : Coherent states in terms of creation and annihilation operators
4. Harmonic oscillator : Properties of coherent states
5. Harmonic oscillator : The wave function of coherent states in the x -representation
6. The Ehrenfest theorem
7. Path integral representation of the quantum evolution operator
8. Free particle: evolution amplitude via the path integral
9. Physical interpretation of the path integral and the principle of minimal action
10. WKB approximation : The semiclassical wave function and its range of validity
11. WKB approximation : Turning points and matching conditions
12. WKB approximation : Applicability of the matching condition formula leading to the wave-function $\cos(\int p dx + \pi/4)$ in the allowed region.
13. WKB approximation : Bohr-Sommerfeld quantisation condition
14. WKB approximation : Nearby energy levels and the Planck formula
15. WKB approximation : Tunneling probability through a potential barrier
16. WKB approximation : Lifetime of a metastable state
17. WKB approximation : Splitting of energy levels in the double-well potential
18. Scattering in classical physics: differential cross section, total cross section, luminosity
19. Scattering in quantum mechanics: Moller operators and S-matrix
20. S-matrix and the evolution operator in the interaction picture

21. Properties of S-matrix and Moller operators: isometric and unitary operators
22. Energy conservation and S-matrix
23. S-matrix and scattering amplitudes
24. The optical theorem
25. Differential cross section and the scattering amplitude
26. Green's function and Moller operators
27. Analytic properties of Green's function
28. T-matrix and its on-shell matrix elements
29. Lippmann-Schwinger equation for the Green's function and the T-matrix
30. The scattering amplitude in the first Born approximation
31. Scattering amplitude and the stationary scattering states
32. S-matrix as T-product
33. Early attempts to construct relativistic quantum mechanics
34. Relativistic quantum mechanics: The Dirac equation
35. The Pauli equation
36. Relativistic description of bosons
37. Relativistic description of fermions