Exam 2 Outline
Chapters 5–6

Chapter 5: Bound States

- The time-dependent and time-independent Schrodinger equations
- What is the solution of the time-independent Schrodinger equation? How does it vary in time?
- What restrictions must a wavefunction satisfy to describe an actual object?
- What is the difference between a bound and unbound states?
- Be able to read a potential diagram, and how to read the speed of the particle from it?

Infinite Square Well

- What is the infinite well potential?
- What are its stationary solutions?
- What are their energies? Why are they quantized?
- Why isn't the ground state energy zero?
- What is the probability that the particle will be found in a certain portion of the well?

Finite Square Well

- What do the stationary solutions look like for the finite square well?
- How far do the waves penetrate into the forbidden region?
- How do the energy levels of the finite well compare with the energy levels of the infinite well?

Harmonic Oscillator

- What is the harmonic oscillator potential $U(x)$?
- What are the possible energy states of the wavefunctions in this potential?
- What do the wavefunctions look like (roughly)?

Expectation Values and Operators

- How do you find the expectation value of a function, $\langle f(x) \rangle$?
- How do you find the standard deviation $\Delta f(x)$ of a function?
- What is an observable?
- What is an operator?
- How do you find the expectation value of an observable?
- What is the operator $\hat{p}$? $\hat{x}$? $\widehat{E_K}$?
- What is an eigenfunction of an operator? The eigenvalue?
- What is the eigenfunction of $\hat{p}$? $\hat{x}$?

Chapter 6: Unbound States

- What is $\psi(x)$ for a particle moving to the right? To the left?
- How can we write the wavefunction of a particle that is incident on a potential, and is part reflected and part transmitted?
- What is the relationship between the potential and the force?
- What happens when a particle comes upon a potential step?
- What are the reflection and transmission probabilities R and T?
- Sketch the wavefunction of a particle incident on a narrow potential barrier.
- What is quantum tunnelling?
- What are the conditions for tunnelling to occur?
- Give some examples of tunnelling in real life and why it's so important.
- What does the function $f(x - vt)$ represent, for some generic function f?
- What is a *dispersion relation*?
- What is the difference between phase velocity and group velocity? How can you calculate both?