Exercise 4.1
Heisenberg and deBroglie

1. An electron in a ground state hydrogen atom has an approximate speed of 2.2×10^6 m/s.

(a) Calculate the deBroglie wavelength for this electron.

(b) The Bohr radius of a ground state hydrogen atom is 53 pm. How does the deBroglie wavelength of the electron compare to the size of the hydrogen atom? How does it compare to the size of the electron (if treated as a particle)?

(c) What does this suggest about the behaviour of an electron within an atom?

2.

(a) If the speed of the electron can be measured to within 10.% of the correct value (i.e. if the electron's speed is known to be 2.2×10^6 m/s ±10%), how accurately is it possible to measure the electron's position?

(b) If the speed of the electron can be measured to within 1.0% of the correct value (i.e. if the electron's speed is known to be 2.2×10^6 m/s ±1%), how accurately is it possible to measure the electron's position?

(c) Under what circumstances (if any), could you measure the electron's position exactly? (i.e. with no uncertainty)

(d) What does this suggest about the behaviour of an electron within an atom?