Bohr's Successes and failures: The wave nature of the electron

The Photon and Quantum

- Read 192-194 (up to "The significance...")
- Introduced to the concept of the photon
- light is still traveling as a wave, but not as an unlimited one

Like this 

Not this 

- The energy of a photon is: $E = h\nu$
- I.e. energy is dependent upon frequency
- Pg. 219 - 220, Q. 6.12, 6.19, 6.21, 6.23

Explaining the line spectrum

- Read remainder of pg. 194
- The jumps between orbitals have different energies (like jumping between different steps on a staircase)
- Energy dictates frequency ($E = h\nu$)
- frequency dictates type of EM radiation, or type of colour
- Conclusion: the different lines of the spectra are explained by the different energies between orbitals

The Bohr model of the atom

- Recall that Bohr added to Rutherford's model the idea of fixed shells
- Evidence for Bohr's Theory came from the existence of line spectra
- However, Bohr had difficulty explaining other observations
- Study notes

Important aspects of Bohr's model

- Introduced the concept of n

Q - What is n (give name and explain)

A –

- Introduced the concept of ground state: the lowest energy state of an atom
- For hydrogen the ground state is when the electron is in n = 1. Later, elements with more than 2 electrons have ground states where some electrons are in n =2 or higher.

Bohr: testing concepts

Q - How many lines are in the spectrum for H (i.e. how many possible values of E exist)?

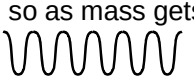
A –

Q - Why don't we see all the lines (2 reasons)

A1 -

The Wave Nature of Matter

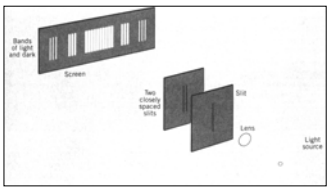
- Reference 6.4
- Louis de Broglie (1924) suggested that electrons are also waves (not particles)
- This can be difficult to comprehend: normally we perceive objects as solid.
- The reason objects seem solid is because they have a small wave length…
- According to De Broglie: $\lambda = h/mv$
- All that really matters is that mass is on the bottom, so as mass gets large, λ gets small

small m  large m 

Evidence For Wave Nature

- 2 lines of evidence show that electrons have wave properties: 1) diffraction pattern of light, 2) electron microscopes

1) Areas of light and dark indicate typical interference pattern of waves such as water waves
- Fig 6.16



2) The Electron Microscope

- The wavelength determines the resolution of a microscope

A) Visible light has a wavelength of ≈500 nm

B) Electrons have a wavelength of ≈0.005 nm

- A shorter wavelength means waves cannot slip pass edges of a sample, thus yielding a sharper image

Read 6.4,
Do 6.33, 6.34
on Pg. 220.