Lecture 1 Introduction

Monday, 29 February 2016
10:15 AM

Significant figures

1. All non-zero digits are significant
2. Zeroes appearing between non-zero digits are significant
3. Leading zeroes are not significant
4. Trailing zeroes in a number containing a decimal point are significant

How many significant figures do I use in my answer?

- Use the same precision as what is given in the question
- If more than one precision is given, use the least precise number of significant figures

Recall from HSC,
Allotropes are different structural arrangements of the same atoms of an element

- Carbon forms graphite and diamond allotropes
- Oxygen forms diatomic and triatomic molecules

Lecture 2 The Nucleus

Tuesday, 1 March 2016
12:00 PM

Atom	An electrically neutral particle. Formed from positively charged nucleus and a cloud of negatively charged electrons.

Neutrons dampen electrostatic forces in the nucleus

Atomic number (Z)	Protons
Mass number (A)	Protons + neutrons

Nuclide	An atom with a particular mass number and atomic number
Isotope	Nuclides with the same atomic number (Z) but different mass numbers (A)

Atomic mass unit (amu) is defined by setting the mass of C-12 to exactly 12 amu. The atomic mass of an element is the weighted average of the amu of the isotopes present in nature.

<u>Nuclear reactions</u>

Reaction rate is controlled by the number of atoms present.

Nucleogenesis	Formation of new nuclei from existing nucleons

All atoms are generated from the simplest nuclide, hydrogen, by nuclear reactions

Balancing nuclear reactions is simple. Total mass number should be the same on both sides. Total atomic numbers should be the same on both sides.

Alpha decay	releasing He nucleus
Beta decay	neutron converted to proton, production of beta particle
Positron decay	proton converted to neutron, production of position

Proton	p
Neutron	n
Electron	e^- OR $_{-1}\beta$
Positron	e^+ OR $_{1}\beta$

Lecture 7 s-Orbitals

Thursday, 10 March 2016
12:23 PM

Matter waves (or particle waves) are described by standing waves

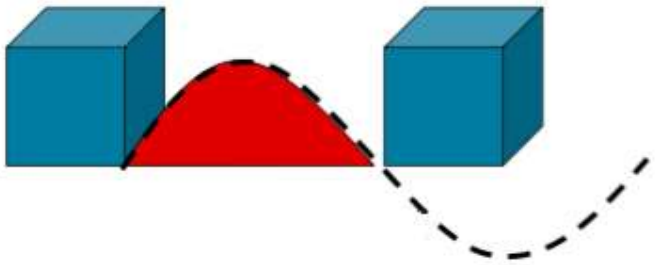
- Can be one, two, or three dimensional
- Minimum energy (low frequency) waveform has no node

Consider matter waves in the context of music:

	MUSIC	MATTER WAVES
More nodes	Shorter wavelength, higher frequency	higher momentum, higher E_k
More confinement	Higher frequency (pitch)	Higher momentum, higher E_k

Electrons resist being confined (particle in a box model)

- When confined between two walls, it will adopt a minimum energy waveform
- Wavelength is twice the confined distance



- Confinement INCREASES momentum, DECREASES wavelength

Electrons are not stationary

- There is a minimum energy waveform
- A bound electron is described by a 3D standing wave

"An electron will not fall right down into the nucleus, because to do so would make a very tight wave with a very short wavelength, high momentum and thus high kinetic energy. The minimum energy waveform is a compromise."

Electron density

- Wave function, ψ, mathematical function describing the state of an electron
- Ψ^2 is proportional to electron density
- Ψ^2 is proportional to the probability of finding in electron at a particular point in space

Standing wave

- Wave does not propagate, zero point does not move
- Node: point were amplitude is 0.
- Lowest energy waveform has no nodes

Lecture 9 Higher orbitals

Thursday, 10 March 2016
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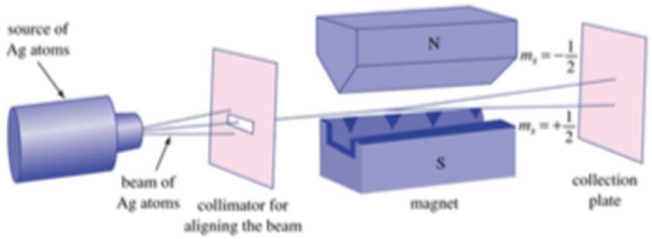
Electrons behave like a magnet

- Atoms with an odd number of electrons may be deflected in an inhomogeneous magnetic field
- Magnetic spin can take on only two values. +1/2(spin up) and -1/2 (spin down).
- Every orbital can take a spin up electron and a spin down electron.
- Stern-Gerlach experiment



<u>Pauli exclusion principle:</u>
No two electrons in an atom may be in the same quantum state (quantum numbers: n, l, ml, and ms).

<u>Aufbau principle:</u>
Electrons in atoms (and molecules) generally exist in their lowest possible energy state -- ground state.

Electron 1 goes into the 1s orbital (n=1, l=0, m_l=0) with m_s = +½

Electron 2 goes into the 1s orbital (n=1, l=0, m_l=0) with m_s = -½