Summary

Unit 2 - Atomic structure

Subject	Year	Start date	Duration
Chemistry	IB1	Week 3, September	2 weeks 8 hours

Course Part

Core and Higher level

Description

Almost all of an atom's mass is in its tiny, positively charged nucleus. Energy transitions of the electrons in atoms and molecules can only be understood using a quantum model.

Inquiry & Purpose

Inquiry / Higher Order Questions

Type	Inquiry Questions
Concept-based	What are the implications of the Heisenberg Uncertainty Principle for the limits of human knowledge? To what degree can sense perception give us objective knowledge about the world? How is it meaningful to talk of properties that can never be observed usi

Curriculum

Aims

Acquire a body of knowledge, methods and techniques that characterize science and technology

Apply and use a body of knowledge, methods and techniques that characterize science and technology

Develop an ability to analyse, evaluate and synthesize scientific information

Develop a critical awareness of the need for, and the value of, effective collaboration and communication during scientific activities

Develop and apply 21st century communication skills in the study of science

Objectives

Demonstrate knowledge and understanding of

facts, concepts, and terminology

Apply

methods of communicating scientific information

Formulate, analyse and evaluate

scientific explanations

Syllabus Content

Core

2. Atomic structure

2.1 The nuclear atom

Nature of science:

Evidence and improvements in instrumentation - alpha particles were used in the development of the nuclear model of the atom that was first proposed by Rutherford.

Paradigm shifts - the subatomic particle theory of matter represents a paradigm shift in science that occurred in the late 1800s.

Understandings:

Atoms contain a positively charged dense nucleus composed of protons and neutrons (nucleons).

Negatively charged electrons occupy the space outside the nucleus.

The mass spectrometer is used to determine the relative atomic mass of an element from its isotopic composition.

Applications and skills:

Use of the nuclear symbol notation AZX to deduce the number of protons, neutrons and electrons in atoms and ions.

Calculations involving non-integer relative atomic masses and abundance of isotopes from given data, including mass spectra.

2.2 Electron configuration

Nature of science:

Developments in scientific research follow improvements in apparatus - the use of electricity and magnetism in Thomson's cathode rays.

Theories being superseded—quantum mechanics is among the most current models of the atom.

Use theories to explain natural phenomena - line spectra explained by the Bohr model of the atom.

Understandings:

Emission spectra are produced when photons are emitted from atoms as excited electrons return to a lower energy level.

The line emission spectrum of hydrogen provides evidence for the existence of electrons in discrete energy levels, which converge at higher energies.

The main energy level or shell is given an integer number, n, and can hold a maximum number of electrons, $2n^2$.

A more detailed model of the atom describes the division of the main energy level into s, p, d and f sub-levels of successively higher energies.

Sub-levels contain a fixed number of orbitals, regions of space where there is a high probability of finding an electron.

Each orbital has a defined energy state for a given electronic configuration and chemical environment and can hold two electrons of opposite spin.

Applications and skills:

Description of the relationship between colour, wavelength, frequency and energy across the electromagnetic spectrum.

Distinction between a continuous spectrum and a line spectrum.

Description of the emission spectrum of the hydrogen atom, including the relationships between the lines and energy transitions to the first, second and third energy levels.

Recognition of the shape of an s atomic orbital and the px, py and pz atomic orbitals.

Application of the Aufbau principle, Hund's rule and the Pauli exclusion principle to write electron configurations for atoms and ions up to Z = 36.

Additional higher level

12. Atomic structure

12.1 Electrons in atoms

Nature of science:

Experimental evidence to support theories - emission spectra provide evidence for the existence of energy levels.

Understandings:

In an emission spectrum, the limit of convergence at higher frequency corresponds to the first ionization energy.

Trends in first ionization energy across periods account for the existence of main energy levels and sub-levels in atoms.

Successive ionization energy data for an element give information that shows relations to electron configurations.

Applications and skills:

Solving problems using E=hv.

Calculation of the value of the first ionization energy from spectral data which gives the wavelength or frequency of the convergence limit.

Deduction of the group of an element from its successive ionization energy data.

Explanation of the trends and discontinuities in first ionization energy across a period.

ATL Skills

Approaches to Learning

Thinking

- In this unit, we will

  ask students to formulate a reasoned argument to support their opinion or conclusion

  reward a new personal understanding, solution or approach to an issue

  ask open questions

  set students a task which required higher-order thinking skills (such as analysis or evaluation)

  build on a specific prior task

  include a reflection activity

  make a link to TOK

Self-management

- In this unit, we will

  set deadlines for students to meet

  require students to revise and improve on work previously submitted

  ask students to set their own learning goals

  ask students to break down a larger task into specific steps

  ask students to look for personal relevance in the subject matter

  practise or discuss strategies to increase concentration

  help students to learn from failures or mistakes

  create an atmosphere where students do not think they have to get everything right first time

Developing IB Learners

Learner Profile

Communicators

Open-minded