Summary

Topic 7 - Atomic, Nuclear and Atomic Physics

Subject	Year	Start date	Duration
Physics	IB1, IB2	Week 3, November	5 weeks 16 hours

Course Part

Core in IB2

Curriculum

Aims

Appreciate scientific study and creativity within a global context through stimulating and challenging opportunities

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 experimental and investigative scientific skills including the use of current technologies

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

Become critically aware, as global citizens, of the ethical implications of using science and technology

Develop an appreciation of the possibilities and limitations of science and technology

Develop an understanding of the relationships between scientific disciplines and their influence on other areas of knowledge

Objectives

Demonstrate knowledge and understanding of

- facts, concepts and terminology
- methodologies and techniques
- communicating scientific information

Apply

- facts, concepts and terminology
- methodologies and techniques
- methods of communicating scientific information

Syllabus Content

Core

7. Atomic, nuclear and particle physics

7.1 – Discrete energy and radioactivity

Nature of science:

Accidental discovery: Radioactivity was discovered by accident when Becquerel developed photographic film that had accidentally been exposed to radiation from radioactive rocks. The marks on the photographic film seen by Becquerel probably would not lead to anything further for most people. What Becquerel did was to correlate the presence of the marks with the presence of the radioactive rocks and investigate the situation further.

Understandings:

Discrete energy and discrete energy levels

Transitions between energy levels

Radioactive decay

Fundamental forces and their properties

Alpha particles, beta particles and gamma rays

Half-life

Absorption characteristics of decay particles

Isotopes

Background radiation

Applications and skills:

Describing the emission and absorption spectrum of common gases

Solving problems involving atomic spectra, including calculating the wavelength of photons emitted during atomic transitions

Completing decay equations for alpha and beta decay

Determining the half-life of a nuclide from a decay curve

Investigating half-life experimentally (or by simulation)

7.2 – Nuclear reactions

Nature of science:

Patterns, trends and discrepancies: Graphs of binding energy per nucleon and of neutron number versus proton number reveal unmistakable patterns. This allows scientists to make predictions of isotope characteristics based on these graphs.

Understandings:

The unified atomic mass unit

Mass defect and nuclear binding energy

Nuclear fission and nuclear fusion

Applications and skills:

Solving problems involving mass defect and binding energy

Solving problems involving the energy released in radioactive decay, nuclear fission and nuclear fusion

Sketching and interpreting the general shape of the curve of average binding energy per nucleon against nucleon number

7.3 – The structure of matter

Nature of science:

Predictions: Our present understanding of matter is called the Standard Model, consisting of six quarks and six leptons. Quarks were postulated on a completely mathematical basis in order to explain patterns in properties of particles. Collaboration: It was much later that large-scale collaborative experimentation led to the discovery of the predicted fundamental particles.

Understandings:

Quarks, leptons and their antiparticles

Hadrons, baryons and mesons

The conservation laws of charge, baryon number, lepton number and strangeness

The nature and range of the strong nuclear force, weak nuclear force and electromagnetic force

Exchange particles

Feynman diagrams

Confinement

The Higgs boson

Applications and skills:

Describing the Rutherford-Geiger-Marsden experiment that led to the discovery of the nucleus

Applying conservation laws in particle reactions

Describing protons and neutrons in terms of quarks

Comparing the interaction strengths of the fundamental forces, including gravity

Describing the mediation of the fundamental forces through exchange particles

Sketching and interpreting simple Feynman diagrams

Describing why free quarks are not observed

ATL Skills

Approaches to Learning

Thinking

- In this unit, we will
  - ask students to formulate a reasoned argument to support their opinion or conclusion
  - give students time to think through their answers before asking them for a response
  - 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
  - help students to make their thinking more visible (for example, by using a strategy such as a thinking routine)
  - require students to take an unfamiliar viewpoint into account when formulating arguments
  - ask questions that required the use of knowledge from a different subject from the one you are teaching
  - include a reflection activity
  - make a link to TOK

Social

- In this unit, we will
  - have students work in small groups
  - allocate, or ask students to allocate among themselves, different roles in a classroom discussion or activity
  - have students peer assess their group performance or process
  - support students in resolving a conflict in a team
  - give a group assessment task
  - give students feedback on how they worked as a group
  - have students discuss their understanding of a text or idea among themselves and come up with a shared understanding
  - provide an opportunity for students to analyse the impact of their behaviour on the class or on a group performance
  - encourage students to consider alternative points of view or to take the perspective of others
  - provide opportunities for students to make decisions

Developing IB Learners

Learner Profile

- Inquirers
- Knowledgeable
- Thinkers
- Reflective

Stream & Resources

Resources

Humayan Moyhuddin
Posted **1 file** on May 2, 2021 at 12:35 AM

Topic 7 - Atomic Physics

Topic_7.2_-_Nuclear_reactions.pptx
2 MB PowerPoint Presentation