M6 Additional Physics 5

Course Syllabus - 2024, Term 2

Teacher: Mike Lynch

Department: Science **Subject Code:** ST33204

Periods per week: 3 **Credits:** 1.5

Course Description

In this semester-long course, students will delve into the intriguing realms of nuclear physics, decay and half-life, radioactive dating, the photoelectric effect, and Planck's constant. Through a balanced blend of theoretical discussions and hands-on experiments, students will unravel the mysteries of the atomic nucleus and the behavior of subatomic particles.

The course kicks off with an in-depth study of nuclear physics, understanding the structure of atoms and the forces that bind their nuclei together. Students will explore concepts of radioactive decay and half-life, gaining insight into the principles that govern the stability of atomic nuclei. Moving forward, the class will investigate practical applications, such as radioactive dating techniques, shedding light on the ancient origins of materials and artifacts. Additionally, students will dive into the fascinating world of quantum physics, exploring the photoelectric effect and the significance of Planck's constant. By the end of the semester, students will have a comprehensive understanding of nuclear phenomena and a deeper appreciation of the atomic universe.

Course Content

1. Nuclear Physics
    1.1. Atomic Structure and Radioactivity
    1.2. Decay and Half-life
    1.3. Radioactive Dating
    1.4. Mass Defect and Binding Energy
    1.5. Fission and Fusion

2. Modern Physics
    2.1. Energy Levels
    2.2. Photo-electric Effect
    2.3. Planck's Constant
    2.4. Wave Particle Duality

Learning Outcomes

- describe a simple model for the nuclear atom to include protons, neutrons and orbital electrons and distinguish between nucleon number and proton number
- show an understanding that an element can exist in various isotopic forms, each with a different number of neutrons
- use the usual notation for the representation of nuclides
- appreciate that nucleon number, proton number, and mass-energy are all conserved in nuclear processes
- represent simple nuclear reactions by nuclear equations
- show an appreciation of the spontaneous and random nature of nuclear decay
- show an understanding of the nature and properties of α-, β- and γ- radiation
- show an appreciation of the association between energy and mass as represented by E = mc2 and recall and solve problems using this relationship
- sketch the variation of binding energy per nucleon with nucleon number
- explain what is meant by nuclear fusion and nuclear fission
- evaluate the use of nuclear energy
- explain the relevance of binding energy per nucleon to nuclear fusion and to nuclear fission
- define the terms activity and decay constant and recall and solve problems using $A = \lambda N$
- infer and sketch the exponential nature of radioactive decay and solve problems using the relationship $x = x_0 \exp(-\lambda t)$, where x could represent activity, number of undecayed particles or received count rate
- define half-life and solve problems using the relation $\lambda = 0.693/T(\frac{1}{2})$
- define displacement, speed, velocity and acceleration
- use graphical methods to represent displacement, speed, velocity and acceleration
- find displacement from the area under a velocity-time graph
- use the slope of a displacement-time graph to find velocity
- use the slope of a velocity-time graph to find acceleration
- derive, from the definitions of velocity and acceleration, equations that represent uniformly accelerated motion in a straight line
- solve problems using equations that represent uniformly accelerated motion in a straight line, including the motion of bodies
- pinpoint the historical aspects of development of quantum mechanic
- understand the idea of wave function

- Demonstrate the photoelectric effect.
- Discuss the nature of the photon.
- Discuss the effect of intensity and frequency on the photoelectric effect
- Determine the maximum kinetic energy of photoelectrons ejected by photons of one energy or wavelength, when given the maximum kinetic energy of photoelectrons for a different photon energy or wavelength
- Describe the structure and operation of a photocell.
- Demonstrate the use of a photocell.
- Give uses of photocells.

Learning Resources

Holt Physics (Online Textbook)

PHet Colorado and Gizmo Simulations

Online learning resources (EdPuzzle, YouTube, Veritasium, etc.)

Worksheets and lab activities produced by the teacher.

Assessment Methods

Some form of Student Work will be assigned every week. This work may be a reading/video assignment, a worksheet, review questions, take-home activities, or unfinished class work. I encourage you to check the Physics page on Google Classroom on a regular basis so that you know how well your son or daughter is doing.

Students will be doing a number of exciting laboratory activities this year. Lab work will be judged on planning, safe lab practices, attention to detail, ability to draw conclusions and depth of evaluation.

I anticipate assigning one project per semester. Special projects are fun and challenging additions to your child's regular course work.

To ensure that students are regularly completing and understanding their course work, I usually administer one assessment per unit. This is usually in the form of a unit quiz and will assess students' understanding of the basic concepts within each unit.

Final exams will include a range of problems. About 25% of each exam will consist of problems that will cover the fundamental skills. About 25% of each exam will consist of problems that will require a deeper understanding of each topic and will require students to combine skills from several topics. About 50% of each exam will consist of real-world application problems.

Homework Policy

Details of all student work can be found on your Google Classroom page. If for some reason you cannot submit your work on time then you must let your teacher know at least 24 hours before the due date.

If you do not hand in your work on time then your score can be reduced by 50%. If your work is more than 2 weeks late then you will receive a zero.

If students are absent when assignments are assigned or on an assignment due date it is the responsibility of the student to contact the teacher to make arrangements for submission.

Evaluation Breakdown

Assessments	30%
Student Work	40%
Final Exam	30%