**a-g PHYSICS A & B**

**COURSE TITLE/ TRANSCRIPT CODE**

a-g Physics A 6E1007
a-g Physics B 6E1014

**COURSE DESCRIPTION**

Throughout the course of the year, the students gain an appreciation of Laws of Nature (Physics) by engaging in experiments and relating experimental data to physical scientific concepts. In this one year course, students will cover measurement, vectors, Laws of Motion, work and energy, momentum and collisions, circular motion, gravitation, heat, thermodynamics, waves, sound, light, refraction, electrical energy and current, circuits and magnetism, and atomic physics.
The general objective of this course is to provide a clear conceptual development and practice with both fundamental physics concepts and problem solving skills. Students will develop abilities necessary to meet the following learning outcomes: understand scientific inquiry, build an understanding of linear motion and two dimensional motion including circular motion, develop an understanding of forces and Newton's Laws of Motion, describe and apply concepts of impulse and momentum, develop an understanding of energy as the ability to cause change, describe wave motion and the wave nature of sound and light, express and understanding of static electricity and direct current electrical circuits.

**PREQUISITES**: Completion of Algebra 1 with a grade of "C" or better.

**REQUIRED TEXTBOOK**: HOLT PHYSICS, California Edition; 2007; Holt, Rinehart and Winston

**SUPPLEMENTAL INSTRUCTIONAL MATERIALS**: PHYSICS WITH VERNIER (Lab Manual) 2007

**COURSE PURPOSE**

Throughout the course of the year, the students gain an appreciation of Laws of Nature (Physics) by engaging in experiments and relating experimental data to physical scientific concepts. In this one year course students will master the CA state content standards for Physics. Students' studies will cover measurement, vectors, Laws of Motion, work and energy, momentum and collisions, circular motion, gravitation, heat, thermodynamics, waves, sound, light, refraction, electrical energy and current, circuits and magnetism and atomic physics.
The general objective of this course is to provide a clear conceptual development and practice with both fundamental physics concepts and problem solving skills. Students will develop abilities necessary to meet the following learning outcomes: understand scientific inquiry, build an understanding of linear motion and two dimensional motion including circular motion, develop an understanding of forces and Newton's Laws of Motion, describe and apply concepts of impulse and momentum, develop an understanding of energy as the ability to cause change, describe wave motion and the wave nature of sound and light, express and understanding of static electricity and direct current electrical circuits.

**COURSE OUTLINE**

Chapter 1 – The Science of Physics
Students will learn about the branches of physics, the scientific method, and the use of models in physics. In addition, they will also learn some useful tools for working with measurements and data.

Chapter 2 – Motion in One Dimension
Students will learn how to analyze one-dimensional motion in terms of displacement, time, speed and velocity, and learn how to distinguish between accelerated and nonaccelerated motion.

Chapter 3 – Two-Dimensional Motion and Vectors
Students will use vectors to analyze two-dimensional motion and to solve problems in which objects are projected into the air.

Chapter 4 – Forces and the Laws of Motion
Students will learn to analyze interactions by identifying the forces involved as well as predict and understand many types of motion.

Chapter 5 – Work and Energy
Student will learn about work and different types of energy that are relevant to mechanics. Kinetic energy, which is associated with motion, and potential energy, which is related to an object's position, are two forms of energy covered within this chapter.

Chapter 6 – Momentum and Collisions
Students will analyze momentum and collisions between two or more objects. In addition, they will consider the mass and velocity of one or more objects and the conversation of momentum and energy.

Chapter 7 – Circular Motion and Gravitation
Students will learn how to describe circular motion and the forces associated with it, including the force due to gravity.

Chapter 9 – Heat
Students will learn the difference between temperature and heat. In addition, they will learn how different substance change temperature or phase when energy is added to or removed from the substances.

Chapter 10 – Thermodynamics
Students will learn how two types of energy transfer – work and heat – serve to change a system's internal energy. Also, they will learn a new form of the law of energy conservation and will see how machine efficiency is limited.

Chapter 11 – Vibrations and Waves
Students will study a kind of periodic motion called simple harmonic motion and will learn about the relationship between simple harmonic vibrations and waves.

Chapter 12 – Sound
Students will study many physical aspects of sound, including the nature of sound waves, frequency, intensity, resonance, and harmonics.

Chapter 13 – Light and Reflection
Students will learn about the characteristics of light and other forms of electromagnetic radiation. They will learn how flat and curved mirrors can be used to reflect light and create real and virtual images of objects.

Chapter 14 – Refraction
Students will study optical phenomena associated with the refraction of light as it passes from one transparent medium to another. They will learn how to analyze converging and diverging lenses and better understand how optical devices work.

Chapter 15 – Interface and Diffraction
Students will learn about interference of light. In interference, light waves combine to produce resultant waves that are either brighter or less bright than the component waves.

Chapter 16 - Electric Forces and Fields
Students will be introduced to the basic properties of electrical charges. They will learn to calculate the electric force produced by point charges and will learn to interpret electric fields lines.

Chapter 17 – Electric Energy and Current
Students will learn about electric potential and electrical and will learn about how capacitor can be used to store electrical energy. In addition, they will be introduced to electric current and resistance.

Chapter 18 – Circuits and Circuit Elements
Students will explore the basic properties of series and parallel circuits.

Chapter 19 – Magnetism
Students will learn that current-carrying coil of wire behaves like a magnet. They will also study the forces exerted on charged particles that are moving in a magnetic field.

Chapter 20 – Electromagnetic Induction
Students will learn how induction produces and changes alternating currents and will explore electromagnetic waves and the electromagnetic spectrum.

**LABORATORY ACTIVITIES** –
Laboratory Activities include, but are not limited to, the following:

Graph Matching – Students will analyze the motion of a student walking across a room and predict, sketch, and test position vs. time kinematics graphs.

Back and Forth Motion – Students will quantitatively analyze the motion of objects that move back and forth and interpret motion in kinematics graphs. Students will then use kinematic graphs to catalog objects that exhibit similar motion.

Cart on a Ramp – Students will collect position, velocity, and acceleration data as a cart rolls up and down a ramp. Student will determine a best-fit equations for the position vs. time and velocity vs. time graphs.

Determining g on an Incline – Student will be able to determine the mathematical relationship between the angle of an incline and the acceleration for a cart rolling down the ramp. Students will also be able to determine the value of free-fall acceleration, g, by extrapolating the acceleration vs. sine of track angle graph.

Picket Fence Free Fall – Students will measure the acceleration of a freely falling body (g) to better than 0.5% precision using a photogate.

Ball Toss – Students will collect velocity, position, and acceleration data as a ball travels straight up and down. Students will determine the mean acceleration from the acceleration vs. time graph.

Bungee Jump Accelerations – Students will use an Accelerometer to analyze the motion of a bungee jumper from just prior to the jump through a few oscillations after the jump. Students will then compare the laboratory jump with an actual bungee jump.

Projectile Motion – Students will apply concepts from two-dimensional kinematics to predict the impact point of a ball in projectile motion. Students will also take into account trial-to trial velocity measurement when calculating the impact point.

Newton's Second Law – Students will collect force and acceleration data for a cart as it is moved back and forth. Through this experiment, students will learn the relationship between force, mass, and acceleration.

Atwood's Machine – Students will determine the relationship between the masses on an Atwood's machine and the acceleration.

Newton's Third Law – Students will observe the bidirectional relationship between force pairs and observe time variations between force pairs.

Static and Kinetic Friction – Students will determine the relationship between force of static friction and the weight of an object and measure the coefficients of static and kinetic friction for a particular block and track.

Air Resistance – Students will determine how the terminal velocity of a falling object is affected by air resistance and mass. Students will then choose between two competing force models for the air resistance on falling coffee filters.

Pendulum Periods – Students will measure the period of a pendulum as a function of amplitude, length, and bob mass.

Simple Harmonic Motion – Students will measure the position and velocity as a function of time for an oscillation mass and spring system and then compare the observed motion of a mass and spring system to a mathematical model of simple harmonic motion.

Energy of a Tossed Ball – Students will measure the change in the kinetic and potential energies as a ball moves in free fall. Also students will observe how total energy of the ball changes during the free fall.

Energy in Simple Harmonic Motion – Students will examine the energies involved in simple harmonic motion and test the principle of conservation of energy.

Momentum, Energy and Collisions – Students will observe collisions between two carts, testing of the conservation of momentum. Also, they will measure energy changes during different types of collisions and classify collision as elastic, inelastic, or completely inelastic.

Impulse and Momentum – Students will measure a cart's momentum change and compare to the impulse it receives and compare average and peak forces in impulses.

Accelerations in the Real World – Students will measure acceleration in a real-world setting and compare the acceleration measure to the value calculated from other data.

Ohm's Law – Students will determine the mathematical relationship between current, potential difference, and resistance in a simple circuit. They will also compare the potential vs. current behavior of a resistor to that of al light bulb.

Series and Parallel Circuits – Students will study the current flow in a series and parallel circuits and use Ohm's law to calculate equivalent resistance of series and parallel circuits.

The Magnetic Field in a Slinky – Students will determine the relationship between magnetic field and the current in a solenoid and study how the field varies inside and outside a solenoid.

Polarization of Light – Students will observe the change in light intensity of light passing through crossed polarizing filters and measure the transmission of light through two polarizing filters as a function of the angle between their axes and compare it to Malus's law.

Sound Waves and Beats – Students will measure the frequency of a period of sound waves from tuning forks and measure the amplitude of sound waves. In addition, they will observe the beat between the sounds of two tuning forks.

Mathematic of Music – Students will determine the frequency of the notes of a musical scale and examine

the differences and ratio between these notes. From this, they will determine the mathematical patterns used in musical scales.

**KEY ASSIGNMENTS**

Textbook Practice Problems (60% of Final Grade)

For each chapter, students will be required to answer the "Section Review" questions at the end of each assigned chapter section (to include the Critical Thinking questions)

In addition, students are required to answer Review questions at the end of each chapter (to include "Review Questions", "Conceptual Questions", and all "Mixed Review" questions.

Sample questions from Chapter 1 include:

REVIEW QUESTIONS

1. Refer to Table 1 of this chapter to identify at least two areas of physics involved in the following:

a. building a louder stereo system in your car

b. bungee jumping

c. judging how hot an electric stove burner is by looking at it

d. cooling off on a hot day by diving into a swimming pool.

2. If you divide a force measured in newtons (1 newton – 1 kg . m/s2) by a speed expressed in meters per second, in what units will the answer be expressed?

CONCEPTUAL QUESTIONS

1. Explain the advantages in having the meter officially defined in terms of the distance light travels in a given time rather than as a length of a specific metal bar.

2. Use the fact that the speed of light in a vacuum is about 3.00 X 108 m/s to determine how many kilometers a pulse from a laser beam travels in exactly one hour.

3. A chain of hamburger restaurants advertises that is has sold more than 50 billion hamburgers over the years. Estimate how many pounds of hamburger meat must have been used by the restaurant chain to make 50 billion hamburgers and how many head of cattle were required to furnish the meat for these hamburgers.

MIXED REVIEW

1. You can obtain a rough estimate of the size of a molecule with the following simple experiment: Let a droplet of oil spread out on a fairly large but smooth water surface. The resulting "oil slick" that forms on the surface of the water will be approximately one molecule thick. Given an oil droplet with a mass of 9.00 X 10-7 kg and a density of 918 kg/m3 that spreads out to for a circle with a radius of 41.8 cm on the water surface, what is the approximate diameter of an oil molecule?

Laboratory Investigations (20% of Final Grade)

Students will be required to participate in 2-hour, Subject Matter Expert (SME) supervised lab activities once every two weeks. Students will apply the scientific method. Data collected and represented in tables and graphs will be incorporated in lab reports with concept analysis questions.

Exams (20% of Final Grade)

End-of-chapter exams will be administered at the conclusion of each textbook chapter.

Mid-term and final examinations will be administered each semester.

GRADING CRITERION:

Grading Scale:
90-100% A
80-89% B
70-79% C
60-69% D
below 60% F

Textbook Practice Problems: 60% of final grade
Laboratory Investigations: 20% of final grade
Exams: 20% of final grade

**INSTRUCTIONAL METHODS AND/OR STRATEGIES**

Instructional methods include, but are not limited to:
Direct Instruction
Teacher demonstration
Lecture
Guided practice
Laboratory Experimentation
Cooperative problem solving
Student-directed personal study
Discussion
Tutorials
Multimedia presentations
Regular access to Subject Matter Expert (SME)

**ASSESSMENT METHODS AND/OR TOOLS**

Methods by which student progress is assessed will be through a variety and/or combination of methods. The methods available include but are not limited to the following:
Regular review of work by Education Specialist (credentialed teacher) and Subject Matter Expert (SME)
Regular access to Subject Matter Expert (SME)
Portfolios
Observation by Parent Facilitator, Education Specialist, and Subject Matter Expert (SME)
Student demonstrations
Discussion
Student grades
Student work samples
Written examination
Student participation in lab activities