KAP Physics 140 & 131
Mr. Herring
Course Description & Syllabus
2017 - 18
Hilliard Davidson High School

Course Goals: Physics is the study of the physical world. We will be exploring the fundamental laws that govern natural phenomena and use those laws to develop theories that can predict the results of future experiments. Using these laws to solve everyday problems is a major goal of this course. This course is designed to be the equivalent of a college-level first semester Physics class. Students can earn college credit by scoring well on the AP Physics Exams which take place in May. Students can also earn college credit through the Kenyon Academic Program (KAP).

Requirements: Success in previous college preparatory science and math classes (B or better) indicates the academic maturity necessary for this course. A thorough understanding of Algebra, Geometry, and Trigonometry is essential to solving many problems. It is strongly recommended that students be concurrently enrolled in Calculus.

Text:
Physics for Scientists and Engineers, 6th edition, by Raymond A. Serway & John W. Jewett
Bring this book with you to every class unless otherwise directed.

Additional Requirements:
1. Scientific calculator (graphing calculator will prove most helpful)
2. Pencil, pen, notebook paper
3. A four color pen or four separate colored pens (black, green, red, blue)

Student Expectations:
1. Be ready to begin class when the bell rings.
2. Participate, this is not a course you can sit back and expect to grasp concepts just by watching me.
3. Do homework practice problems. Practice is essential to understanding Physics.
4. Ask questions. One of the most important ways to learn is from asking questions.
5. Work together in groups. Collaborate with each other specifically on homework.
6. Do your own work on quizzes and tests. Be responsible and ready.

About attendance:
You are responsible for obtaining any missed assignments and for making them up. This includes getting the class notes, completing homework, and making up any tests, quizzes, or labs. According to school policies, you will have as many days to make up assignments as you have missed; after that they are considered late. You must arrange time with the teacher to make up missed work.

Grading: Your grade will be determined approximately as follows:

Quizzes	50%
Labs	30%
Tests	10%
Homework	10%

Quizzes: Quizzes are given to determine how successful you are at mastering the material in class. They will cover homework problems and concepts presented in class. Expect one quiz a week most often on Fridays.

Tests: Tests will consist of problems similar to the ones in the quizzes and homework covering all the material in the nine weeks. Expect one test at the end of each nine weeks. The 4th nine weeks test will be a practice AP Physics Exam which all students will take.

Labs: Labs are an excellent method to learn and reinforce Physics concepts. Expect one lab per week. Labs are conducted on double blocks days giving ample time to complete the lab. Students will typically work in student selected groups of three. Tests may include a lab practical component. Each individual student is responsible for understanding how to execute the labs conducted during the year. Each student will keep a lab notebook. The lab book will be collected and graded randomly during the year.

Homework: Problems will be assigned every week. There will be challenging problems that we need to go over in class; however, I expect you to make an honest effort before class or before asking for assistance. Struggling is natural, expected, and part of the process to learn Physics. Work in groups to help each other solve challenging problems.

Extra Help: I want to help each student be successful. Often, only a few minutes of small group or 1:1 help with me will greatly improve student understanding. I am often available before and after school and during some periods during the day. The best method is to schedule a time with me during class to meet later. Also, you can email me (rusty_herring@hboe.org)

Course Outline:

1st Semester – Mechanics

- Dimensional Analysis
- Motion (1D, 2D, projectile, and circular)
- Newton's Laws
- Friction
- Work, Energy, Power
- Impulse, Momentum, Collisions
- Rotation
- Gravitation and planetary motion
- Simple Harmonic Motion

2nd Semester – Electricity and Magnetism

- Charged Particles and Electric Fields
- Electric Potential
- Capacitance
- Current and Resistance
- Circuits
- Magnetic Fields
- Inductance

Mechanics Outline

Mechanics is covered during the fall semester. Each subject is covered in the same order as in Serway and Jewett and other standard texts. Concepts and problem-solving techniques are introduced through a combination of lectures, demonstrations, lab experiments, question–answer sessions, assignments from the text and teacher-generated worksheets.

Topic	~ Time (days)	Text Chapter	Labs and Demos
I. **SI Units, Dimensional Analysis, Vectors**	4	1	Lab: Vectors
II. **Rectilinear Motion** A. Kinematics with time-varying accel. B. Kinematics with constant accel.	8	2	Demo: Air Track cart - graph position, velocity, and acceleration. Lab: Intro to Motion - make x vs t, v vs t, a vs t graphs using sonic ranger motion detector. Lab: Reaction Time - students calculate their reaction time to catch a falling ruler.
III. **Planar motion** A. Kinematics of projectiles B. Kinematics of circular motion	8	3,4	Demo: Calculating freefall "g" in class Lab: Projectile Motion – calculate range of small ball from spring launcher.
IV. **Introduction to Newton's Laws** A. Newton's three laws B. Free-body diagrams C. Intro to weight, normal, friction	10	5	Demo: Intro to Friction - find friction between a stool and table top with a student sitting on the stool. Lab: Static and Kinetic Friction - measuring the coefficients of friction of various surfaces.
V. **Applications of Newton's Laws** A. Pulley system B. Uniform circular motion C. Non-uniform circular motion D. Non-constant friction force	8	6	Demo: Intro to Circular Motion – DJ on a record player with coins. Lab: Uniform Circular Motion – centripetal force of a rubber stopper on the end of string. Lab: Air resistance – falling coffee filters.
VI. **Work, Energy, and Power** A. Work by constant force B. Work by position-varying force C. Work–energy theorem D. Power	5	7	Lab: Power – determine power of a standing jump. Demo: Bowling Ball – bowling ball pendulum dropped from a fixed height.
VII. **Conservation of Energy** A. Energy conservation B. Work by nonconservative forces C. Potential energy functions D. Potential energy vs. position graphs	8	8	Lab: Bulleyes Pendulum - predict where a ball will land after a razor blade cuts the string of a swinging pendulum. Lab: Conservation of Energy Springs - measuring velocity of a mass on a spring.
IX. **Impulse, Momentum, and Collisions** A. Impulse–momentum relationship B. Conservation of linear momentum C. Elastic and inelastic collisions D. Position and velocity of center of mass	8	9	Demo: Linear momentum on air track. Lab: Impulse and Momentum - a cart rolls downhill and collides with a force sensor. Demo: Ballistic Pendulum
X. **Rotational Kinematics** A. Kinematics with time-varying angular acceleration B. Kinematics with constant angular accel. C. Introduction to torque and angular accel.	5	10	Demo: Race Day – a hoop vs. solid cylinder race down an incline. Lab: Torque Feeler – moment arm with ruler and weights.
XI. **Rotational Dynamics** A. Moment of inertia B. Newton's laws for rotation C. Conservation of energy with rotation D. Conservation of angular momentum	6	10,11	Lab: Moment of Inertia – student spinning on stool with barbell weights. Demo: Conservation of angular momentum - student on stool with rotating bicycle wheel.
XII. **Translational and Rotational Equilib.**	2	12	
XIII. **Gravitation** A. Newton's law of gravitation B. Energy and angular momentum	4	13	
XIV. **Simple Harmonic Motion SHM** A. Kinetics and Dynamics of SHM	3	15	Demo: Spring swing.

Electricity and Magnetism (E & M) Outline

Electricity and Magnetism is covered between the first of January and the administration of the AP Exam. Concepts and problem-solving techniques are introduced through a combination of lectures, demonstrations, lab experiments, question–answer sessions, assignments from the text and teacher-generated worksheets.

Topic	~ Time (days)	Text Chapter	Labs and Demos
I. **Charged Particles and Electric Fields** A. Review of the field concept and the definition of the electric field B. Coulomb's Law C. Statics and dynamics of point charges	10	23	Demos: Electroscope overhead. Lab: Electroscope - electroscope is charged by contact and induction is explained in terms of electron flow.
II. **Electrostatic Fields and Gauss's Law** A. Electric fields of a uniformly charged rod, circular loop, disk, and sheet B. The flux concept and Gauss's law C. Using Gauss's law to determine the electric fields of various charge distributions	6	23 24	Demo: Van de Graff Generator – static charge.
III. **Electric Potential** A. The concept of electric potential B. Calculating the electric potential of various charge distributions C. Equipotential lines and surfaces D. Electric fields as the derivative of the potential	12	25	Lab: Electric Field and Equipotential Lines - map equipotential lines and field lines around two parallel electrodes.
IV. **Capacitors and Dielectrics** A. The concept of capacitance B. Capacitors with planar, cylindrical, and spherical symmetry C. Equivalent capacitance D. Effects of dielectrics in capacitors	6	26	Demo: Qualitative effects of capacitors on circuits with light bulbs. Lab: Capacitors – determine the time constant for various RC circuits.
V. **Ohm's Law and Direct Current Circuits** A. Resistivity and resistance B. Ohm's Law and Kirchoff's rules applied to DC circuits C. Equivalent resistance D. RC circuits E. Parallel and series circuits	18	27 28	Demo: Intro to Circuits – light board with switches. Lab: Resistors / Ohm's Law - wire circuit and set up multimeter to study the difference between ohmic and non-ohmic resistors. Lab: DC circuits - Kirchhoff's Rules. Lab: Internal resistance - determine the internal resistance and emf of a D cell battery. Lab: Irreducible circuits – system of equations using Kirchhoff and Junction rules to find currents.
VI. **Magnetic Forces and Fields** A. The field concept applied to magnetism B. Charged particles in magnetic fields, mass spectrometer C. Current-carrying wires in magnetic fields	5	29	Demo: Hemholtz coil - effect of 'E' and 'B' on electrons. Lab: Vernier 'Charged Particles' simulation
VII. **Calculating Magnetic Fields** A. Intro to and applying the Biot-Savan law B. Intro to and applying Ampere's law	5	30	Demo: Ampere's Law – observe current in wire with compasses.
VIII. **Electromagnetic Induction** A. Intro to Faraday's law and Lenz's law B. Determine the induced emf and the induced current C. Inductance and RL circuits D. Maxwell's Equations	5	31 32 34	Demo: Using primary and secondary coils. Lab: Induction - drop bar magnets through a coil and experimentally determine the factors that increase the induced emf.
Review for AP Exam	15		