Learning Power Course: AP® Physics B

Sections: Online AP® Physics B: Students view class segments as streamed digital video via a direct link to the NSU server

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Grade Level: 11 or 12
Course Prerequisites: Algebra 1 & 2 and Junior or Senior standing
Course Textbook and other materials:
Required: Serway & Faughn, **College Physics, 7th Edition** (Thomson*Brooks/Cole Publishing)
All materials and internet sites linked to our D2L have been examined by the instructor and deemed appropriate and readable by high school juniors and seniors.
Project/Papers/Tests: Through the D2L course site, e-mail, FAX, or Snail Mail
Equipment Needed: Classroom with at least 1 Microsoft Windows compatible computer with internet access for every 3-4 students. Students will also need access to string, masking tape, scissors, rulers, protractors, graphing paper, and white paper.

Learning Power will assemble and loan physics equipment kits to each school for every 3 – 4 students. A list of equipment and replacement costs will be included in each kit. These kits must be returned to Learning Power. A charge will be assessed for any missing or damaged items.

Course Description: This is a college level general physics course with a problem-solving component requiring an Algebra 2 level of mathematics preparation and will include basic trigonometry (taught in the course). The topics to be covered in the first semester are Measurements, Mechanics, Fluids, Thermodynamics, and Circular and Rotational Motion. The topics to be covered in the second semester are Electricity, Magnetism, Waves and Modern Physics.

Course Objectives: The intent of this course is to introduce students to the principles and methods of physics and to show them how these principles are applied in order to explain the phenomena of the physical world. The laboratory experiences and demonstrations will give the students insight into how experimentation leads to the discovery of new scientific principles. Cooperative attitudes will be nurtured through the use of group activities. In addition to the knowledge base developed in physics, use of computer technologies are integrated throughout the entire course. The use of these technologies are intended to impart the following specific skills: ability to use a Web browser to access online information; ability to use bulletin boards; ability to download files; ability to use software packages for data acquisition and analysis.

This Course will prepare students for the AP Physics B exam, which will be given in May.

Syllabus: (The order of this may change but the topics covered will be the same.)

1st Semester

Exam	Chapters	Topics
1	1, 2,	Standard measurements, significant figures, scientific notation, Vectors and nature of science
2	3,4	Motion in one dimension, free fall, projectile motion and Newton's Laws of Motion
3	5,6,7, 8,	Work, energy, power, momentum, circular motion, gravity, and torque
4	9,10, 11, 12	Fluid mechanics, thermal physics, heat transfer, and thermodynamics

2nd Semester

Exam	Chapters	Topics
5	13, 14, 22, 23, 24	Vibrations, waves, light sound, interference, and lenses and mirrors
6	26, 27, 28, 29, 30	Relativity, quantum physics, nuclear physics, and elementary particles
7	15, 16, 17,	Electrostatics, capacitance, current, and resistance
8	18, 19, 20	Direct current and magnetism

Exam Objectives
Unit One

<u>You the Student must demonstrate an understanding of:</u>

1. the nature of science by being able to:
    A. explain some of the scientific methods of inquiry.
    B. describe the role of observation and evidence in the development of hypothesis, Theories and laws.
    C. evaluate a scientific discovery to determine and describe how societal, cultural, and

personal beliefs influence scientific investigation and interpretations.

D. evaluate and describe the impact of scientific discoveries on historical events and Social, economic, and ethical issues.
E. evaluate the ethical roles and responsibilities of scientists and scientific research.
F. differentiate between a theory and a law.

2. measurement by being able to:
   A. identify the four subdivisions of physics and give examples of each.
   B. calculate problems using significant figures,
   C. report answers in correct S.I. units and convert to others when necessary.
   D. convert within the metric system.
   E. utilize proper scientific notation.

3. analyzing measurements by being able to:
   A. acquire the necessary data to analyze for a given phenomena.
   B. construct a graph from given or acquired data.
   C. relate graphs to physical phenomena
   D. interpret the graphs to draw sound conclusions.
   E. compare and contrast accuracy and precision.
   F. calculate absolute and relative error.
   G. calculate absolute and relative deviation.

4. trigonometric functions by being able to:
   A. utilize sine, cosine, and tangent appropriately.
   B. apply the Pythagorean Theorem appropriately.
   C. differentiate between vector and scalar quantities and give several examples of each.
   D. solve vector problems graphically and analytically.
   E. state directions in terms of geographic directions, β, and θ.

Exam Objectives
Unit Two

<u>You the Student must demonstrate an understanding of:</u>

1. motion in one dimension by being able to:
   A. justify the statement "All Motion is Relative".
   B. derive equations for velocity, acceleration, time, and displacement from graphs.
   C. apply concepts of distance and time to the quantitative relationships of motion using mathematical formulas, equations, and units.
   D. create a velocity v.s. time graph from a position v.s. time graph.
   E. relate motion equations to freefall.
   F. calculate freefall problems.
   G. utilize trig to resolve displacement and velocity vector problems.

2. motion in 2 dimensions by being able to:
   A. articulate the conditions necessary to create projectile motion.
   B. calculate projectile motion problems.

C. utilize vector addition methods to solve resultant velocity problems in projectiles.
D. design a projectile motion apparatus capable of performing a specific task.

3. Newton's Three Laws of Motion by being able to:
   A. name, explain, and give examples of each.
   B. relate Newton's Laws to several real-world situations.
   C. predict the resulting motion of an object using Newton's Laws.
   D. relate motion to net force.
   E. calculate F=ma problems.

4. concurrent forces by being able to
   A. identify the characteristics of a force.
   B. calculate the resultant magnitude and direction of concurrent forces.
   C. label the major forces acting on an object by drawing free-body diagrams.
   D. calculate the equilibriant force and relate it to the resultant.

5. friction by being able to:
   A. define friction and give examples.
   B. justify how friction is both advantages and disadvantages.
   C. construct free-body force diagrams and be able to label F_T, F_p, F_F, F_N, and F_w.
   D. calculate friction problems.
   E. relate friction to net force.

6. laboratory skills by being able to:
   A. apply science process skills to design and conduct student investigations.
   B. practice safe and effective lab techniques.
   C. manipulate variables with repeated trials.
   D. use statistical analysis of data to evaluate the validity of results.
   E. demonstrate correct precision in measurements, calculations and reporting of results.

Exam Objectives
Unit Three

<u>You the Student must demonstrate an understanding of:</u>

1. work, energy and power by being able to:
   A. differentiate between work, power, and energy.
   B. relate the concepts of force, distance, and time to the quantitative relationships of Work, power, and energy.
   C. calculate problems involving work, power, and energy.
   D. compare and contrast potential and kinetic energy.
   E. explain the Law of Conservation of Energy.
   F. apply the Law of Conservation of Energy to various situations.
   G. justify the Work-Energy Theorem.
   H. Describe the relationship among potential energy, kinetic energy and work as applied to the Law of Conservation of Energy.

2. linear momentum by being able to:
   A. calculate momentum.

B. analyze the Impulse-Momentum Theorem.
C. calculate impulse, force, time, and change in momentum.
D. prove that impulse = change in momentum by giving examples.
E. Explain the Law of Conservation of Linear Momentum.
F. Calculate problems using the Law of conservation of Linear Momentum.

3. uniform circular motion by being able to:
   A. Explain how circular motion is created.
   B. justify why centrifugal force is considered a pseudo force.
   C. calculate problems involving centripetal force and centripetal acceleration.
   D. apply circular motion to vertical circles.
   E. calculate vertical circle problems.

4. gravity by being able to:
   A. explain Newton's Universal Law of Gravitation.
   B. relate gravity and centripetal force to projectile and circular motion.
   C. calculate gravity problems.
   D. relate G to g.
   E. explain what is meant by 'center of gravity" or "center of mass".

5. rotary motion by being able to:
   A. mathematically compare linear and angular displacement, velocity, and acceleration.
   B. calculate angular motion problems
   C. relate torque to rotary motion.
   D. calculate torque problems.
   E. relate center of gravity to torque.
   F. relate torque and rotary motion to real-world situations.

6. angular momentum by being able to:
   A. Explain the Law of Conservation of Angular Momentum.
   B. Give examples of the Law of Conservation of Angular Momentum.
   C. relate moment of inertia to angular momentum problems.
   D. calculate angular momentum problems.

Exam Objectives
Unit Four

You the Student must demonstrate an understanding of:

1. solids and liquids by being able to:
   A. compare and contrast states of matter.
   B. differentiate between stress and strain.
   C. calculate problems involving density, specific gravity and pressure.
   D. relate pressure and depth.
   E. calculate problems involving pressure and depth.
   F. apply and define gauge pressure.
   G. analyze Pascal's Principle.
   H. analyze Archimedes's Principle.

I. calculate buoyancy problems.
J. analyze Bernoulli's Principle and relate it to the Law of Conservation of Energy.
K. calculate problems involving Bernoulli's Principle.

2. thermal physics by being able to:
   A. distinguish between heat and temperature.
   B. convert between Celsius, Fahrenheit and Kelvin.
   C. calculate thermal expansion problems and relate them to real-world situations.
   D. evaluate the relationships between Temperature, Pressure and Volume of ideal gases as determined by Boyle's Law, Charles' Law, and Gay-Lussac's Law.
   E. apply kinetic molecular theory to solve problems involving temperature, pressure, volume and number of moles.
   F. distinguish between chemical, physical and nuclear changes.

3. heat energy by being able to:
   A. calculate internal energy problems.
   B. compare and contrast heat and thermal energy.
   C. calculate and apply specific heats.
   D. calculate calorimetry problems.
   E. relate latent heat to phase change.
   F. calculate calorimetry problems involving phase change.
   G. examine energy transfers as matter changes.
   H. distinguish between conduction, convection and radiation.

4. the Laws of Thermodynamics by being able to:
   A. apply the variables of work (pressure, volume, temperature and internal energy) in Thermodynamic processes.
   B. interpret PV diagrams.
   C. calculate problems from information given on a PV diagram.
   D. restate the 1^{st} and 2^{nd} Laws of Thermodynamics.
   E. relate the Laws of Thermodynamics to real life situations.
   F. analyze and describe the benefits, limitations, cost, and consequences involved in using, conserving, or recycling resources.
   G. calculate change in internal energy.
   H. calculate and explain entropy.
   I. relate entropy to the heat death of the universe.

Exam Objectives
Unit Five

<u>You the Student must demonstrate an understanding of:</u>

1. periodic motion by being able to:
   A. define periodic motion.
   B. graph periodic motion.
   C. differentiate between mechanical and electromagnetic waves.
   D. differentiate between longitudinal and transverse waves.
   E. explain wave behavior in the fundamental processes of reflection, refraction, diffraction,

Interference, and resonance.
F. describe how v, f, T, λ, and c relate to each other.
G. calculate problems involving v, f, T, λ, and c.
H. apply periodic motion to pendulums and springs.
I. calculate Hooke's Law problems.
J. calculate pendulum problems.

2. sound by being able to:
   A. define sound.
   B. contrast audible frequencies to infrasonic and ultrasonic frequencies.
   C. contrast speed of sound to subsonic and supersonic.
   D. calculate speed of sound problems.
   E. measure the speed of sound experimentally.
   F. calculate intensity and relative intensity of sound.
   G. explain the Doppler effect and give real-life examples.
   H. compare and contrast harmonics and octaves.
   I. calculate harmonics and octave problems.
   J. compare and contrast open-end and closed-end air columns.
   K. calculate open-end and closed-end air column problems.
   L. apply the Laws of Strings.
   M. design a musical instrument capable of playing "Twinkle Twinkle Little Star".
   N. give examples of forced vibrations and resonance.

3. light by being able to:
   A. explain the Dual Wave-Particle Theory.
   B. describe the photoelectric effect and relate it to the duality of light..
   C. explain quanta in terms of light.
   D. calculate wave duality equations.
   E. evaluate the relationships among members of the electromagnetic spectrum.
   F. give examples of uses fro various electromagnetic waves.
   G. apply the law of reflection to mirrors.
   H. apply Snell's Law of Refraction.
   I. explain wave behavior in the fundamental processes of reflection, refraction, diffraction, Interference, resonance, and image formation.
   J. differentiate between real and virtual images
   K. calculate mirror-lens problems.
   L. relate diffraction to interference.

Exam Objectives
Unit Six

You the Student must demonstrate an understanding of:

1. relativity by being able to:
   A. compare Newton's and Einstein's views of gravity.
   B. explain the general theory of relativity.
   C. give the 2 premises behind the Special Theory of Relativity.
   D. explain the 4 consequences to approaching the speed of light.
   E. graph mass, time and appeared length to the speed of light.

2. quantum physics by being able to:
    A. relate thermal energy to electromagnetic waves.
    B. calculate Wein's Displacement Law problems.
    C. relate Planck's equation to the photoelectric effect.
    D. apply the work function to the photoelectric effect
    E. calculate kinetic energy, cutoff frequencies, and cutoff wavelengths.
    F. analyze deBroglie's Theory
    G. analyze and apply Heisenberg's Uncertainity Principle.
    H. relate Newtonian physics, relativity, quantum physics and string theory.

3. atomic physics by being able to:
    A. explain Bohr's idea of the structure of an atom..
    B. relate Bohr's energy levels to spectral emissions.
    C. compare and contrast emission and absorption spectra.
    D. calculate energy, wavelength and frequency released/absorbed between hydrogen energy Levels of the Bohr's atom
    E. compare and contrast the Balmer and Paschen series.
    F. calculate the mass defect and binding energy
    G. prove Einstein's Mass-Energy Theorem.
    H. distinguish between chemical and nuclear changes.

4. nuclear physics by being able to:
    A. explain the nature and characteristics of radioactive decay.
    B. distinguish between various symbols for subatomic particles.
    C. calculate radioactive decay problems involving logarithms.
    D. graph logarithmic functions.
    E. calculate half-life, decay constant, and average life.
    F. complete transmutation equations.
    G. apply nuclear physics to real-world situations.

5. high-energy particle physics by being able to:
    A. identify elementary particle groupings.
    B. explain the Grand Unified Field Theory
    C. analyze recent findings in theoretical physics (i.e. String Theory)
    D. describe immediate and long-term consequences of potential solutions for technological issues.
    E Analyze factors that could limit technological design.

Exam Objectives
Unit Seven

<u>You the Student must demonstrate an understanding of:</u>

1. electrostatics by being able to:
    A. define and explain electrification and static electricity.
    B. describe the relationship between charged particles, static electricity and electric fields.
    C. apply electrostatics to work, charge and capacitance.
    D. define and explain dielectrics

E. calculate electric Force, electric fields, flux, work, charge, capacitance and potential difference.
F. describe electrical effects in terms of motion and concentration of charged particles.

2. current and resistance by being able to
   A. define current
   B. relate current to charge.
   C. calculate current.
   D. analyze Ohm's Law
   E. calculate resistance
   F. relate work, energy, and power to electricity.
   G. calculate electrical problems involving work, energy, and power..
   H. analyze and calculate an electric bill.

Exam Objectives
Unit Eight

<u>You the Student must demonstrate an understanding of:</u>

1. direct current circuits by being able to :
   A. identify the 5 main sources of emf
   B. compare and contrast series, parallel and networked circuits.
   C. calculate I, V, R, and C in series, parallel, and networked circuits.
   D. apply Kirchhoff's Rules

2. magnetism by being able to:
   A. explain how magnets form.
   B. explain why the earth has a magnetic field.
   C. apply the right-hand rule #1 to magnetic force on current carrying wires.
   D. calculate forces on particles in magnetic fields.
   E. calculate magnetic fields on long wires
   F. apply the right-hand rule #2 to magnetic fields around long straight wires.
   G. apply Ampere's Law
   H. relate number of turns on a coil to magnetic fields.

3. induced currents by being able to :
   A. calculate magnetic fields and flux.
   B. explain the relationships between magnetic fields, current, changing magnetic fields and electric fields.
   C. compare and contrast AC and DC.
   D. calculate induced emf.
   F. differentiate between generators, motors, and engines.
   G. explain how transformers work.
   H. calculate transformer problems.
   I. apply Faraday's Law and Lenz' Law.

South Dakota Science Standards

Grades 9-12 South Dakota Science Standards can be found at the following website: http://doe.sd.gov/contentstandards/science/index.asp. This course addresses the following state standards:

NATURE OF SCIENCE STANDARDS
9-12

Indicator 1: Understand the nature and origin of scientific knowledge.

Core HS Standards
9-12.N.1.1. (Evaluation) Evaluate a scientific discovery to determine and describe how societal, cultural, and personal beliefs influence scientific investigations and interpretations. ***Covered in Unit One outcome 1C**
9-12.N.1.2. (Synthesis) Describe the role of observation and evidence in the development and modification of hypotheses, theories, and laws. ***Covered in Unit One outcome 1B**

Indicator 2: Apply the skills necessary to conduct scientific investigations.

Core HS Standards
9-12.N.2.1. (Synthesis) Apply science process skills to design and conduct student investigations**.** ***Covered in labs and Unit Two outcome 6A**
9-12.N.2.2. (Application) Practice safe and effective laboratory techniques. ***Covered in labs and Unit Two outcome 6B**
Advanced HS Standards
9-12.N.2.1A. (Synthesis) Manipulate multiple variables with repeated trials. ***Covered in labs and Unit Two outcome 6C**
9-12.N.2.2A. (Evaluation) Use statistical analysis of data to evaluate the validity of results. ***Covered in labs and Unit Two outcome 6D**
9-12.N.2.3A. (Analysis) Demonstrate correct precision in measurements and calculations. ***Covered in labs, Unit One outcomes 3E, 3F, and 3G and also in Unit Two outcome 6E**

PHYSICAL SCIENCE STANDARDS
9-12

Indicator 1: Describe structures and properties of, and changes in, matter.

Core HS Standards
9-12.P.1.5. (Comprehension) Distinguish among chemical, physical, and nuclear changes. ***Covered in Unit Four outcome 1B and Unit Six outcome 4A**
Advanced HS Standards
9-12.P.1.5A. (Application) Examine energy transfer as matter changes. ***Covered in Unit Four outcome 3G**
9-12.P.1.7A. (Application) Apply the kinetic molecular theory to solve quantitative problems involving pressure, volume, temperature, and number of moles of gas. ***Covered in Unit Four outcome 2E**

Indicator 2: Analyze forces, their forms, and their effects on motions.

Core HS Standards
9-12.P.2.1. (Analysis) Apply concepts of distance and time to the quantitative relationships of motion using appropriate mathematical formulas, equations, and units. ***Covered in Unit Two outcome 1C**
9-12.P.2.2. (Application) Predict motion of an object using Newton's Laws. ***Covered in Unit Two outcome 3C**
9-12.P.2.3. (Application) Relate concepts of force, distance, and time to the quantitative relationships of work, energy, and power. ***Covered in Unit Three outcome 1B**
Advanced HS Standards
9-12.P.2.1A. (Synthesis) Solve vector problems graphically and analytically. ***Covered in Unit One outcome 4D**
9-12.P.2.2A. (Analysis) Relate gravitational or centripetal force to projectile or uniform circular motion. ***Covered in Unit Three outcome 4B**

Indicator 3: Analyze interactions of energy and matter.

Core HS Standards
9-12.P.3.1. (Application) Describe the relationships among potential energy, kinetic energy, and work as applied to the Law of Conservation of Energy. ***Covered in Unit Three outcome 1H**
9-12.P.3.2. (Comprehension) Describe how characteristics of waves are related to one another. ***Covered in Unit Five outcome 1F**
9-12.P.3.3. (Application) Describe electrical effects in terms of motion and concentrations of charged particles. ***Covered in Unit Seven outcome 1F**
Advanced HS Standards
9-12.P.3.1A. (Synthesis) Explain wave behavior in the fundamental processes of reflection, refraction, diffraction, interference, resonance, and image formation. ***Covered in Unit Five outcomes 1E, 2N, 3I, 3J, and 3K**
9-12.P.3.2A. (Application) Describe the relationship between charged particles, static electricity, and electric fields. ***Covered in Unit Seven outcome 1B**
9-12.P.3.3A. (Analysis) Describe the relationship between changing magnetic and electric fields. ***Covered in Unit Eight outcome 3B**

SCIENCE, TECHNOLOGY, ENVIRONMENT, AND SOCIETY STANDARDS 9-12

Indicator 1: Analyze various implications/effects of scientific advancement within the environment and society.

Core HS Standards
9-12.S.1.1. (Application) Explain ethical roles and responsibilities of scientists and scientific research. ***Covered in Unit One outcome 1E**
9-12.S.1.2. (Evaluation) Evaluate and describe the impact of scientific discoveries on historical events and social, economic, and ethical issues. ***Covered in Unit One outcome 1D**

Indicator 2: Analyze the relationships/interactions among science, technology, environment, and society.

Core HS Standards
9-12.S.2.1. (Evaluation) Describe immediate and long-term consequences of potential solutions for technological issues. ***Covered in Unit Six outcome 5D**
9-12.S.2.2. (Analysis) Analyze factors that could limit technological design. ***Covered in Unit Six outcome 5E**
9-12.S.2.3. (Synthesis) Analyze and describe the benefits, limitations, cost, and consequences involved in using, conserving, or recycling resources. ***Covered in Unit Four outcome 4F**

Class format:

The class is primarily an online course. Course materials such as pre-taped lectures and demonstrations, lecture notes and powerpoints are all available on your D2L which you will have access to upon completion of your registration and behavior contract. You will also be expected to do some type of face-to-face synchronous conference with the instructor 2 hours per week either through the used of DDN or the webcams provided for you, as well as Elluminate. You will be expected to do hands-on lab activities using the lab materials provided in kits by this institution. You will also be expected to read the assigned chapters and do assigned problems. Graded problems will be assigned on Webassign for each unit. Exams (four per semester) will be 80 minutes long and also done on Webassign. Students are required to take the AP Physics B exam offered by the College Board in May of 2009. It is a three-hour exam plus breaks. Two weeks will be set aside to prepare for this test.

Evaluation and grading:

The following grading scale will be used:

Percentage	Grade
90.0% - 100.0%	A
80.0% - 89.9%	B
70.0% - 79.9%	C
60.0% - 69.9%	D
Below 60.0%	F

Under Board of Regents and University policy student academic performance may be evaluated solely on an academic basis, not on opinions or conduct in matters unrelated to academic standards. Students should be free to take reasoned exception to the data or views offered in any course of study and to reserve judgment about matters of opinion, but they are responsible for learning the content of any course of study for which they are enrolled. Students who believe that an academic evaluation reflects prejudiced or capricious consideration of student opinions or conduct unrelated to academic standards should contact the E-learning Center office to initiate a review of the evaluation.

Exams: There will be four 80-minute exams each semester (see syllabus above for contents.) Each exam will have a multiple choice section and a problem section. The multiple choice questions will be taken from notes and/or conceptual questions in your text. The problems will be taken from the assigned problems and un-graded suggested problems, worksheets, and practice test problems. After some exams, I will allow you to correct mistakes and obtain up to one-half of the points missed. Each test will be worth 100 – 150 points. There will also be an un-graded pre-test at the beginning of the year and a graded final post-test exam at the end of the year.

Students are also required to take the AP Physics B exam that will be offered by the College Board in May of 2009. It is a three- hour exam plus breaks and will be proctored by your e-mentor. It will be comprised of 70 multiple choice questions taken in 90 minutes with out the use of a calculator and a 90 minute problem exam with the use of a calculator and provided formula sheet. More instructions about this final will be given closer to the exam date.

Laboratory activities: Various types of labs will be conducted. They will involve computer-acquired data, digital video analysis, computer simulations and hands-on measurements. Each lab will require a written report. There will be approximately one lab per week and range between 10 – 30 points each.

Problems: Before exams there will be a set of graded problems on-line through Webassign which is linked to our D2L. I will also be suggesting other problems, questions, worksheets and practice test problems for some tests. These will not be graded but will be important to try, as some of these may be on the exam.

All assignments are expected to be done completely and on time. If work is not turned in by the due date, a 10% reduction will be made for each day late up to a maximum of 50%. Exceptions to this may be granted on an individual basis due to unforeseen, unusual circumstances.

Plagiarism of any kind is totally unacceptable!! Any assignment deemed to be plagiarized will receive a grade of 0% and your parents and school officials will be notified immediately!!