TEXAS TECH UNIVERSITY
TTU K-12™

PHYSICS 1A
Physics I, First Semester
CBE Review (ONLINE)
(v.4.0)

To the Student:

After your registration is complete, you may take the online Credit by Examination for PHYSICS 1A.

WHAT TO BRING

- calculator
- pencil
- copy of the formula sheet
- blank lined scratch paper

ABOUT THE EXAM

The examination for the first semester of Physics consists of 51 multiple choice, short answer, and problem-solving questions. The exam is based on the Texas Essential Knowledge and Skills (TEKS) for this subject. The full list of TEKS is included in this document (it is also available online at the Texas Education Agency website). The TEKS outline specific topics covered in the exam, as well as more general areas of knowledge and levels of critical thinking. Use the TEKS to focus your study in preparation for the exam.

The CBE for Physics 1A must be completed in one sitting without aid from persons, notes, textbooks, or electronic devices, but you may use a calculator and a formula sheet during the entire examination. Where appropriate, show formulas used, essential steps for the solutions of problems, clearly indicate answers, and give appropriate units.

The examination will take place under supervision, and the recommended time limit is three hours. A percentage score from the examination will be reported to the official at your school.

In preparation for the examination, review the TEKS for this subject. All TEKS are assessed. A list of key concepts is included in this document to focus your studies. It is important to prepare adequately. Since questions are not taken from any one source, you can prepare by reviewing any of the state-adopted textbooks that are used at your school. The textbook used with our PHYSICS 1A course is:

> Walker, James S. (2014). *Physics*. New Jersey: Pearson Education, Inc. ISBN 0-13-9780131371156

Good luck on your examination!

PHYSICS 1A Key Concepts

Physics is a course in which the successful student will learn to understand, explain, and calculate the effects of nature. Concepts include motion, energy, gravitation, circular motion and thermodynamics. The student will apply concepts by answering questions, calculating values, and performing experiments to deepen their understanding of physics.

In Physics 1A, students:

- demonstrate safe practices during laboratory investigations.
- explain the impacts of the scientific contributions of scientists.
- distinguish between scientific hypotheses and theories.
- make measurements with accuracy and record data using scientific notation and si units.
- interpret free-body force diagrams.
- know and apply the laws of motion.
- calculate work, energy, and power.
- contrast and give examples of thermal energy transfer.

PHYSICS 1A Formula Chart

Velocity-Position Equation:	$\text{change in position} = \dfrac{\left(\text{final velocity}^2 - \text{initial velocity}^2\right)}{\left(2 \times \text{acceleration}\right)}$ $\Delta x = \dfrac{v_f^{\,2} - v_i^{\,2}}{2a}$
Acceleration:	$\text{Acceleration} = \dfrac{\text{change in velocity}}{\text{change in time}}$ $A = \dfrac{v_f - v_i}{t}$
Force:	$\text{Force} = \text{mass} \times \text{acceleration}$ $F = ma$
Work:	$\text{Work} = \text{force} \times \text{distance}$ $W = Fd$
Free Fall:	$\text{distance} = \dfrac{1}{2} \times \text{gravity} \times \text{time squared}$ $d_x = \dfrac{1}{2} g t^2$
Energy:	$\text{Potential Energy} = \text{mass} \times \text{gravity} \times \text{height}$ $PE = mgh$ $\text{Kinetic Energy} = \dfrac{1}{2} \times \text{mass} \times \text{velocity squared}$ $KE = \dfrac{1}{2} m v^2$
Power:	$\text{Power} = \dfrac{\text{Work}}{\text{time}}$ $P = \dfrac{W}{t}$
Position-Time for Projectiles: $\text{final position} = \text{initial position} + \text{initial velocity} \times \text{time}$ $x_f = x_i + v_i t$	
Conservation of Momentum:	$mv_{1\text{initial}} + mv_{2\text{initial}} = mv_{1\text{final}} + mv_{2\text{final}}$ $mv_{1\text{initial}} + mv_{2\text{initial}} = \left(m + m\right) v_{\text{final}}$

Universal Gravitation:	$$\text{Force} = \frac{\text{gravitational constant} \times \text{mass}_1 \times mass_2}{\text{distance squared}}$$ $$F = \frac{GmM}{d^2}$$
Acceleration Due to Gravity:	$$\text{acceleration due to gravity} = \frac{\text{Gravitational constant} \times \text{mass}}{\text{radius squared}}$$ $$g = \frac{Gm}{r^2}$$
Constants:	$$G = 6.67 \times 10^{-11}\ \text{Nm}^2/\text{kg}^2$$ $$\text{g on Earth} = 9.81\ \text{m/s}^2$$
Temperature:	$$\text{Fahrenheit temperature} = \frac{9}{5}\ \text{Temperature}^{\text{O}}\text{C} + 32$$ $$\text{T}_f = \frac{9}{5}\ \text{T}_c + 32$$ $$\text{Celcius temperature} = \frac{5}{9}\ \text{Temperature}^{\text{O}}\text{F} - 32$$ $$\text{T}_c = \frac{5}{9}\ \text{T}_f - 32$$
Specific Heat Capacity:	$$\text{specific heat capacity} = \frac{\text{heat}}{\text{mass} \times \text{Temperature change}}$$ $$c = \frac{Q}{m\Delta T}$$
Engine Efficiency:	$$\text{engine efficiency} = \frac{\text{Work done by heat engine}}{\text{heat supplied by hot resevoir}}$$ $$e = \frac{W}{Q_h}$$
Coefficient of Thermal Expansion:	$$\text{change in length} = \text{coefficient of expansion} \times \text{initial length} \times \text{temperature change}$$ $$\Delta L = \propto L \Delta T$$
Average Velocity:	$$\text{average velocity} = \frac{\text{displacement}}{\text{time}}$$ $$v = \frac{d}{t}$$

Momentum:	Momentum = mass × velocity $p = mv$
Impulse:	Impulse = force × time $I = ft$
Hooke's Law for a Spring:	force = spring constant × change in length $f = kx$

Texas Essential Knowledge and Skills
PHYSICS 1 – Physics

§112.39. Physics, Beginning with School Year 2010-2011 (One Credit).

(b) Introduction.

(1) Physics. In Physics, students conduct laboratory and field investigations, use scientific methods during investigations, and make informed decisions using critical thinking and scientific problem solving. Students study a variety of topics that include: laws of motion; changes within physical systems and conservation of energy and momentum; forces; thermodynamics; characteristics and behavior of waves; and atomic, nuclear, and quantum physics. Students who successfully complete Physics will acquire factual knowledge within a conceptual framework, practice experimental design and interpretation, work collaboratively with colleagues, and develop critical thinking skills.

(2) Nature of science. Science, as defined by the National Academy of Sciences, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process." This vast body of changing and increasing knowledge is described by physical, mathematical, and conceptual models. Students should know that some questions are outside the realm of science because they deal with phenomena that are not scientifically testable.

(3) Scientific inquiry. Scientific inquiry is the planned and deliberate investigation of the natural world. Scientific methods of investigation can be experimental, descriptive, or comparative. The method chosen should be appropriate to the question being asked.

(4) Science and social ethics. Scientific decision making is a way of answering questions about the natural world. Students should be able to distinguish between scientific decision-making methods and ethical and social decisions that involve the application of scientific information.

(5) Scientific systems. A system is a collection of cycles, structures, and processes that interact. All systems have basic properties that can be described in terms of space, time, energy, and matter. Change and constancy occur in systems as patterns and can be observed, measured, and modeled. These patterns help to make predictions that can be scientifically tested. Students should analyze a system in terms of its components and how these components relate to each other, to the whole, and to the external environment.

(c) Knowledge and skills.

(1) Scientific processes. The student conducts investigations, for at least 40% of instructional time, using safe, environmentally appropriate, and ethical practices. These investigations must involve actively obtaining and analyzing data with physical equipment, but may also involve experimentation in a simulated environment as well as field observations that extend beyond the classroom. The student is expected to:

(A) demonstrate safe practices during laboratory and field investigations; and

(B) demonstrate an understanding of the use and conservation of resources and the proper disposal or recycling of materials.

(2) Scientific processes. The student uses a systematic approach to answer scientific laboratory and field investigative questions. The student is expected to:

(A) know the definition of science and understand that it has limitations, as specified in subsection (b)(2) of this section;

(B) know that scientific hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durable explanatory power which have been tested over a wide variety of conditions are incorporated into theories;

(C) know that scientific theories are based on natural and physical phenomena and are capable of being tested by multiple independent researchers. Unlike hypotheses, scientific theories are well-established and highly-reliable explanations, but may be subject to change as new areas of science and new technologies are developed;

(D) distinguish between scientific hypotheses and scientific theories;

(E) design and implement investigative procedures, including making observations, asking well-defined questions, formulating testable hypotheses, identifying variables, selecting appropriate equipment and technology, and evaluating numerical answers for reasonableness;

(F) demonstrate the use of course apparatus, equipment, techniques, and procedures, including multimeters (current, voltage, resistance), triple beam balances, batteries, clamps, dynamics demonstration equipment, collision apparatus, data acquisition probes, discharge tubes with power supply (H, He, Ne, Ar), hand-held visual spectroscopes, hot plates, slotted and hooked lab masses, bar magnets, horseshoe magnets, plane mirrors, convex lenses, pendulum support, power supply, ring clamps, ring stands, stopwatches, trajectory apparatus, tuning forks, carbon paper, graph paper, magnetic compasses, polarized film, prisms, protractors, resistors, friction blocks, mini lamps (bulbs) and sockets, electrostatics kits, 90-degree rod clamps, metric rulers, spring scales, knife blade switches, Celsius thermometers, meter sticks, scientific calculators, graphing technology, computers, cathode ray tubes with horseshoe magnets, ballistic carts or equivalent, resonance tubes, spools of nylon thread or string, containers of iron filings, rolls of white craft paper, copper wire, Periodic Table, electromagnetic spectrum charts, slinky springs, wave motion ropes, and laser pointers;

(G) use a wide variety of additional course apparatus, equipment, techniques, materials, and procedures as appropriate such as ripple tank with wave generator, wave motion rope, micrometer, caliper, radiation monitor, computer, ballistic pendulum, electroscope, inclined plane, optics bench, optics kit, pulley with table clamp, resonance tube, ring stand screen, four inch ring, stroboscope, graduated cylinders, and ticker timer;

(H) make measurements with accuracy and precision and record data using scientific notation and International System (SI) units;

(I) identify and quantify causes and effects of uncertainties in measured data;

(J) organize and evaluate data and make inferences from data, including the use of tables, charts, and graphs;

(K) communicate valid conclusions supported by the data through various methods such as lab reports, labeled drawings, graphic organizers, journals, summaries, oral reports, and technology-based reports; and

(L) express and manipulate relationships among physical variables quantitatively, including the use of graphs, charts, and equations.

(3) Scientific processes. The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions within and outside the classroom. The student is expected to:

(A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;

(B) communicate and apply scientific information extracted from various sources such as current events, news reports, published journal articles, and marketing materials;

(C) draw inferences based on data related to promotional materials for products and services;

(D) explain the impacts of the scientific contributions of a variety of historical and contemporary scientists on scientific thought and society;

(E) research and describe the connections between physics and future careers; and

(F) express and interpret relationships symbolically in accordance with accepted theories to make predictions and solve problems mathematically, including problems requiring proportional reasoning and graphical vector addition.

(4) Science concepts. The student knows and applies the laws governing motion in a variety of situations. The student is expected to:

(A) generate and interpret graphs and charts describing different types of motion, including the use of real-time technology such as motion detectors or photogates;

(B) describe and analyze motion in one dimension using equations with the concepts of distance, displacement, speed, average velocity, instantaneous velocity, and acceleration;

(C) analyze and describe accelerated motion in two dimensions using equations, including projectile and circular examples;

(D) calculate the effect of forces on objects, including the law of inertia, the relationship between force and acceleration, and the nature of force pairs between objects;

(E) develop and interpret free-body force diagrams; and

(F) identify and describe motion relative to different frames of reference.

(5) Science concepts. The student knows the nature of forces in the physical world. The student is expected to:

(A) research and describe the historical development of the concepts of gravitational, electromagnetic, weak nuclear, and strong nuclear forces;

(B) describe and calculate how the magnitude of the gravitational force between two objects depends on their masses and the distance between their centers;

(C) describe and calculate how the magnitude of the electrical force between two objects depends on their charges and the distance between them;

(D) identify examples of electric and magnetic forces in everyday life;

(E) characterize materials as conductors or insulators based on their electrical properties;

(F) design, construct, and calculate in terms of current through, potential difference across, resistance of, and power used by electric circuit elements connected in both series and parallel combinations;

(G) investigate and describe the relationship between electric and magnetic fields in applications such as generators, motors, and transformers; and

(H) describe evidence for and effects of the strong and weak nuclear forces in nature.

(6) Science concepts. The student knows that changes occur within a physical system and applies the laws of conservation of energy and momentum. The student is expected to:

(A) investigate and calculate quantities using the work-energy theorem in various situations;

(B) investigate examples of kinetic and potential energy and their transformations;

(C) calculate the mechanical energy of, power generated within, impulse applied to, and momentum of a physical system;

(D) demonstrate and apply the laws of conservation of energy and conservation of momentum in one dimension;

(E) describe how the macroscopic properties of a thermodynamic system such as temperature, specific heat, and pressure are related to the molecular level of matter, including kinetic or potential energy of atoms;

(F) contrast and give examples of different processes of thermal energy transfer, including conduction, convection, and radiation; and

(G) analyze and explain everyday examples that illustrate the laws of thermodynamics, including the law of conservation of energy and the law of entropy.

(7) Science concepts. The student knows the characteristics and behavior of waves. The student is expected to:

(A) examine and describe oscillatory motion and wave propagation in various types of media;

(B) investigate and analyze characteristics of waves, including velocity, frequency, amplitude, and wavelength, and calculate using the relationship between wavespeed, frequency, and wavelength;

(C) compare characteristics and behaviors of transverse waves, including electromagnetic waves and the electromagnetic spectrum, and characteristics and behaviors of longitudinal waves, including sound waves;

(D) investigate behaviors of waves, including reflection, refraction, diffraction, interference, resonance, and the Doppler effect;

(E) describe and predict image formation as a consequence of reflection from a plane mirror and refraction through a thin convex lens; and

(F) describe the role of wave characteristics and behaviors in medical and industrial applications.

(8) Science concepts. The student knows simple examples of atomic, nuclear, and quantum phenomena. The student is expected to:

A) describe the photoelectric effect and the dual nature of light;

(B) compare and explain the emission spectra produced by various atoms;

(C) describe the significance of mass-energy equivalence and apply it in explanations of phenomena such as nuclear stability, fission, and fusion; and

(D) give examples of applications of atomic and nuclear phenomena such as radiation therapy, diagnostic imaging, and nuclear power and examples of applications of quantum phenomena such as digital cameras.

Source: The provisions of this §112.39 adopted to be effective August 4, 2009, 34 TexReg 5063.