CERTIFICATION EXAMINATIONS FOR OKLAHOMA EDUCATORS™ (CEOE™)

OKLAHOMA SUBJECT AREA TESTS™ (OSAT™)

FIELD 014: PHYSICS

TEST FRAMEWORK

September 2011

	Subarea	Range of Competencies
I.	Scientific and Engineering Processes	0001–0002
II.	Motion, Forces, and Energy	0003–0006
III.	Electricity and Magnetism	0007–0009
IV.	Waves, Acoustics, and Optics	0010–0012
V.	Thermal and Modern Physics	0013–0015

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SUBAREA I—SCIENTIFIC AND ENGINEERING PROCESSES

Competency 0001

Apply knowledge of scientific inquiry and experimental and engineering design.

The following topics are examples of content that may be covered under this competency.

- Use the International System of Units and prefixes appropriately.
- Apply knowledge of accuracy and precision and the use of appropriate tools and technologies.
- Analyze appropriate means of asking questions and planning and carrying out investigations.
- Evaluate the design of a physics or scientific experiment or investigation.
- Apply scientific reasoning and experiences to define, analyze, solve, evaluate, and optimize engineering problems.

Competency 0002

Apply knowledge of cross cutting concepts in science.

The following topics are examples of content that may be covered under this competency.

- Apply knowledge of the use of models to explore and explain phenomena.
- Apply concepts of scale, proportion, and quantity to analyze natural phenomena.
- Apply a variety of broad scientific concepts (e.g., systems, classification, patterns, energy and matter, structure and function, stability and change) across science.
- Apply knowledge of major theories and concepts in chemistry, biology, and Earth and space science.
- Interpret data presented in a variety of formats.
- Apply concepts of statistics (e.g., correlation, standard deviation) and mathematics (e.g., inverse variation, exponential growth) to analyze data and develop models.
- Apply knowledge of the historical development of concepts in physics.
- Apply physics knowledge to societal issues (e.g., environmental quality, personal and community health).

SUBAREA II—MOTION, FORCES, AND ENERGY

Competency 0003

Analyze motion in one and two dimensions.

The following topics are examples of content that may be covered under this competency.

- Analyze the motion of an object using multiple representations (e.g., graphs, equations, motion maps).
- Apply principles of algebra and basic calculus to solve problems involving motion in one dimension.
- Apply principles of geometry and trigonometry to vectors to analyze motion in two dimensions, including uniform circular motion.
- Solve problems involving free-fall and projectile motion.

Competency 0004

Apply the laws of motion in one and two dimensions.

The following topics are examples of content that may be covered under this competency.

- Understand free body diagrams and use them to represent a given situation.
- Analyze the forces acting in a variety of situations (e.g., inclined plane, Atwood's machine).
- Solve problems involving frictional forces and elastic forces (i.e., Hooke's law).
- Apply Newton's laws to solve problems in one and two dimensions, including uniform circular motion.
- Apply knowledge of concepts associated with Newton's laws (e.g., inertia, reference frames, force pairs).

Competency 0005

Apply the laws of motion to systems of particles and simple harmonic motion.

The following topics are examples of content that may be covered under this competency.

- Apply the law of universal gravitation in a variety of situations, including satellite and planetary motion.
- Apply the concept of torque to solve problems involving static equilibrium and rotational dynamics.
- Apply principles of fluids (e.g., Archimedes' principle, Bernoulli's principles) to situations involving fluids.
- Analyze simple harmonic motion using graphs, equations, and trigonometric functions.

Competency 0006

Apply the principles of the conservation of energy and momentum.

The following topics are examples of content that may be covered under this competency.

- Analyze systems and situations in terms of work, energy, power, momentum, and impulse.
- Apply the conservation of energy and the work energy theorem to solve problems (e.g., gravitational potential energy, simple harmonic motion).
- Apply the principle of conservation of linear momentum to solve problems in one and two dimensions.
- Apply the law of conservation of angular momentum.
- Evaluate situations for the appropriate use of conservation laws.

SUBAREA III—ELECTRICITY AND MAGNETISM

Competency 0007

Apply knowledge of electric charge and the electric field.

The following topics are examples of content that may be covered under this competency.

- Analyze situations involving static electricity (e.g., the behavior of an electroscope, charging by induction).
- Apply Coulomb's law to find the electric force on a given charge due to a simple charge distribution in one or two dimensions.
- Understand the electric field for a simple or symmetric charge distribution (e.g., point charge, electric dipole, line charge).
- Analyze the force on and the motion of a charged particle in a uniform electric field.
- Apply knowledge of electric potential energy and potential difference to solve problems.

Competency 0008

Analyze characteristics of the magnetic field, magnetic interactions with charges, and principles of electromagnetic induction.

The following topics are examples of content that may be covered under this competency.

- Apply knowledge of properties of permanent magnets and understand the magnetic domain model.
- Analyze the magnitude and direction of the magnetic field of various simple current-carrying sources (e.g., wire of infinite length, solenoid).
- Analyze the magnitude and direction (e.g., right-hand rule) of the force on and the motion of a charged particle in a uniform magnetic field.
- Analyze factors that affect the magnitude and direction of an induced electromotive force.
- Apply knowledge of the use of electricity and magnetism in technology (e.g., electric motors, microphones, power generation and transmission).

Competency 0009

Apply knowledge of electric circuits.

The following topics are examples of content that may be covered under this competency.

- Apply knowledge of current, resistance, potential difference, capacitance, and Ohm's law to solve problems.
- Analyze series and parallel circuits and apply Kirchhoff's rules.
- Apply knowledge of schematics and characteristics of capacitors and inductors as well as RC and RLC circuits.
- Analyze energy and power relationships and transformations in electric circuits.
- Apply knowledge of fundamental characteristics of AC circuits (e.g., frequency, amplitude, RMS voltage).

SUBAREA IV—WAVES, ACOUSTICS, AND OPTICS

Competency 0010

Apply knowledge of waves and wave motion.

The following topics are examples of content that may be covered under this competency.

- Apply knowledge of the transfer of energy and momentum in longitudinal and transverse waves.
- Apply concepts of amplitude, frequency, period, speed, and wavelengths to wave phenomena.
- Apply the superposition principle to determine characteristics of a resultant wave.
- Analyze the reflection, refraction, and diffraction of waves.

Competency 0011

Apply knowledge of sound propagation and sound waves.

The following topics are examples of content that may be covered under this competency.

- Analyze factors that affect the speed of sound in different media.
- Apply concepts of amplitude, frequency, period, speed, and wavelengths to analyze acoustic phenomena.
- Understand the relationships between sound wave properties and the physiological perceptions of sound.
- Apply knowledge of the Doppler effect.
- Apply the superposition principle to solve problems involving standing waves (e.g., vibrating strings, air columns).

Competency 0012

Apply knowledge of light and optics.

The following topics are examples of content that may be covered under this competency.

- Apply Snell's law to analyze wave refraction.
- Apply the ray model of light to analyze the formation of real and virtual images formed by lenses and mirrors.
- Apply the thin lens equation to solve problems.
- Apply the wave properties of light to analyze optical phenomena (e.g., single- and double-slit interference patterns, polarizers, thin films, Doppler effect).
- Apply knowledge of the electromagnetic spectrum and the production and transmission of electromagnetic waves.
- Apply knowledge of models of light to optical devices (e.g., prisms, microscopes, telescopes).

SUBAREA V—THERMAL AND MODERN PHYSICS

Competency 0013

Apply knowledge of kinetic theory and the laws of thermodynamics.

The following topics are examples of content that may be covered under this competency.

- Compare and contrast mechanisms of heat transfer (i.e., conduction, convection, radiation).
- Apply knowledge of kinetic theory, including the molecular interpretation of temperature and entropy.
- Analyze the properties of solids, liquids, and gases in terms of the motion and interactions of the molecules.
- Apply principles of specific heat, thermal expansion, and phase changes to solve problems.
- Apply the first and second laws of thermodynamics in a variety of situations (e.g., the mechanical equivalence of work, analyzing PV diagrams and heat engines).

Competency 0014

Apply knowledge of atomic structure and nuclear physics.

The following topics are examples of content that may be covered under this competency.

- Apply knowledge of the development of atomic theory and of various models of the atom (e.g., Bohr, Schrödinger).
- Interpret notation used to represent elements, molecules, ions, and radiation.
- Apply the half-life concept to analyze radioactive decay.
- Apply knowledge of nuclear fission and fusion.
- Analyze equations representing nuclear reactions.
- Recognize the fundamental characteristics of the standard model of particle physics (e.g., quarks, leptons, bosons).

Competency 0015

Apply knowledge of quantum theory of light and matter.

The following topics are examples of content that may be covered under this competency.

- Apply knowledge of the quantization of energy to the photoelectric effect and atomic spectra.
- Recognize evidence supporting the wave/particle nature of light and matter.
- Apply the de Broglie relations to solve problems.
- Apply knowledge of the special theory of relativity.
- Apply knowledge of basic principles of quantum mechanics (e.g., wave functions, probability amplitudes, the double-slit experiment, Heisenberg uncertainty principle).