CERTIFICATION EXAMINATIONS FOR OKLAHOMA EDUCATORS (CEOE™)

OKLAHOMA SUBJECT AREA TESTS (OSAT™)

FIELD 13: PHYSICAL SCIENCE

TEST FRAMEWORK

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Foundations of Scientific Inquiry
Motion, Forces, and Energy
Structure of Matter and Changes in Matter

SUBAREA I—FOUNDATIONS OF SCIENTIFIC INQUIRY

Competency 0001

Understand the relationships and common themes that connect mathematics, science, and technology.

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

Apply the laws of science to other disciplines, such as biology.

Analyze the use of science and mathematics in the design of a solution to a given scientific or technological problem.

Analyze the role of technology in the advancement of scientific knowledge.

Use a variety of software (e.g., spreadsheets, graphing utilities, statistical packages, simulations) and information technologies to model and solve problems in mathematics, science, and technology.

Competency 0002

Understand the historical and contemporary contexts of the study of science and the applications of science to everyday life.

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

Analyze the significance of key events, theories, and individuals in the history of science.

Assess the societal implications of developments in science (e.g., nuclear technology, solid-state technology).

Competency 0003

Understand the process of scientific inquiry and the role of observation and experimentation in explaining natural phenomena.

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

Analyze processes by which new scientific knowledge and hypotheses are generated.

Analyze ethical issues related to the process of scientific research (e.g., accurately reporting experimental results).

Evaluate the appropriateness of a specified experimental design to test a given hypothesis.

Assess the role of communication among scientists in promoting scientific progress.

Competency 0004

Understand principles of measurement and the process of gathering, organizing, reporting, and interpreting scientific data.

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

Apply knowledge of units of measurement, measuring devices, or methods of measurement to a given situation.

Assess the appropriateness of a given method or procedure for collecting data for a specified purpose.

Assess the use of statistical methods for summarizing and analyzing data.

Analyze relationships among factors (e.g., inverse, direct, linear) as indicated by experimental data.

Competency 0005

Understand equipment, materials, and chemicals used in science investigations; and apply procedures for their proper and safe use.

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

Analyze the principles upon which given laboratory instruments are based (e.g., telescopes, spectrometers).

Analyze hazards associated with given laboratory materials (e.g., lasers, electrical equipment, chemicals).

Apply proper procedures for safety in the laboratory (e.g., use of goggles).

Apply proper procedures for dealing with accidents and injuries in the laboratory.

Competency 0006

Understand types and uses of natural resources and the effects of human activities on the environment.

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

Demonstrate an understanding of the classification, uses, and importance of natural resources and methods of locating and obtaining natural resources.

Assess the positive and negative effects of human activities on the earth's environment (e.g., reclamation of strip mines), and evaluate strategies for dealing with environmental problems.

Analyze the chemical processes that result from the release of chemicals into the atmosphere (e.g., acid rain, greenhouse effect, ozone depletion, global warming, photochemical smog).

Identify sources of radioactive emissions in the environment, and analyze the risks and benefits they pose for humans.

SUBAREA II—MOTION, FORCES, AND ENERGY

Competency 0007

Understand concepts related to motion in one and two dimensions, and solve problems that require the use of algebra, calculus, and graphing.

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

Apply the terminology, units, and equations used to describe and analyze one- and two-dimensional motion.

Analyze the motion of freely falling objects near the surface of the earth.

Solve problems involving distance, displacement, speed, velocity, and acceleration.

Interpret information presented in one or more graphic representations related to distance, displacement, speed, velocity, and constant acceleration.

Competency 0008

Understand characteristics of forces, and apply the laws of motion.

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

Identify the forces acting in a given situation.

Understand the vector nature of force, and solve problems involving composite and resultant forces.

Analyze and solve problems involving gravitational and frictional forces.

Apply Newton's laws of motion to solve problems.

Competency 0009

Understand the concepts of energy, work, and power, and the principles of conservation of energy and momentum.

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

Analyze mechanical systems in terms of work, power, and energy.

Use the concept of conservation of energy to solve problems.

Determine power, mechanical advantage, and efficiency as they relate to work and energy in simple machines.

Use the concept of conservation of momentum to solve problems.

Competency 0010

Understand electric charge, electric fields, and electric potential.

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

Apply Coulomb's law to determine the forces between charges.

Apply principles of electrostatics to determine electric field intensity.

Determine the electric potential for a given charge distribution, and analyze the relationship between the electric field and the electrostatic potential.

Analyze the motion of a charged particle in an electric field.

Competency 0011

Understand electric current and electric circuits, capacitance, and direct current circuits.

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

Understand the flow of electric charge in conductors, semiconductors, and superconductors.

Analyze and simplify DC circuits using Ohm's law and Kirchoff's rules.

Analyze energy and power relationships in DC circuits.

Understand the basic principles of alternating current and alternating current circuits.

Competency 0012

Understand magnetic fields and electromagnetic induction.

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

Determine the orientation and magnitude of a magnetic field in a given situation (e.g., wire of infinite length, solenoid).

Determine the magnitude and direction of the force on a charge or charges moving in a magnetic field.

Analyze factors that affect the magnitude and direction of an induced electromotive force (EMF).

Analyze the use of electromagnetism in technology (e.g., motors, generators, meters, transformers).

Competency 0013

Understand simple harmonic motion, waves, and wave motion.

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

Analyze the simple harmonic motion of the simple pendulum and a mass on a spring.

Compare the transfer of energy and momentum in longitudinal and transverse waves.

Analyze the characteristics (e.g., frequency, period, amplitude, speed, wavelength) of waves.

Apply the superposition principle to analyze wave interference and diffraction.

Competency 0014

Understand the characteristics of sound waves and electromagnetic waves (including light and optics).

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

Analyze the energy, power, and intensity of sound waves (including the decibel scale).

Solve problems involving resonance, harmonics, and overtones in vibrating strings and air columns.

Analyze the properties (e.g., energy, frequency, wavelength) and components (e.g., visible light, ultraviolet radiation) of the electromagnetic spectrum.

Use ray diagrams and the thin lens equation to analyze the characteristics of lenses and mirrors.

SUBAREA III—STRUCTURE OF MATTER AND CHANGES IN MATTER

Competency 0015

Understand various models of atomic structure and the organization of the periodic table.

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

Understand major features of models of atomic structure (e.g., Bohr, Rutherford, Heisenberg, Schrödinger) and the fundamental principles of quantum theory.

Understand subatomic particles, types of radiation, and nuclear reactions.

Differentiate among elements, compounds, and mixtures.

Analyze trends (e.g., ionization energies, atomic radii) within periods and groups in the periodic table, and predict chemical properties of given elements based on their positions in the periodic table.

Competency 0016

Understand the physical and chemical properties of matter and the types of bonds between atoms.

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

Distinguish between physical and chemical changes in matter.

Relate the physical properties of material to the material's intermolecular forces.

Analyze the characteristics of various types of bonds between atoms (e.g., ionic, covalent, polar).

Predict properties of a substance (e.g., high or low melting point) based on the type of bonds holding the atoms together.

Competency 0017

Understand the relationship between the mole concept, chemical formulas, and chemical equations.

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

Relate the mole to Avogadro's number, and calculate the number of moles in a given mass or volume of a substance.

Solve problems involving molecular and formula masses and percent composition.

Balance chemical equations and predict theoretical yields.

Competency 0018

Understand the principles of thermodynamics.

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

Understand the difference between heat and temperature, and solve problems involving specific heat, heats of fusion, and heats of vaporization.

Analyze energy changes, and solve problems involving the formation or breaking of chemical bonds (e.g., heat of combustion, heat of formation).

Analyze energy conversions (e.g., chemical to mechanical) using the first and second laws of thermodynamics.

Apply the laws of thermodynamics to predict the spontaneity of given reactions based on enthalpy changes, entropy changes, and temperature.

Competency 0019

Understand the kinetic theory of matter.

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

Understand the molecular interpretation of temperature.

Apply the principles of kinetic theory to solve problems involving ideal gases.

Analyze phase changes and arrangements and movements of particles in solids, liquids, and gases in terms of kinetic theory.

Understand the molecular interpretation of entropy.

Competency 0020

Understand chemical reactions, reaction rates, and chemical equilibrium.

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

Analyze common types of reactions (i.e., combustion, addition, substitution, and oxidation-reduction).

Analyze factors that affect the rate of chemical reactions.

Apply Le Chatelier's principle to chemical systems.

Analyze the effects of concentration, pressure, temperature, and catalysts on chemical equilibrium.

Competency 0021

Understand the properties of solutions and the theories, principles, and applications of acid-base chemistry.

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

Analyze factors (e.g., temperature, pressure, molecular structure) that affect solubility, and solve problems involving concentrations of solutions (e.g., molarity, molality, percent concentration).

Analyze acids and bases according to operational and conceptual definitions (e.g., Arrhenius, Brönsted-Lowry, Lewis).

Analyze the principles and applications of acid-base titration.

Determine the hydronium ion concentration and the pH for various acid, base, and salt solutions.