Missouri Educator Gateway Assessments

FIELD 024: PHYSICS
TEST FRAMEWORK

January 2014

DRAFT

Content Domain		Range of Competencies	Approximate Percentage of Test Score
I.	Science and Engineering Practices	0001–0003	23%
II.	Mechanics	0004–0006	24%
III.	Electricity and Magnetism	0007–0009	23%
IV.	Waves	0010–0011	15%
V.	Modern Physics	0012–0013	15%

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A scientific calculator will be available to examinees taking the Physics test.

SCIENCE AND ENGINEERING PRACTICES

0001 Understand the practices of scientific inquiry and engineering design.

For example:

1.1 Apply knowledge of the principles and procedures for designing and carrying out scientific investigations.

1.2 Recognize methods and criteria for collecting, organizing, analyzing, and presenting scientific data.

1.3 Analyze the evidential basis of scientific claims and engineering solutions.

1.4 Apply knowledge of safety procedures and hazards associated with scientific investigations.

1.5 Demonstrate knowledge of the materials, equipment, and technology used in the sciences.

1.6 Apply mathematical procedures and modeling to the analysis and interpretation of data and to solve problems in the sciences.

1.7 Apply knowledge of engineering design practices to solve a problem or address a need (e.g., defining problems, designing and evaluating solutions, optimizing solutions).

0002 Understand crosscutting concepts in the sciences and engineering.

For example:

2.1 Demonstrate knowledge of the crosscutting concepts that unite core ideas across the sciences and engineering (e.g., patterns, cause and effect, stability and change).

2.2 Apply knowledge of the nature of science as a system of inquiry based on a set of shared characteristics (e.g., empirical evidence, peer review, ethics in experimentation and in the reporting of results).

2.3 Demonstrate knowledge of the historical development of major scientific ideas, including contributions by men and women of diverse backgrounds.

2.4 Demonstrate knowledge of major contemporary theories, laws, models, and concepts in biology, chemistry, and Earth and space science.

2.5 Apply literacy skills to the interpretation, synthesis, and analysis of information from scientific and technical sources (e.g., explaining central ideas, interpreting domain-specific terminology, recognizing how texts structure information into categories and hierarchies).

0003 Understand the relationships between science, technology, and human activity in a global context.

For example:

3.1 Demonstrate knowledge of ways in which science and technology can be used to solve problems affecting society or to address a societal need.

3.2 Recognize the ways in which society affects scientific progress.

3.3 Recognize how technology is used in the sciences and the scientific advances its use has made possible.

3.4 Evaluate the accuracy of reported scientific information and the credibility of the reporting source (e.g., scientific journals, newspapers, Web sites).

3.5 Analyze social, economic, and ethical issues and contexts associated with technological and scientific developments.

MECHANICS

0004 Understand motion in one and two dimensions.

For example:

4.1 Use multiple representations (e.g., pictures, graphs, equations, motion maps) to analyze one-dimensional motion.

4.2 Solve problems involving constant acceleration.

4.3 Apply properties of vectors to describe motion in two dimensions.

0005 Understand forces as interactions and their effects on motion.

For example:

5.1 Identify characteristics of Newton's laws in a variety of situations.

5.2 Analyze free body diagrams.

5.3 Use Newton's laws to solve problems involving force and motion, including problems involving frictional and elastic forces.

5.4 Apply knowledge of Newton's law of universal gravitation.

5.5 Solve problems involving uniform circular motion, including satellite and planetary motion.

0006 Understand the conservation of energy and linear momentum.

For example:

6.1 Describe sources and common uses of types of energy.

6.2 Apply principles of work, potential energy, kinetic energy, energy transfer, efficiency, and power to solve problems.

6.3 Apply the work-energy theorem to conservative and nonconservative systems.

6.4 Analyze the relationships between force, impulse, and momentum.

6.5 Compare the momentum of objects, explain conservation of momentum in systems, and analyze systems using conservation of energy and momentum.

ELECTRICITY AND MAGNETISM

0007 Understand properties of the electric field.

For example:

7.1 Describe electric forces and electric fields for various simple charge distributions.

7.2 Describe the motion of a charged particle in a constant electric field.

7.3 Demonstrate knowledge of electric potential energy, energy transfer, and potential difference.

0008 Understand properties of the magnetic field and electromagnetic induction.

For example:

8.1 Analyze the magnetic force on a moving charge in a magnetic field.

8.2 Demonstrate knowledge of the interaction between electric currents and magnetic fields (e.g., changing magnetic fields can produce electric currents, electric currents produce magnetic fields).

8.3 Describe the operation of devices such as electric motors, generators, and transformers.

0009 Understand properties of electric circuits.

For example:

9.1 Describe and classify energy sources, storage components, and transfers in electrical devices.

9.2 Describe characteristics of conductors, insulators, and common electrical components (e.g., capacitor, transistor).

9.3 Apply Ohm's law to solve problems.

9.4 Describe characteristics of parallel and series circuits.

9.5 Analyze electric circuits and devices in terms of energy or power.

WAVES

0010 Understand the fundamental properties of waves.

For example:

10.1 Demonstrate knowledge of the characteristics and types of waves.

10.2 Demonstrate knowledge of wave propagation and how waves transfer energy and momentum.

10.3 Solve problems involving wave speed, wave frequency, and wavelength.

10.4 Analyze the reflection, refraction, and superposition of waves.

10.5 Analyze the characteristics of sound.

0011 Understand the characteristics of light and electromagnetic radiation.

For example:

11.1 Demonstrate knowledge of the electromagnetic spectrum and the production and transmission of electromagnetic waves.

11.2 Identify information that the electromagnetic spectrum provides (e.g., chemical composition, temperature, age of stars, location and motion of objects).

11.3 Apply knowledge of light behavior and models (e.g., ray, wave, particle) to describe optical phenomena.

11.4 Recognize technological applications of electromagnetic waves in information technology and instrumentation.

MODERN PHYSICS

0012 Understand thermal energy and the kinetic theory of matter.

For example:

12.1 Demonstrate knowledge of the concepts of thermal energy and temperature.

12.2 Solve problems involving thermal expansion, specific heat, and phase changes.

12.3 Demonstrate knowledge of the kinetic theory of matter.

12.4 Demonstrate knowledge of thermal energy sources, energy conversions, efficiency, heat transfer (by conduction, convection, and radiation), and conductors and insulators of thermal energy.

0013 Understand the fundamental principles of modern and nuclear physics.

For example:

13.1 Demonstrate knowledge of the fundamental concepts of quantum physics (e.g., wave-particle duality, uncertainty principle).

13.2 Demonstrate knowledge of the structure of an atom and the nucleus.

13.3 Apply knowledge of radioactive decay processes and the concept of the half-life to analyze and solve problems.

13.4 Demonstrate knowledge of the processes of nuclear fission and nuclear fusion and their role as a source of thermal energy within Earth's mantle, as fuel for stars, and in nuclear power plants.

13.5 Apply the principles of conservation of charge and conservation of mass-energy to analyze nuclear reactions.