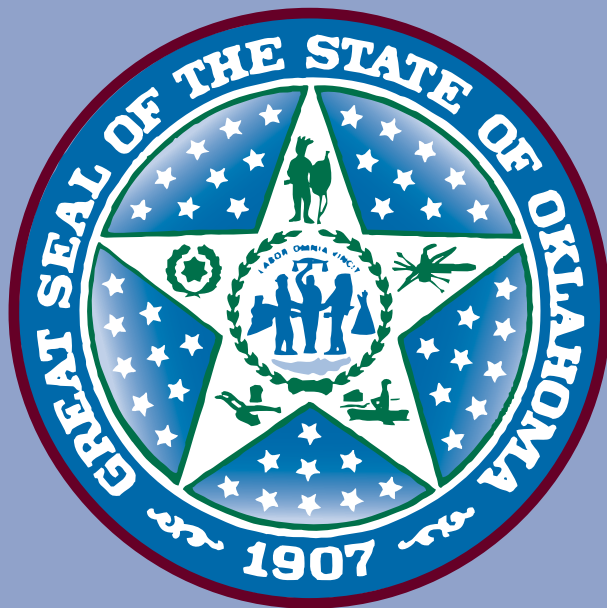


Certification Examinations for Oklahoma Educators™

Oklahoma Subject Area Tests™

STUDY GUIDE

013 Physical Science



Oklahoma Commission
for Teacher Preparation

OK-SG-FLD013-03

TABLE OF CONTENTS

STUDY GUIDE INTRODUCTION

PURPOSE OF THIS STUDY GUIDE.....	1-1
KEY FEATURES OF THIS STUDY GUIDE	1-1
FOR OTHER CEOE STUDY GUIDES.....	1-1
FOR FURTHER INFORMATION	1-1

GENERAL INFORMATION ABOUT THE CERTIFICATION EXAMINATIONS FOR OKLAHOMA EDUCATORS

AN OVERVIEW OF THE TESTING PROGRAM.....	1-2
Test Development Process	1-2
Characteristics of the CEOE Tests.....	1-3
Test Descriptions	1-3
Test Administration	1-7
Score Reports	1-8
HOW TO PREPARE FOR THE TEST	1-8
Study the Competencies	1-8
Identify Resources	1-8
Study Techniques	1-8
Review the Practice Test Questions	1-8
SAMPLE TEST DIRECTIONS	1-9
Sample General Test Directions.....	1-9
Sample Constructed-Response Assignment Directions	1-10
THE DAY OF THE TEST.....	1-11
Preparation	1-11
At the Test Site.....	1-11

FIELD-SPECIFIC INFORMATION

INTRODUCTION.....	2-1
Test Competencies	2-1
Practice Test Questions	2-1
TEST COMPETENCIES	2-2
SAMPLE PERIODIC TABLE.....	2-8
PRACTICE TEST QUESTIONS AND ANSWERS	2-9
Practice Selected-Response Questions	2-9
Practice Constructed-Response Assignment.....	2-21
A Very Good Response to the Practice Constructed-Response Assignment.....	2-22
CONSTRUCTED-RESPONSE ASSIGNMENT SCORING.....	2-24
Sample Performance Characteristics for Constructed-Response Assignments	2-24
Sample Scoring Scale for Constructed-Response Assignments	2-24

Readers should be advised that this study guide, including many of the excerpts used herein, is protected by federal copyright law.

Copyright © 2007 by the Oklahoma Commission for Teacher Preparation and Pearson Education, Inc. or its affiliate(s). All rights reserved.
National Evaluation Systems, P.O. Box 226, Amherst, MA 01004

Certification Examinations for Oklahoma Educators, CEOE, Oklahoma General Education Test, OGET, Oklahoma Professional Teaching Examination, OPTE, Oklahoma Subject Area Tests, and OSAT are trademarks, in the U.S. and/or other countries, of the Oklahoma Commission for Teacher Preparation and Pearson Education, Inc. or its affiliate(s).

NES and its logo are trademarks in the U.S. and/or other countries of Pearson Education, Inc. or its affiliate(s).



STUDY GUIDE INTRODUCTION AND GENERAL INFORMATION ABOUT THE CERTIFICATION EXAMINATIONS FOR OKLAHOMA EDUCATORS

The first two sections of the study guide are available in a separate PDF file. Click the link below to view or print these sections.

[Study Guide Introduction and General Information About the Certification Examinations for Oklahoma Educators](#)



FIELD-SPECIFIC INFORMATION

- Test Competencies
 - Practice Test Questions and Answers
 - Constructed-Response Assignment Scoring
-

INTRODUCTION

This section includes a list of the test competencies, as well as a set of practice selected-response (multiple-choice) questions and one or more practice constructed-response assignments (if applicable), for the test field included in this study guide.

Test Competencies

The test competencies are broad, conceptual statements that reflect the subject-matter skills, knowledge, and understanding an entry-level educator needs to teach effectively in Oklahoma public schools. The list of test competencies for each test field represents the **only** source of information about what a specific test will cover and therefore should be reviewed carefully.

The descriptive statements that follow the competencies are included to provide examples of possible content covered by each competency. These descriptive statements are neither exhaustive nor exclusionary.

Practice Test Questions

The practice selected-response questions and any practice constructed-response assignments included in this section are designed to give you an introduction to the nature of the questions included in this OSAT test field. The practice test questions represent the various types of questions you may expect to see on an actual test; however, they are **not** designed to provide diagnostic information to help you identify specific areas of individual strengths and weaknesses or to predict your performance on the test as a whole.

To help you prepare for your OSAT, each practice selected-response question in this section is preceded by the competency it measures and followed by a brief explanation of the correct response. On the actual test, the competencies, correct responses, and explanations will **not** be given.

If the test field included in this guide has a constructed-response assignment, a sample response is provided immediately following the practice constructed-response assignment. The sample response in this guide is for illustrative purposes only. Your written response should be your original work, written in your own words, and not copied or paraphrased from some other work.

A description of the process that is used for scoring the constructed-response assignment is provided in addition to the OSAT performance characteristics and score scale.

When you are finished with the practice test questions, you may wish to go back and review the entire list of test competencies and descriptive statements for your test field.

TEST COMPETENCIES: PHYSICAL SCIENCE

SUBAREAS:

- I. Foundations of Scientific Inquiry
- II. Motion, Forces, and Energy
- III. 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, Brønsted-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.

PERIODIC TABLE OF THE ELEMENTS

																		18
																		VIIIA
																		2
																		He
																		4.00
																		10
																		Ne
																		20.18
																		17
																		VIIA
																		9
																		F
																		19.00
																		16
																		VIA
																		8
																		O
																		16.00
																		15
																		VA
																		7
																		N
																		14.01
																		14
																		IVA
																		6
																		C
																		12.01
																		13
																		IIIA
																		5
																		B
																		10.81
																		14
																		IIA
																		13
																		Al
																		27.0
																		12
																		IIB
																		31
																		Ga
																		69.7
																		30
																		Zn
																		65.4
																		11
																		IB
																		29
																		Cu
																		63.5
																		10
																		VIIIB
																		28
																		Ni
																		58.7
																		9
																		VIIIB
																		27
																		Co
																		58.9
																		8
																		VIIIB
																		26
																		Fe
																		55.8
																		7
																		VIIIB
																		25
																		Mn
																		54.9
																		6
																		VIB
																		24
																		Cr
																		52.0
																		5
																		VB
																		23
																		V
																		50.9
																		4
																		IVB
																		22
																		Ti
																		47.9
																		3
																		IIIB
																		21
																		Sc
																		45.0
																		2
																		IIA
																		20
																		Ca
																		40.1
																		1
																		IA
																		19
																		K
																		39.1
																		38
																		Sr
																		87.6
																		37
																		Rb
																		85.5
																		56
																		Ba
																		137.3
																		55
																		Cs
																		132.9
																		88
																		Ra
																		(226)
																		87
																		Fr
																		(223)
																		89-103
																		Rf
																		(261)
																		104
																		Rf
																		(261)
																		105
																		Db
																		(262)
																		106
																		Sg
																		(263)
																		107
																		Bh
																		(264)
																		108
																		Hs
																		(265)
																		109
																		Mt
																		(268)
																		110
																		111
																		112
																		113
																		114
																		115
																		116
																		117
																		118

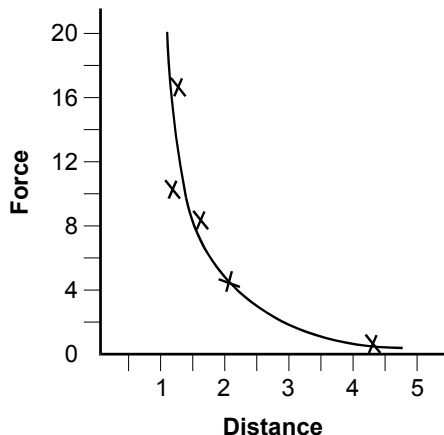
Lanthanide Series	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71
	La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
	138.9	140.1	140.9	144.2	(145)	150.4	152.0	157.3	158.9	162.5	164.9	167.3	168.9	173.0	175.0
Actinide Series	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103
	Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr
	(227)	232.0	231.0	238.0	(237)	(244)	(243)	(247)	(247)	(251)	(252)	(257)	(258)	(259)	(262)

Some of the elements 110 and above have been reported but not fully authenticated and named.

PRACTICE TEST QUESTIONS AND ANSWERS: PHYSICAL SCIENCE

Practice Selected-Response Questions

Use the graph and information below to answer the two questions that follow.



A physicist has empirically determined the values given on the graph above and drawn a smooth curve to fit the data.

Competency 0004

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

1. The physicist was most likely working on a project involving:
 - A. automobile test crashes.
 - B. electrically charged objects.
 - C. the compression of a spring.
 - D. the impact of objects dropped from heights.

Correct Response: B. As the distance between electrically charged objects is increased, the force they exert upon one another decreases. This characteristic is consistent with the data presented in the graph.

Competency 0009

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

2. The physicist would like to use the graph to determine how much work is required to move an object from a distance of 1 unit to a distance of 3 units. If d equals distance, which of the following steps should be an important part of the physicist's strategy?
- A. Find the slope of the curve between $d = 1$ and $d = 3$.
 - B. Find the area under the curve between $d = 1$ and $d = 3$.
 - C. Find the average of the plotted values between $d = 1$ and $d = 3$.
 - D. Find the midpoint of the curve between $d = 1$ and $d = 3$.

Correct Response: B. If the force is constant, the work required to move an object a given distance is the product of the applied force and the distance the object travels. In the graph above, the force is not constant, but varies with distance. If the force varies with distance, the force can be assumed to be constant over small increments of distance and the product of the force and the incremental distance can be calculated. Adding these products together results in a value for the work that is equivalent to the area under the force versus distance curve.

Competency 0010

Understand electric charge, electric fields, and electric potential.

3. Two $100\ \mu\text{C}$ charges are located so that they exert an attractive force of $10\ \text{N}$ on each other. What is the distance of separation? ($k = 9 \times 10^9\ \text{N m}^2/\text{C}^2$)

- A. $\sqrt{\frac{(9 \times 10^9\ \text{N m}^2/\text{C}^2)(100 \times 10^{-6}\ \text{C})(100 \times 10^{-6}\ \text{C})}{10\ \text{N}}}$
- B. $\frac{(9 \times 10^9\ \text{N m}^2/\text{C}^2)(100 \times 10^{-6}\ \text{C})(100 \times 10^{-6}\ \text{C})}{10\ \text{N}}$
- C. $\frac{10\ \text{N}}{(9 \times 10^9\ \text{N m}^2/\text{C}^2)(100 \times 10^{-6}\ \text{C})(100 \times 10^{-6}\ \text{C})}$
- D. $\sqrt{(9 \times 10^9\ \text{N m}^2/\text{C}^2)(10\ \text{N})(100 \times 10^{-6}\ \text{C})(100 \times 10^{-6}\ \text{C})}$

Correct Response: A. Coulomb's law states that the force between two charges is directly proportional to the constant (k) and the product of the two charges and is inversely proportional to the square of the distance of separation, which is given by

$$F = \frac{kQ_1Q_2}{d^2}.$$

Solving this equation for distance (d) gives

$$d = \sqrt{\frac{kQ_1Q_2}{F}}.$$

Substituting the values from the question,

$$d = \sqrt{\frac{(9 \times 10^9)\ \text{N m}^2/\text{C}^2 (100 \times 10^{-6})\text{C} (100 \times 10^{-6})\text{C}}{10\ \text{N}}} = 3\ \text{m}.$$

Competency 0012

Understand magnetic fields and electromagnetic induction.

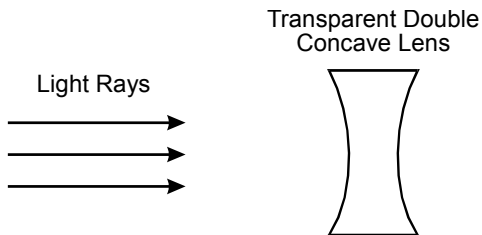
4. An alternating-current-carrying wire induces a current in another nearby wire. This phenomenon is the basis of operation of which of the following devices?
- A. motor
 - B. generator
 - C. galvanometer
 - D. transformer

Correct Response: D. As the magnetic lines of force (flux lines) build up and collapse with the changes in current passing through one coil, current is induced in another coil. This process, known as electromagnetic induction, is the basis for the operation of transformers, which are used to either increase or decrease voltages in electrical systems.

Competency 0014

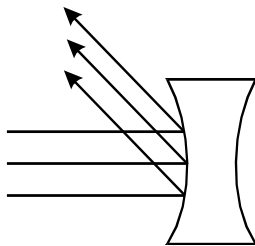
Understand the characteristics of sound waves and electromagnetic waves (including light and optics).

5. Use the diagram below to answer the question that follows.

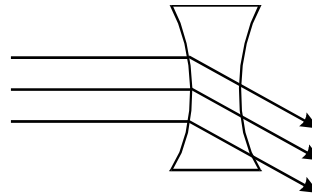


Which of the following diagrams correctly traces the path of parallel light rays as they travel from the light source and encounter the lens shown in the diagram above?

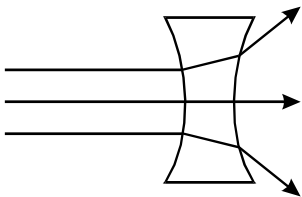
A.



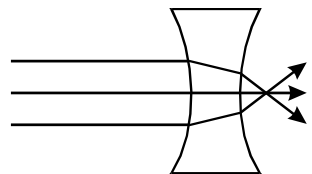
B.



C.



D.

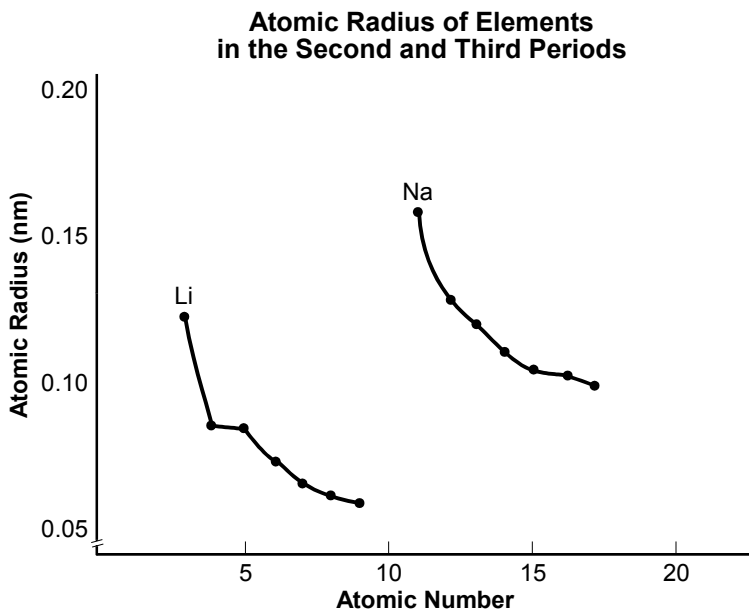


Correct Response: C. The speed of light is slower in glass than in air. As light passes from air to glass, its trajectory is bent towards the normal, a line drawn perpendicular to the surface of the lens. As the light exits the glass on the other side of the lens its speed increases, causing its trajectory to be bent away from the normal. Applying this property to the geometry of the double concave lens shows that parallel rays incident on the lens diverge.

Competency 0015

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

6. Use the graph below to answer the question that follows.



The graph above shows the relationship between atomic radius and atomic number for elements in the second and third periods of the periodic table. According to the diagram, which of the following statements are true?

- I. Within a group, atomic radius tends to decrease as atomic number increases.
 - II. Within a period, atomic radius tends to decrease as atomic number increases.
 - III. The largest element in the fourth period is expected to be potassium.
 - IV. Within a period, main group metals tend to be smaller than nonmetals.
-
- A. I and III only
 - B. I and IV only
 - C. II and III only
 - D. III and IV only

Correct Response: C. In each curve on the graph, the atomic number is increasing in increments of one as the atomic radius decreases. This indicates that each curve represents a period of the periodic table. The second period starts with lithium (Li), which has the largest atomic radius of the elements in the second period. The third period starts with sodium (Na), which has the largest atomic radius of the elements in the third period. Given this trend in the periodic table, the fourth period should start with potassium (K), which will have the largest atomic radius of the elements in the fourth period.

Competency 0016

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

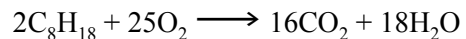
7. Which of the following properties is most likely to be associated with nonpolar covalent substances?
- A. high freezing point
 - B. good electrical conduction
 - C. high boiling point
 - D. poor thermal conduction

Correct Response: D. Molecules held together by covalent molecular bonds are formed by the sharing of electrons. In a nonpolar molecule, the electrons are shared equally between the bonding atoms. This equal sharing causes the forces between the molecules of a nonpolar covalent substance to be relatively weak. Weak intermolecular forces result in the poor conduction of thermal energy—the energy of molecular motion—through the substance.

Competency 0017

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

8. Use the reaction below to answer the question that follows.



The chemical equation above represents the combustion of octane, a component of gasoline. If 114 g of octane are burned, how many grams of carbon dioxide will be produced?

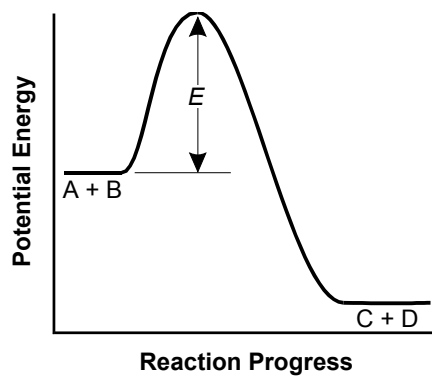
- A. 44 g
- B. 176 g
- C. 352 g
- D. 912 g

Correct Response: C. The coefficients of the chemical equation state that for every 2 moles of octane consumed, 16 moles of carbon dioxide will be produced. Since 1 mole of octane has a mass of $8(12 \text{ g}) + 18(1 \text{ g}) = 114 \text{ g}$, 1 mole of octane is combining with oxygen and will therefore produce 8 moles of carbon dioxide. The mass of 8 moles of carbon dioxide is $8[1(12 \text{ g}) + 2(16 \text{ g})] = 352 \text{ g}$.

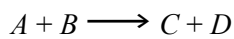
Competency 0020

Understand chemical reactions, reaction rates, and chemical equilibrium.

9. Use the graph below to answer the question that follows.

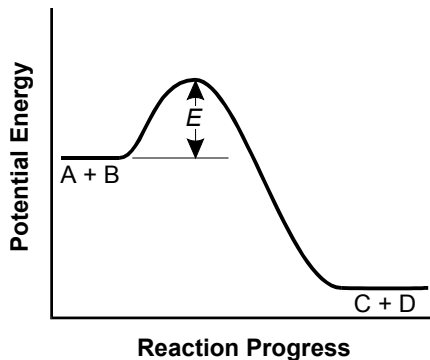


The graph above shows the activation energy (E) for the following reaction:

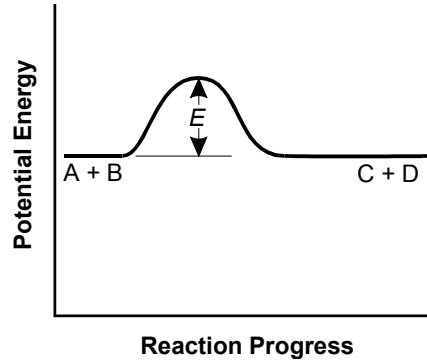


Which of the following graphs will result if a catalyst is added to the reactants?

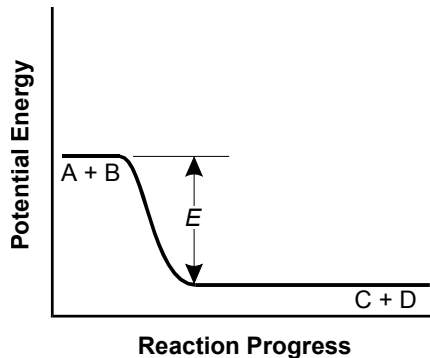
A.



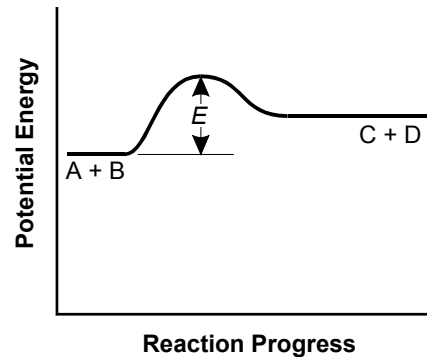
B.



C.



D.



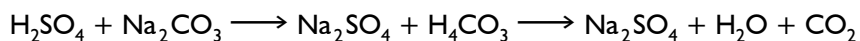
Correct Response: A. A catalyst increases the reaction rate of a chemical reaction's progress without altering the chemical properties of the reactants or the products. It does this by lowering the activation energy of the reaction. This is reflected in graph A.

Competency 0021

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

10. The reaction of a strong acid with a carbonate will result in the formation of a salt plus which of the following?
- A. $\text{CO}_2 + \text{H}_2\text{O}$
 - B. $\text{CO} + \text{H}_2\text{O}$
 - C. $\text{CO}_2 + \text{H}_2\text{O}_2$
 - D. $\text{CO} + \text{H}_2$

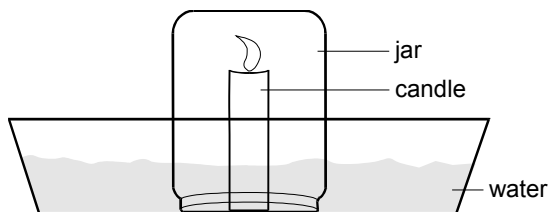
Correct Response: A. When a strong acid reacts with a carbonate, a salt plus carbon dioxide and water are produced. In such a reaction, the acid donates two hydrogen ions (H^+) to the carbonate ion (CO_3^{2-}) to produce carbonic acid (H_2CO_3), which is a weak acid. Carbonic acid, which is unstable, rapidly decomposes into water (H_2O) and carbon dioxide (CO_2). An example of this type of reaction is that between sulfuric acid and sodium carbonate as shown below.



Practice Constructed-Response Assignment

11. **Read the information below; then complete the exercise that follows.**

A lit candle, with a molecular formula of $C_{25}H_{52}$, is placed upright in a pan of water, and a glass jar is inverted and placed over the candle. The mouth of the jar is submerged in the water, as shown in the diagram below.



The water level in the jar rises, the candle's flame goes out, and the water rises further. An observer suggests that the water rises because oxygen is being consumed, which creates a partial vacuum. A second observer points out that this explanation violates the law of conservation of matter since the system is closed.

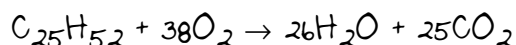
Using your knowledge of science, write an essay in which you explain the behavior of this system in terms of scientific laws and concepts. In your essay:

- evaluate each observer's conclusion about the system;
- write a balanced chemical equation for the burning of the candle;
- describe how the gas laws explain the behavior of this system; and
- describe the system's initial state and its final state in terms of pressure.

A Very Good Response to the Practice Constructed-Response Assignment

The second observer's conclusion is more accurate, because matter can neither be created nor destroyed. Also, the water acts as a seal, creating a closed system inside the jar. Because it is a closed system, matter cannot enter or leave the system. The first observer's conclusion is partially correct if one considers that the oxygen being "consumed" during combustion is molecular oxygen (O_2) rather than atomic oxygen. However, the first observer has failed to take into account the fact that a chemical change has occurred, and the oxygen atoms have been incorporated into water and carbon dioxide molecules. Since the system is closed, there is no net loss of oxygen atoms from the system.

The balanced chemical equation for the burning candle is:



If one assumes that the O_2 and CO_2 are in a gaseous state, the $C_{25}H_{52}$ is in a solid state, and the H_2O is in a liquid state, then the gas laws would pertain to the O_2 and CO_2 only. According to Avogadro's law, the volume of a gas is directly proportional to the number of moles of the gas present (at constant pressure and temperature). Also, one mole of any ideal gas, regardless of its identity or chemical structure, occupies the same volume at a given temperature and pressure. The balanced chemical equation for the combustion of the candle indicates that there are more moles of O_2 than there are of CO_2 , so according to Avogadro's law, there would be a smaller volume of gas at the conclusion of the reaction than there was in the system initially.

The rise in the water level can be explained by looking at the conditions in the system when the jar is first inverted over the candle and after the flame burns out. Initially when the jar is inverted over the burning candle, the air pressure inside the jar equals the atmospheric pressure, so the water level is even inside and outside the jar. As O_2 reacts and CO_2 is produced, the volume of gas in the jar decreases. However, because the jar is rigid, the actual volume of space occupied by the gas does not change. This results in fewer gas molecules occupying the same volume of space, and so the pressure inside the jar drops. The pressure exerted by the air on the water outside the jar does not change though. Essentially, the atmospheric pressure pushes down on the water outside the jar and pushes the water up into the jar where the pressure is less. The gas laws state that the pressure exerted by a gas is inversely proportional to its volume, so as the water rises in the jar, there is less space available for the gas molecules and the pressure increases. When the water stops rising in the jar, equilibrium has been reached. That is, the pressure inside the jar pushing down on the water plus the weight of the water equals the force pushing down on the water outside the jar.

CONSTRUCTED-RESPONSE ASSIGNMENT SCORING

All responses to OSAT constructed-response assignments (written and oral) are scored using scoring scales that describe varying levels of performance. These scales were approved by committees of Oklahoma educators who reviewed both the performance characteristics and the scoring scales.

Each response is scored by multiple scorers according to standardized procedures during scoring sessions held immediately after each administration of the CEOE. Scorers with relevant professional backgrounds are oriented to these procedures before the scoring session and are carefully monitored during the scoring sessions.

A constructed-response assignment response is designated unscorable if it is blank, not on the assigned topic, illegible or unintelligible, not in the appropriate language, or of insufficient length to score. If you do not provide a scorable response for each constructed-response assignment on your test, you cannot pass the test regardless of your scores on the other section(s) of the test.

Sample Performance Characteristics for Constructed-Response Assignments

PURPOSE	The extent to which the response achieves the purpose of the assignment
SUBJECT MATTER KNOWLEDGE	Accuracy and appropriateness in the application of subject matter knowledge
SUPPORT	Quality and relevance of supporting details
RATIONALE	Soundness of argument and degree of understanding of the subject matter

Sample Scoring Scale for Constructed-Response Assignments

SCORE POINT	SCORE POINT DESCRIPTION
4	The "4" response reflects a thorough knowledge and understanding of the subject matter. <ul style="list-style-type: none">• The purpose of the assignment is fully achieved.• There is a substantial, accurate, and appropriate application of subject matter knowledge.• The supporting evidence is sound; there are high-quality, relevant examples.• The response reflects an ably reasoned, comprehensive understanding of the topic.
3	The "3" response reflects a general knowledge and understanding of the subject matter. <ul style="list-style-type: none">• The purpose of the assignment is largely achieved.• There is a generally accurate and appropriate application of subject matter knowledge.• The supporting evidence generally supports the discussion; there are some relevant examples.• The response reflects a general understanding of the topic.
2	The "2" response reflects a partial knowledge and understanding of the subject matter. <ul style="list-style-type: none">• The purpose of the assignment is partially achieved.• There is a limited, possibly inaccurate or inappropriate application of subject matter knowledge.• The supporting evidence is limited; there are few relevant examples.• The response reflects a limited, poorly reasoned understanding of the topic.
1	The "1" response reflects little or no knowledge and understanding of the subject matter. <ul style="list-style-type: none">• The purpose of the assignment is not achieved.• There is little or no appropriate or accurate application of subject matter knowledge.• The supporting evidence, if present, is weak; there are few or no relevant examples.• The response reflects little or no reasoning about or understanding of the topic.
U	The response is unscorable because it is illegible, not written to the assigned topic, written in a language other than English, or of insufficient length to score.
B	There is no response to the assignment.

**CERTIFICATION EXAMINATIONS FOR OKLAHOMA EDUCATORS
NATIONAL EVALUATION SYSTEMS
AMHERST, MA 01004-9007**

**www.octep.org
www.ceoe.nesinc.com**

