

The Praxis® Study Companion

# Chemistry: Content Knowledge

5245



# Welcome to *The Praxis*® Study Companion

## Prepare to Show What You Know

You have been working to acquire the knowledge and skills you need for your teaching career. Now you are ready to demonstrate your abilities by taking a *Praxis*® test.

Using the *Praxis*® Study Companion is a smart way to prepare for the test so you can do your best on test day. This guide can help keep you on track and make the most efficient use of your study time.

The Study Companion contains practical information and helpful tools, including:

- An overview of the *Praxis* tests
- Specific information on the *Praxis* test you are taking
- A template study plan
- Study topics
- Practice questions and explanations of correct answers
- Test-taking tips and strategies
- Frequently asked questions
- Links to more detailed information

So where should you start? Begin by reviewing this guide in its entirety and note those sections that you need to revisit. Then you can create your own personalized study plan and schedule based on your individual needs and how much time you have before test day.

Keep in mind that study habits are individual. There are many different ways to successfully prepare for your test. Some people study better on their own, while others prefer a group dynamic. You may have more energy early in the day, but another test taker may concentrate better in the evening. So use this guide to develop the approach that works best for you.

Your teaching career begins with preparation. Good luck!

## Know What to Expect

### Which tests should I take?

Each state or agency that uses the *Praxis* tests sets its own requirements for which test or tests you must take for the teaching area you wish to pursue.

Before you register for a test, confirm your state or agency's testing requirements at [www.ets.org/praxis/states](http://www.ets.org/praxis/states).

### How are the *Praxis* tests given?

*Praxis* tests are given on computer. Other formats are available for test takers approved for accommodations (see page 38).

### **What should I expect when taking the test on computer?**

When taking the test on computer, you can expect to be asked to provide proper identification at the test center. Once admitted, you will be given the opportunity to learn how the computer interface works (how to answer questions, how to skip questions, how to go back to questions you skipped, etc.) before the testing time begins. Watch the [What to Expect on Test Day](#) video to see what the experience is like.

### **Where and when are the *Praxis* tests offered?**

You can select the test center that is most convenient for you. The *Praxis* tests are administered through an international network of test centers, which includes Prometric® Testing Centers, some universities, and other locations throughout the world.

Testing schedules may differ, so see the *Praxis* web site for more detailed test registration information at [www.ets.org/praxis/register](http://www.ets.org/praxis/register).

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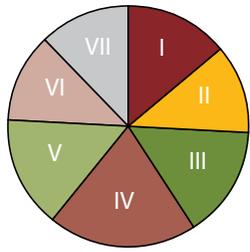
*The Praxis® Study Companion guides you through the steps to success*

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# 1. Learn About Your Test

*Learn about the specific test you will be taking*

## Chemistry: Content Knowledge (5245)

Test at a Glance			
<b>Test Name</b>	Chemistry: Content Knowledge		
<b>Test Code</b>	5245		
<b>Time</b>	2.5 hours		
<b>Number of Questions</b>	125		
<b>Format</b>	Selected-response questions		
<b>Test Delivery</b>	Computer delivered		
	<b>Content Categories</b>	<b>Approximate Number of Questions</b>	<b>Approximate Percentage of Examination</b>
	I. Basic Principles of Matter and Energy; Thermodynamics	17	14%
	II. Atomic and Nuclear Structure	15	12%
	III. Nomenclature; Chemical Composition; Bonding and Structure	19	15%
	IV. Chemical Reactions; Periodicity	25	20%
	V. Solutions and Solubility; Acid-Base Chemistry	19	15%
	VI. Scientific Inquiry and Social Perspectives of Science	15	12%
	VII. Scientific Procedures and Techniques	15	12%

### About This Test

The Chemistry: Content Knowledge test is designed to measure the knowledge and competencies necessary for a beginning teacher of secondary school Chemistry. Examinees have typically completed or nearly completed a bachelor's degree program with appropriate coursework in chemistry and education. This test may contain some questions that will not count toward your score.

The development of the test questions and the construction of the test reflect the National Science Education Standards (NSES) and the National Science Teacher Association (NSTA) standards and recognize that there are conceptual and procedural schemes that unify the various scientific disciplines. These fundamental concepts and processes (systems; models; constancy and change; equilibrium; form and function) are useful in understanding the natural world. Insofar as possible, then, the test questions will have the primary objective of evaluating the content areas by using questions that focus on conceptual understanding, critical thinking, and problem solving in science. The test content is developed and reviewed in collaboration with practicing high school chemistry teachers, teacher-educators, and higher education content specialists to keep the test updated and representative of current standards.

The 125 selected-response questions include concepts, terms, phenomena, methods, applications, data analysis, and problem solving in Chemistry, and include an understanding of the impact of science and technology on the environment and human affairs. The topics are typically those covered in introductory college-level chemistry courses, although some questions of a more advanced nature are included, because secondary school teachers must understand the subject matter from a more advanced viewpoint than that presented to their students.

Examinees will not need to use calculators in taking this test. The periodic table of the elements is available as a Help screen, along with a table of information that presents various physical constants and a few conversion factors among SI units. Whenever necessary, additional values of physical constants are included with the text of a question.

## Test Specifications

Test specifications describe the knowledge and skills measured by the test. Study topics to help you prepare to answer test questions can be found on page 27.

### I. Basic Principles of Matter and Energy; Thermodynamics

#### A. Matter and Energy

1. Organization of matter
  - a. pure substances (elements and compounds)
  - b. mixtures (homogeneous, heterogeneous, solutions, suspensions)
  - c. states of matter (solid, liquid, gas, plasma)
2. Particulate structure of matter
  - a. atoms, ions, molecules
3. Differences between chemical and physical properties and chemical and physical changes
  - a. chemical versus physical properties
  - b. chemical versus physical changes
  - c. intensive versus extensive properties
4. Conservation of energy and the conservation of matter in chemical processes
  - a. law of conservation of energy
  - b. law of conservation of matter
5. Different forms of energy
  - a. kinetic and potential
  - b. chemical, electrical, electromagnetic, nuclear, and thermal energy
  - c. conversions between different forms of energy within chemical systems

#### B. Thermodynamics in Chemistry

1. Temperature, thermal energy, and heat capacity, including temperature scales, units of energy, and calculations involving these concepts
  - a. temperature and temperature scales
  - b. thermal energy and units of energy
  - c. heat transfer
  - d. heat capacity and specific heat
  - e. calorimetry calculations
2. Concepts and calculations involving phase transitions between the various states of matter
  - a. phase transitions and diagrams

- b. heats of vaporization, fusion, and sublimation
- c. heating curves
- 3. Kinetic molecular theory and ideal gas laws
  - a. assumptions of the kinetic molecular theory
  - b. ideal gases and the ideal gas laws (e.g., applications, calculations)
  - c. real gas behavior
- 4. Energetics of chemical reactions
  - a. exothermic and endothermic reactions
  - b. bond energy; Hess's law
- 5. How the laws of thermodynamics relate to chemical reactions and phase changes
  - a. laws of thermodynamics
  - b. spontaneous/reversible processes
  - c. change in enthalpy, entropy, and Gibbs energy in chemical/physical processes

## II. Atomic and Nuclear Structure

1. Current model of atomic structure
  - a. description of atomic model (e.g., subatomic particles, orbitals, quantum numbers)
  - b. experimental basis (e.g., cathode ray tube, gold foil experiment, spectral lines)
  - c. isotopes (mass number, average atomic mass)
2. Electron configuration of the elements based on the periodic table
  - a. Aufbau principle, Hund's rule, Pauli exclusion principle
  - b. correlation between electron configuration and periodic table
  - c. relationship between electron configuration and chemical and physical properties
3. Radioactivity
  - a. characteristics of alpha particles, beta particles, and gamma radiation
  - b. radioactive decay processes; half life
  - c. fission, fusion, and other nuclear reactions
  - d. balancing nuclear reactions and identifying products of nuclear reactions
4. How the electronic absorption and emission spectra of elements are related to electron energy levels
  - a. electronic energy transitions in atoms (e.g., ground state, excited states, emission/absorption of energy)

- b. energy of electronic absorption/emission spectral lines in various regions of the electromagnetic spectrum
- c. relationship between energy, frequency, and wavelength

## III. Nomenclature; Chemical Composition; Bonding and Structure

### A. Nomenclature and Chemical Composition

1. Systematic names and chemical formulas of simple inorganic compounds
  - a. binary compounds
  - b. acids, bases, and salts
  - c. hydrates
2. Names of common organic compounds based on their functional groups
  - a. alkanes, alkenes, and alkynes
  - b. alcohols, ethers, ketones, aldehydes, amines
3. Mole concept and how it applies to chemical composition
  - a. Avogadro's number, molar mass, and mole conversions
  - b. calculation of empirical and molecular formulas
  - c. percent composition

### B. Bonding and Structure

1. Common properties of bonds
  - a. relative bond lengths
  - b. relative bond strengths
2. Bond types
  - a. ionic bonding
  - b. covalent bonding (polar, nonpolar, hybridization)
  - c. metallic bonding
3. Structural formulas and molecular geometry (shape)
  - a. Lewis structures including formal charges
  - b. resonance structures
  - c. molecular geometry (shape and approximate bond angles)
4. Identify polar and nonpolar molecules
  - a. analysis of bonding in the molecule
  - b. symmetry of molecular structure

5. Intermolecular interactions
    - a. hydrogen bonding
    - b. London forces (instantaneous induced dipole-dipole)
    - c. dipole-dipole
    - d. dipole-induced dipole
  6. How bonding and structure correlate with physical properties
    - a. boiling points and melting points
    - b. solubility
    - c. equilibrium vapor pressure
3. Identify, write, and predict products of simple reaction types
    - a. combustion, neutralization
    - b. decomposition, dehydration
    - c. single and double replacement
    - d. oxidation-reduction
  4. Chemical kinetics
    - a. rate laws, rate constants, and reaction order
    - b. activation energy and reaction mechanisms including catalysts
    - c. factors affecting reaction rate such as concentration, surface area, and temperature

#### IV. Chemical Reactions; Periodicity

##### A. Periodicity

1. Basis of the periodic table and general layout
  - a. arranged in groups and periods
  - b. atomic number and mass
  - c. symbols of the elements
  - d. metals, nonmetals, metalloids
  - e. transition elements
2. Periodic trends in physical and chemical properties of the elements
  - a. atomic/ionic radius
  - b. ionization energy
  - c. electron affinity
  - d. electronegativity
  - e. physical properties (e.g., boiling/melting points, conductivity)
  - f. chemical reactivity

##### B. Chemical Reactions and Basic Principles

1. Balancing chemical equations
  - a. simple chemical equations
  - b. chemical equations involving oxidation-reduction
2. Stoichiometric calculations
  - a. simple calculations based on balanced chemical equations involving moles, mass, and volume
  - b. limiting reagent calculations and percent yield

##### 5. Chemical reaction equilibrium

- a. equilibrium constants
  - b. Le Châtelier's principle
6. Oxidation-reduction reactions and how to determine oxidation states
    - a. oxidation states
    - b. identify oxidation-reduction reactions and half reactions
    - c. standard reduction potentials
    - d. electrochemical reactivity series
    - e. electrochemical cells

##### C. Biochemistry and Organic Chemistry

1. Important biochemical compounds
  - a. carbohydrates, including simple sugars
  - b. lipids
  - c. proteins and amino acids
  - d. DNA and RNA
  - e. products of photosynthesis and respiration
2. Common organic compounds (i.e., identify functional groups)
  - a. alcohols
  - b. ketones and aldehydes
  - c. alkanes, alkenes, and alkynes
  - d. ethers
  - e. carboxylic acids
  - f. amines
  - g. benzene

## V. Solutions and Solubility; Acid-Base Chemistry

### A. Solutions and Solubility

- Solution terminology and calculations
  - dilute, concentrated
  - saturated, unsaturated, supersaturated
  - solvent, solute
  - concentration units (e.g., molarity, molality, mole fraction, parts per million (ppm), parts per billion (ppb), percent by mass or volume)
  - preparation of solutions of varying concentrations
- Factors affecting solubility and dissolution rate
  - dissolution rate (i.e., temperature, pressure, surface area, agitation)
  - solubility and solubility curves (temperature and pressure dependent)
- Solution phenomena based on colligative properties
  - freezing point depression
  - boiling point elevation
  - vapor pressure effects
  - osmotic pressure
- Common applications of equilibrium in ionic solutions
  - solubility of ionic compounds (e.g., solubility rules, slightly soluble compounds)
  - $K_{sp}$  calculations including percent dissociation and precipitation
  - common ion effect
  - electrolytes, nonelectrolytes, and electrical conductivity

### B. Acid-Base Chemistry

- Define and identify acids and bases and know their properties
  - Arrhenius acids and bases
  - Brønsted-Lowry acids and bases
  - Lewis acids and bases
  - neutralization and equivalence point

- The pH scale and calculations involving pH and pOH
  - pH scale
  - calculation of pH and pOH
  - calculation of  $[H^+]$  and  $[OH^-]$
  - knows the meaning of  $K_w$
- Concepts and calculations involving acid-base titrations
  - use and selection of indicators (e.g., phenolphthalein, litmus paper)
  - endpoint determination
  - calculations based on titrations
- Equilibrium relationships in acid-base chemistry
  - strong/weak acids and bases, including common examples
  - monoprotic and polyprotic acids
  - $K_a$ ,  $K_b$ , and percent dissociation
  - hydrolysis (acidic and basic salts)
  - buffer solutions

## VI. Scientific Inquiry and Social Perspectives of Science

### A. History and Nature of Scientific Inquiry

- Processes involved in scientific inquiry
  - formulating problems
  - forming and testing hypotheses
  - development of theories, models, and laws (postulates, assumptions)
  - process skills including observing, concluding, comparing, inferring, categorizing, and generalizing
- Experimental design
  - testing hypotheses
  - significance of controls
  - use and identification of variables
  - data collection planning

3. Nature of scientific knowledge
  - a. subject to change
  - b. consistent with experimental evidence
  - c. reproducibility
  - d. unifying concepts and processes (e.g., systems, models, constancy and change, equilibrium, form and function)
4. Major historical developments in chemistry and the contributions of major historical figures
  - a. how current chemical principles and models developed over time
  - b. major developments in chemistry (e.g., atomic model, ideal gas behavior) including major historical figures

## **B. Science, Technology, Society, and the Environment**

1. Impact of chemistry and technology on society and the environment
  - a. pharmaceuticals
  - b. acid rain
  - c. medical imaging
  - d. air and water pollution
  - e. greenhouse gases
  - f. ozone layer depletion
  - g. waste disposal and recycling
  - h. nanotechnology
2. Applications of chemistry in daily life
  - a. plastics, soap, batteries, fuel cells, and other consumer products
  - b. water purification
  - c. chemical properties of household products
3. Advantages and disadvantages associated with various types of energy production
  - a. renewable and nonrenewable energy resources
  - b. conservation and recycling
  - c. pros and cons of power generation based on various sources such as fossil and nuclear fuel, hydropower, wind power, solar power, and geothermal power

## **VII. Scientific Procedures and Techniques**

1. Collect, evaluate, manipulate, interpret, and report data
  - a. significant figures in collected data and calculations
  - b. organization and presentation of data
  - c. knows how to interpret and draw conclusions from data presented in tables, graphs, and charts (e.g., trends in data, relationships between variables, predictions and conclusions based on data)
2. Units of measurement, notation systems, conversions, and mathematics used in chemistry
  - a. standard units of measurement
  - b. unit conversion
  - c. scientific notation
  - d. measurement equipment
3. Basic error analysis
  - a. determining mean
  - b. accuracy and precision
  - c. identifying sources and effects of error
  - d. percent error
4. Appropriate preparation, use, storage, and disposal of materials in the laboratory
  - a. appropriate use and storage
  - b. safe disposal
  - c. preparation for classroom use
  - d. safe procedures and safety precautions
5. Appropriate use, maintenance, and calibration of laboratory equipment
  - a. appropriate use and storage
  - b. maintenance and calibration
  - c. preparation for classroom use
  - d. safety procedures and precautions when using equipment
6. Safety procedures and precautions for the high school chemistry laboratory
  - a. location and use of standard safety equipment such as eyewash and shower
  - b. laboratory safety rules for students
  - c. appropriate apparel and conduct in the laboratory, such as wearing goggles
  - d. emergency procedures

## 2. Familiarize Yourself with Test Questions

*Become comfortable with the types of questions you'll find on the Praxis tests*

The *Praxis* assessments include a variety of question types: constructed response (for which you write a response of your own); selected response, for which you select one or more answers from a list of choices or make another kind of selection (e.g., by clicking on a sentence in a text or by clicking on part of a graphic); and numeric entry, for which you enter a numeric value in an answer field. You may be familiar with these question formats from taking other standardized tests. If not, familiarize yourself with them so you don't spend time during the test figuring out how to answer them.

### Understanding Computer-Delivered Questions

Questions on computer-delivered tests are interactive in the sense that you answer by selecting an option or entering text on the screen. If you see a format you are not familiar with, read the directions carefully. The directions always give clear instructions on how you are expected to respond.

For most questions, you respond by clicking an oval to select a single answer from a list of answer choices.

However, interactive question types may also ask you to respond by:

- **Clicking more than one oval** to select answers from a list of choices.
- **Typing in an entry box.** When the answer is a number, you may be asked to enter a numerical answer. Some questions may have more than one place to enter a response.
- **Clicking check boxes.** You may be asked to click check boxes instead of an oval when more than one choice within a set of answers can be selected.
- **Clicking parts of a graphic.** In some questions, you will select your answers by clicking on a location (or locations) on a graphic such as a map or chart, as opposed to choosing your answer from a list.
- **Clicking on sentences.** In questions with reading passages, you may be asked to choose your answers by clicking on a sentence (or sentences) within the reading passage.
- **Dragging and dropping answer choices into targets on the screen.** You may be asked to select answers from a list of choices and drag your answers to the appropriate location in a table, paragraph of text or graphic.
- **Selecting answer choices from a drop-down menu.** You may be asked to choose answers by selecting choices from a drop-down menu (e.g., to complete a sentence).

Remember that with every question you will get clear instructions.

Perhaps the best way to understand computer-delivered questions is to view the [Computer-delivered Testing Demonstration](#) on the Praxis web site to learn how a computer-delivered test works and see examples of some types of questions you may encounter.

## Understanding Selected-Response Questions

Many selected-response questions begin with the phrase “which of the following.” Take a look at this example:

**Which of the following is a flavor made from beans?**

- (A) Strawberry
- (B) Cherry
- (C) Vanilla
- (D) Mint

### How would you answer this question?

All of the answer choices are flavors. Your job is to decide which of the flavors is the one made from beans.

Try following these steps to select the correct answer.

- 1) **Limit your answer to the choices given.** You may know that chocolate and coffee are also flavors made from beans, but they are not listed. Rather than thinking of other possible answers, focus only on the choices given (“which of the following”).
- 2) **Eliminate incorrect answers.** You may know that strawberry and cherry flavors are made from fruit and that mint flavor is made from a plant. That leaves vanilla as the only possible answer.
- 3) **Verify your answer.** You can substitute “vanilla” for the phrase “which of the following” and turn the question into this statement: “Vanilla is a flavor made from beans.” This will help you be sure that your answer is correct. If you’re still uncertain, try substituting the other choices to see if they make sense. You may want to use this technique as you answer selected-response questions on the practice tests.

### Try a more challenging example

The vanilla bean question is pretty straightforward, but you’ll find that more challenging questions have a similar structure. For example:

**Entries in outlines are generally arranged according to which of the following relationships of ideas?**

- (A) Literal and inferential
- (B) Concrete and abstract
- (C) Linear and recursive
- (D) Main and subordinate

You’ll notice that this example also contains the phrase “which of the following.” This phrase helps you determine that your answer will be a “relationship of ideas” from the choices provided. You are supposed to find the choice that describes how entries, or ideas, in outlines are related.

Sometimes it helps to put the question in your own words. Here, you could paraphrase the question in this way: “How are outlines usually organized?” Since the ideas in outlines usually appear as main ideas and subordinate ideas, the answer is (D).

**QUICK TIP:** Don't be intimidated by words you may not understand. It might be easy to be thrown by words like "recursive" or "inferential." Read carefully to understand the question and look for an answer that fits. An outline is something you are probably familiar with and expect to teach to your students. So slow down, and use what you know.

### Watch out for selected-response questions containing "NOT," "LEAST," and "EXCEPT"

This type of question asks you to select the choice that does not fit. You must be very careful because it is easy to forget that you are selecting the negative. This question type is used in situations in which there are several good solutions or ways to approach something, but also a clearly wrong way.

### How to approach questions about graphs, tables, or reading passages

When answering questions about graphs, tables, or reading passages, provide only the information that the questions ask for. In the case of a map or graph, you might want to read the questions first, and then look at the map or graph. In the case of a long reading passage, you might want to go ahead and read the passage first, noting places you think are important, and then answer the questions. Again, the important thing is to be sure you answer the questions as they refer to the material presented. So read the questions carefully.

### How to approach unfamiliar formats

New question formats are developed from time to time to find new ways of assessing knowledge. Tests may include audio and video components, such as a movie clip or animation, instead of a map or reading passage. Other tests may allow you to zoom in on details in a graphic or picture.

Tests may also include interactive questions. These questions take advantage of technology to assess knowledge and skills in ways that standard selected-response questions cannot. If you see a format you are not familiar with, **read the directions carefully**. The directions always give clear instructions on how you are expected to respond.

**QUICK TIP:** Don't make the questions more difficult than they are. Don't read for hidden meanings or tricks. There are no trick questions on *Praxis* tests. They are intended to be serious, straightforward tests of your knowledge.

## Understanding Constructed-Response Questions

Constructed-response questions require you to demonstrate your knowledge in a subject area by creating your own response to particular topics. Essays and short-answer questions are types of constructed-response questions.

For example, an essay question might present you with a topic and ask you to discuss the extent to which you agree or disagree with the opinion stated. You must support your position with specific reasons and examples from your own experience, observations, or reading.

Take a look at a few sample essay topics:

- "Celebrities have a tremendous influence on the young, and for that reason, they have a responsibility to act as role models."
- "We are constantly bombarded by advertisements—on television and radio, in newspapers and magazines, on highway signs, and the sides of buses. They have become too pervasive. It's time to put limits on advertising."
- "Advances in computer technology have made the classroom unnecessary, since students and teachers are able to communicate with one another from computer terminals at home or at work."

### Keep these things in mind when you respond to a constructed-response question

- 1) **Answer the question accurately.** Analyze what each part of the question is asking you to do. If the question asks you to describe or discuss, you should provide more than just a list.
- 2) **Answer the question completely.** If a question asks you to do three distinct things in your response, you should cover all three things for the best score. Otherwise, no matter how well you write, you will not be awarded full credit.
- 3) **Answer the question that is asked.** Do not change the question or challenge the basis of the question. You will receive no credit or a low score if you answer another question or if you state, for example, that there is no possible answer.
- 4) **Give a thorough and detailed response.** You must demonstrate that you have a thorough understanding of the subject matter. However, your response should be straightforward and not filled with unnecessary information.
- 5) **Reread your response.** Check that you have written what you thought you wrote. Be sure not to leave sentences unfinished or omit clarifying information.

**QUICK TIP:** You may find that it helps to take notes on scratch paper so that you don't miss any details. Then you'll be sure to have all the information you need to answer the question.

For tests that have constructed-response questions, more detailed information can be found on page 5.

## 3. Practice with Sample Test Questions

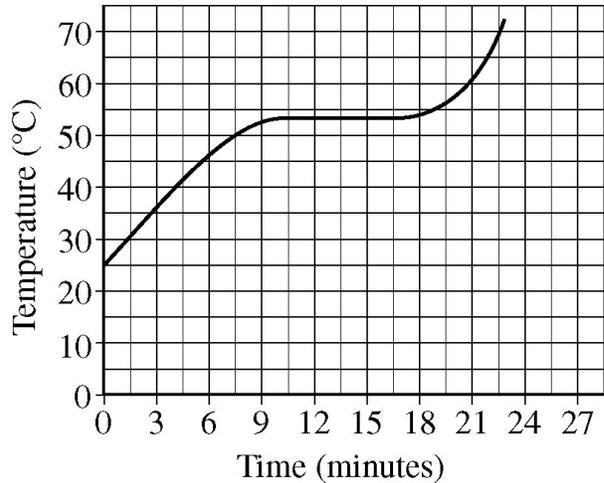
Answer practice questions and find explanations for correct answers

### Sample Test Questions

The sample questions that follow illustrate the kinds of questions on the test. They are not, however, representative of the entire scope of the test in either content or difficulty. Answers with explanations follow the questions.

**Directions:** Each of the questions or incomplete statements below is followed by four suggested answers or completions. Select the one that is best in each case.

- In a laboratory experiment, crystals are heated in a dry glass test tube using a Bunsen burner. During heating, a clear liquid is observed inside the mouth of the test tube. Which of the following is the most reasonable conclusion drawn from this observation?
  - The gas fuel used to heat the crystals forms water as it burns.
  - The crystals give off water when heated.
  - The crystals give off both hydrogen and oxygen gases that combine to form water.
  - Condensation from the air collects on the test tube as the crystals are heated.
- Suppose that a mixture of 8 g of sugar, 5.20 g of salt, and 100.01 g of flour is prepared. What is the total mass of the mixture expressed in exponential notation and with the correct number of significant figures?
  - $1 \times 10^2$  g
  - $1.1 \times 10^2$  g
  - $1.13 \times 10^2$  g
  - $1.132 \times 10^2$  g
- Use of a small quantity of which of the following gases in a classroom requires special consideration because the gas is poisonous?
  - Steam
  - Hydrogen
  - Hydrogen sulfide
  - Carbon dioxide
- A sample of a pure solid substance is heated at a constant rate and its temperature recorded as a function of time. A graph of the data is shown above. At about what temperature is the heat added being used to melt the substance?
  - 25°C
  - 41°C
  - 53°C
  - 60°C
- Changes in which the entropy of the system increases include which of the following?
  - Melting ice at room temperature
  - Evaporating water at room temperature
  - Dissolving NaCl in room-temperature water
  - I only
  - III only
  - I and II only
  - I, II, and III

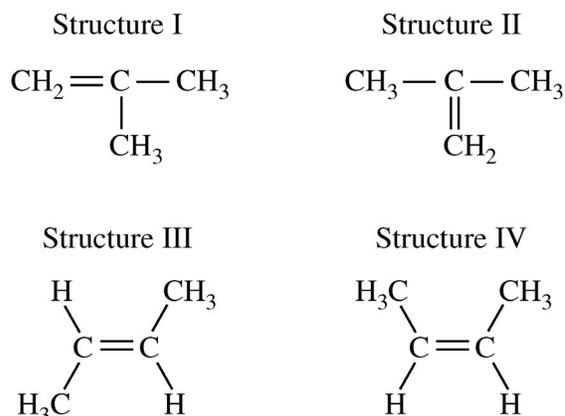


6.	Isotope	Isotopic Mass (amu)	Percent Abundance
	41	40.9	10.0%
	44	43.9	30.0%
	46	45.9	60.0%

A fictional element with the three naturally occurring isotopes described above would be listed in the periodic table with an atomic mass of

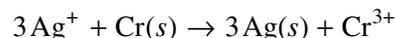
- (A) 42.1  
 (B) 43.6  
 (C) 44.8  
 (D) 45.9
7. In an attempt to compare the half-lives of two radioactive elements, X and Y, a scientist set aside 400 g of each. After six months, the scientist found that 25 g of X and 200 g of Y remained. Which of the following statements is true?
- (A) The half-life of Y is twice the half-life of X.  
 (B) The half-life of Y is four times the half-life of X.  
 (C) The half-life of Y is eight times the half-life of X.  
 (D) Unless the exact time interval is established, a comparison cannot be made.
8. Which of the following statements is correct about any chemical reaction that is at equilibrium?
- (A) The molecules stop reacting.  
 (B) Only side reactions continue; the main reaction stops.  
 (C) Forward and backward reactions occur at equal rates.  
 (D) There are as many molecules of reactant as there are molecules of product.

9. Which, if any, of the following structural formulas represent the same compound?



- (A) I and II only  
 (B) III and IV only  
 (C) I, II, III, and IV  
 (D) None of the formulas represent identical compounds.
10. The correct formula for copper (I) sulfate is
- (A)  $\text{CuSO}_4$   
 (B)  $\text{Cu}_2\text{SO}_4$   
 (C)  $\text{Cu}_4\text{SO}$   
 (D)  $\text{Cu}_4\text{SO}_4$
11. The pH of a  $4.0 \times 10^{-4}$  M HCl solution is between
- (A) 2 and 3  
 (B) 3 and 4  
 (C) 4 and 5  
 (D) 5 and 6
12.  $\text{Ag}^+ + e^- \rightarrow \text{Ag}(s) \quad E^0 = +0.80 \text{ V}$   
 $\text{Cr}^{3+} + 3e^- \rightarrow \text{Cr}(s) \quad E^0 = -0.74 \text{ V}$

Based on the standard reduction potentials for chromium and silver shown above, what is the cell potential for the reaction below?



- (A) 0.06 V  
 (B) 1.54 V  
 (C) 1.66 V  
 (D) 3.14 V

13. Which of the following is an important function of carbohydrates in living organisms?
- (A) They are the primary component of enzymes.
  - (B) They constitute a source of energy for the organism.
  - (C) They contain the genetic information of the cell.
  - (D) They comprise structural parts such as cartilage and tendons.
14. Liquids with molecules held together by van der Waals forces only have which of the following properties?
- (A) High solubilities in water
  - (B) High melting points
  - (C) Low boiling points
  - (D) Significant electrical conductivities in the solid phase
15. The solubility product,  $K_{sp}$  for  $\text{Mg}(\text{OH})_2$  is  $1.0 \times 10^{-11}$ . What is the concentration of  $\text{Mg}^{2+}$  in a saturated solution of this base?
- (A)  $\sqrt{5.0 \times 10^{-12}} \text{ M}$
  - (B)  $\sqrt{1.0 \times 10^{-11}} \text{ M}$
  - (C)  $\sqrt[3]{2.5 \times 10^{-12}} \text{ M}$
  - (D)  $\sqrt[3]{1.0 \times 10^{-11}} \text{ M}$
16. When 0.50 mol of octane,  $\text{C}_8\text{H}_{18}$ , is burned completely and the reaction products are brought to  $20^\circ\text{C}$  and 1 atmosphere, the products include approximately
- (A) 18 moles of water
  - (B) Close to 100 liters of carbon dioxide
  - (C) Close to 180 liters of carbon dioxide
  - (D) Close to 200 liters of water vapor
17. Which of the following properties of a substance depends on the amount of the sample?
- (A) Temperature
  - (B) Radioactive decay half-life
  - (C) Density
  - (D) Inertia
18. What quantity of oxygen,  $\text{O}_2$ , contains very nearly the same number of molecules as 36.0 grams of water,  $\text{H}_2\text{O}$  ?
- (A) 64.0 grams
  - (B) 32.0 grams
  - (C) 16.0 grams
  - (D) 8.0 grams
19. In the reaction of solutions of silver nitrate and sodium phosphate, a silver precipitate is formed. The balanced net ionic equation for this reaction is
- (A)  $\text{Ag}^+ + \text{PO}_4^{3-} \rightleftharpoons \text{Na}^+ + \text{AgPO}_4(s)$
  - (B)  $\text{Ag}^+ + \text{PO}_4^{3-} \rightleftharpoons \text{AgPO}_4(s)$
  - (C)  $3\text{Ag}^+ + \text{PO}_4^{3-} \rightleftharpoons \text{Ag}_3\text{PO}_4(s)$
  - (D)  $4\text{Ag}^+ + \text{PO}_4^{3-} \rightleftharpoons \text{Ag}_4\text{PO}_4(s)$
20. Which of the following pairs of elements have stable ions with a +3 charge?
- (A) Al and Ga
  - (B) N and O
  - (C) Li and Na
  - (D) F and Cl

## Answers to Sample Questions

- The correct answer is (B). The crystals when heated may give off water in the form of steam. When this moist air reaches the top of the tube, condensation occurs inside the top of the tube because the tube is cooler than the rising warmer air.
- The correct answer is (C). For addition, the correct number of significant figures to the right of the decimal point in the answer is the same as the smallest number of digits to the right of the decimal point in any of the terms to be added. In this example, that number is zero, which gives 113 as the total mass of the mixture to the correct number of significant figures. The number is then converted to exponential notation.
- The correct answer is (C). Of the gases listed, only hydrogen sulfide is poisonous in small quantities.
- The correct answer is (C). When a substance is heated, its temperature increases unless it is undergoing a phase change. During melting, the temperature remains constant since the energy absorbed is being used to do work against the attractive forces in becoming liquid particles. In the diagram, melting begins around nine minutes and a temperature around 53°C.
- The correct answer is (D). Entropy is a measure of disorder. In all three cases, the disorder of the system increases.
- The correct answer is (C). A calculation of the atomic mass yields an answer of 44.8 based on the isotopic masses:  $(0.1 \times 40.9) + (0.3 \times 43.9) + (0.6 \times 45.9) = 44.8$ .
- The correct answer is (B). Element X decayed from 400 g to 25 g, in a time period of 4 half-lives. Element Y decayed from 400 g to 200 g, in a time period of 1 half-life. Y decays slower than X, and the half-life of Y is 4 times that of X.
- The correct answer is (C). The definition of an equilibrium is that the forward and backward reactions occur at equal rates.
- The correct answer is (A). I and II are the same compound, 2-methyl-1-propene. III and IV are *cis* and *trans* isomers. They are geometric isomers with different properties.

10. The correct answer is (B). Copper (I) is  $\text{Cu}^+$  and sulfate is  $\text{SO}_4^{2-}$ ; therefore, for charge neutrality the compound is  $\text{Cu}_2\text{SO}_4$ .

11. The correct answer is (B). HCl dissociates completely,  $[\text{H}^+] = 4.0 \times 10^{-4} \text{ M}$  and the pH is between 3 and 4.

12. The correct answer is (B).

$$E = E^0(\text{Ag}) - E^0(\text{Cr}) = 0.80 + 0.74 = 1.54$$

13. The correct answer is (B). Carbohydrates are broken down to glucose during digestion, and glucose is oxidized in the cell to produce energy in the form of ATP.

14. The correct answer is (C). Van der Waals forces is the collective name for weak attractive forces between molecules. In general, liquids held together only by these forces have low boiling points relative to their molecular weights since only weak forces must be overcome during vaporization.

15. The correct answer is (C). The  $K_{sp}$  of a salt is the product of the ion concentrations in a saturated solution. In the present case,

$$K_{sp} = [\text{Mg}^{2+}][\text{OH}^-]^2$$

$$\text{Since } [\text{OH}^-] = 2[\text{Mg}^{2+}],$$

$$K_{sp} = [\text{Mg}^{2+}](2[\text{Mg}^{2+}])^2 =$$

$$4[\text{Mg}^{2+}]^3 = 1.0 \times 10^{-11}$$

Solving for  $\text{Mg}^{2+}$  one obtains

$$[\text{Mg}^{2+}] = [1.0 \times 10^{-11} / 4]^{1/3}$$

16. The correct answer is (B). The equation for the reaction is  $2 \text{C}_8\text{H}_{18} + 25 \text{O}_2 \rightarrow 16 \text{CO}_2 + 18 \text{H}_2\text{O}$ . (B) is correct; 0.5 mol octane produces 4 mol of  $\text{CO}_2$ , which, at 20°C, occupies

$$\frac{(4 \text{ mol} \times 22.4 \text{ L/mol})293 \text{ K}}{273 \text{ K}} = 96 \text{ L} \cong 100 \text{ L}$$

17. The correct answer is (D). Inertia is a property of a substance that is proportional to its mass and, therefore, depends on the amount of the sample.

18. The correct answer is (A). Thirty-six grams of water is 2 moles ( $2 \times 18$  grams). A 2-mole sample of  $O_2$  contains the same number of molecules as does 2 moles of any other molecular substance. A 2-mole sample of  $O_2$  would have a mass of  $2 \times 32.0$  grams = 64.0 grams.

19. The correct answer is (C). The precipitate formed is  $Ag_3PO_4$ . Atoms and net charge must be conserved in a chemical reaction, so the reactants and products must have equal numbers of each type of atom and the same net charge.

20. The correct answer is (A). Al and Ga both form stable ions with a +3 charge.

## 4. Determine Your Strategy for Success

*Set clear goals and deadlines so your test preparation is focused and efficient*

Effective *Praxis* test preparation doesn't just happen. You'll want to set clear goals and deadlines for yourself along the way. Otherwise, you may not feel ready and confident on test day.

### 1) Learn what the test covers.

You may have heard that there are several different versions of the same test. It's true. You may take one version of the test and your friend may take a different version a few months later. Each test has different questions covering the same subject area, but both versions of the test measure the same skills and content knowledge.

You'll find specific information on the test you're taking on page 5, which outlines the content categories that the test measures and what percentage of the test covers each topic. Visit [www.ets.org/praxis/testprep](http://www.ets.org/praxis/testprep) for information on other *Praxis* tests.

### 2) Assess how well you know the content.

Research shows that test takers tend to overestimate their preparedness—this is why some test takers assume they did well and then find out they did not pass.

The *Praxis* tests are demanding enough to require serious review of likely content, and the longer you've been away from the content, the more preparation you will most likely need. If it has been longer than a few months since you've studied your content area, make a concerted effort to prepare.

### 3) Collect study materials.

Gathering and organizing your materials for review are critical steps in preparing for the *Praxis* tests. Consider the following reference sources as you plan your study:

- Did you take a course in which the content area was covered? If yes, do you still have your books or your notes?
- Does your local library have a high school-level textbook in this area? Does your college library have a good introductory college-level textbook in this area?

Practice materials are available for purchase for many *Praxis* tests at [www.ets.org/praxis/testprep](http://www.ets.org/praxis/testprep). Test preparation materials include sample questions and answers with explanations.

### 4) Plan and organize your time.

You can begin to plan and organize your time while you are still collecting materials. Allow yourself plenty of review time to avoid cramming new material at the end. Here are a few tips:

- Choose a test date far enough in the future to leave you plenty of preparation time. Test dates can be found at [www.ets.org/praxis/register/centers\\_dates](http://www.ets.org/praxis/register/centers_dates).
- Work backward from that date to figure out how much time you will need for review.
- Set a realistic schedule—and stick to it.

### 5) Practice explaining the key concepts.

*Praxis* tests with constructed-response questions assess your ability to explain material effectively. As a teacher, you'll need to be able to explain concepts and processes to students in a clear, understandable way. What are the major concepts you will be required to teach? Can you explain them in your own words accurately, completely, and clearly? Practice explaining these concepts to test your ability to effectively explain what you know.

### 6) Understand how questions will be scored.

Scoring information can be found on page 41.

### 7) Develop a study plan.

A study plan provides a road map to prepare for the *Praxis* tests. It can help you understand what skills and knowledge are covered on the test and where to focus your attention. Use the study plan template on page 25 to organize your efforts.

And most important—get started!

## Would a Study Group Work for You?

### Using this guide as part of a study group

People who have a lot of studying to do sometimes find it helpful to form a study group with others who are working toward the same goal. Study groups give members opportunities to ask questions and get detailed answers. In a group, some members usually have a better understanding of certain topics, while others in the group may be better at other topics. As members take turns explaining concepts to one another, everyone builds self-confidence.

If the group encounters a question that none of the members can answer well, the group can go to a teacher or other expert and get answers efficiently. Because study groups schedule regular meetings, members study in a more disciplined fashion. They also gain emotional support. The group should be large enough so that multiple people can contribute different kinds of knowledge, but small enough so that it stays focused. Often, three to six members is a good size.

Here are some ways to use this guide as part of a study group:

- **Plan the group's study program.** Parts of the study plan template, beginning on page 25 can help to structure your group's study program. By filling out the first five columns and sharing the worksheets, everyone will learn more about your group's mix of abilities and about the resources, such as textbooks, that members can share with the group. In the sixth column ("Dates I will study the content"), you can create an overall schedule for your group's study program.
- **Plan individual group sessions.** At the end of each session, the group should decide what specific topics will be covered at the next meeting and who will present each topic. Use the topic headings and subheadings in the Test at a Glance table on page 5 to select topics, and then select practice questions, beginning on page 15.
- **Prepare your presentation for the group.** When it's your turn to present, prepare something that is more than a lecture. Write two or three original questions to pose to the group. Practicing writing actual questions can help you better understand the topics covered on the test as well as the types of questions you will encounter on the test. It will also give other members of the group extra practice at answering questions.

- **Take a practice test together.** The idea of a practice test is to simulate an actual administration of the test, so scheduling a test session with the group will add to the realism and may also help boost everyone's confidence. Remember, complete the practice test using only the time that will be allotted for that test on your administration day.
- **Learn from the results of the practice test.** Review the results of the practice test, including the number of questions answered correctly in each content category. For tests that contain constructed-response questions, look at the Sample Test Questions section, which also contain sample responses to those questions and shows how they were scored. Then try to follow the same guidelines that the test scorers use.
- **Be as critical as you can.** You're not doing your study partner(s) any favors by letting them get away with an answer that does not cover all parts of the question adequately.
- **Be specific.** Write comments that are as detailed as the comments about the sample responses. Indicate where and how your study partner(s) are doing an inadequate job of answering the question. Writing notes in the margins of the answer sheet may also help.
- **Be supportive.** Include comments that point out what your study partner(s) got right.

Then plan one or more study sessions based on aspects of the questions on which group members performed poorly. For example, each group member might be responsible for rewriting one paragraph of a response in which someone else did an inadequate job.

Whether you decide to study alone or with a group, remember that the best way to prepare is to have an organized plan. The plan should set goals based on specific topics and skills that you need to learn, and it should commit you to a realistic set of deadlines for meeting those goals. Then you need to discipline yourself to stick with your plan and accomplish your goals on schedule.

## 5. Develop Your Study Plan

### *Develop a personalized study plan and schedule*

Planning your study time is important because it will help ensure that you review all content areas covered on the test. Use the sample study plan below as a guide. It shows a plan for the *Core Academic Skills for Educators: Reading* test. Following that is a study plan template that you can fill out to create your own plan. Use the "Learn about Your Test" and "Test Specifications" information beginning on page 5 to help complete it.

#### Use this worksheet to:

- 1. Define Content Areas:** List the most important content areas for your test as defined in chapter 1.
- 2. Determine Strengths and Weaknesses:** Identify your strengths and weaknesses in each content area.
- 3. Identify Resources:** Identify the books, courses, and other resources you plan to use for each content area.
- 4. Study:** Create and commit to a schedule that provides for regular study periods.

**Praxis Test Name (Test Code):** Core Academic Skills for Educators: Reading (5712)

**Test Date:** 9/15/15

Content covered	Description of content	How well do I know the content? (scale 1–5)	What resources do I have/need for the content?	Where can I find the resources I need?	Dates I will study the content	Date completed
<b>Key Ideas and Details</b>						
Close reading	Draw inferences and implications from the directly stated content of a reading selection	3	Middle school English textbook	College library, middle school teacher	7/15/15	7/15/15
Determining Ideas	Identify summaries or paraphrases of the main idea or primary purpose of a reading selection	3	Middle school English textbook	College library, middle school teacher	7/17/15	7/17/15
Determining Ideas	Identify summaries or paraphrases of the supporting ideas and specific details in a reading selection	3	Middle and high school English textbook	College library, middle and high school teachers	7/20/15	7/21/15
<b>Craft, Structure, and Language Skills</b>						
Interpreting tone	Determine the author's attitude toward material discussed in a reading selection	4	Middle and high school English textbook	College library, middle and high school teachers	7/25/15	7/26/15
Analysis of structure	Identify key transition words and phrases in a reading selection and how they are used	3	Middle and high school English textbook, dictionary	College library, middle and high school teachers	7/25/15	7/27/15
Analysis of structure	Identify how a reading selection is organized in terms of cause/effect, compare/contrast, problem/solution, etc.	5	High school textbook, college course notes	College library, course notes, high school teacher, college professor	8/1/15	8/1/15
Author's purpose	Determine the role that an idea, reference, or piece of information plays in an author's discussion or argument	5	High school textbook, college course notes	College library, course notes, high school teacher, college professor	8/1/15	8/1/15

(continued on next page)

Content covered	Description of content	How well do I know the content? (scale 1–5)	What resources do I have/need for the content?	Where can I find the resources I need?	Dates I will study the content	Date completed
Language in different contexts	Determine whether information presented in a reading selection is presented as fact or opinion	4	High school textbook, college course notes	College library, course notes, high school teacher, college professor	8/1/15	8/1/15
Contextual meaning	Identify the meanings of words as they are used in the context of a reading selection	2	High school textbook, college course notes	College library, course notes, high school teacher, college professor	8/1/15	8/1/15
Figurative Language	Understand figurative language and nuances in word meanings	2	High school textbook, college course notes	College library, course notes, high school teacher, college professor	8/8/15	8/8/15
Vocabulary range	Understand a range of words and phrases sufficient for reading at the college and career readiness level	2	High school textbook, college course notes	College library, course notes, high school teacher, college professor	8/15/15	8/17/15
<b>Integration of Knowledge and Ideas</b>						
Diverse media and formats	Analyze content presented in diverse media and formats, including visually and quantitatively, as well as in words	2	High school textbook, college course notes	College library, course notes, high school teacher, college professor	8/22/15	8/24/15
Evaluation of arguments	Identify the relationship among ideas presented in a reading selection	4	High school textbook, college course notes	College library, course notes, high school teacher, college professor	8/24/15	8/24/15
Evaluation of arguments	Determine whether evidence strengthens, weakens, or is relevant to the arguments in a reading selection	3	High school textbook, college course notes	College library, course notes, high school teacher, college professor	8/27/15	8/27/15
Evaluation of arguments	Determine the logical assumptions upon which an argument or conclusion is based	5	High school textbook, college course notes	College library, course notes, high school teacher, college professor	8/28/15	8/30/15
Evaluation of arguments	Draw conclusions from material presented in a reading selection	5	High school textbook, college course notes	College library, course notes, high school teacher, college professor	8/30/15	8/31/15
Comparison of texts	Recognize or predict ideas or situations that are extensions of or similar to what has been presented in a reading selection	4	High school textbook, college course notes	College library, course notes, high school teacher, college professor	9/3/15	9/4/15
Comparison of texts	Apply ideas presented in a reading selection to other situations	2	High school textbook, college course notes	College library, course notes, high school teacher, college professor	9/5/15	9/6/15

## My Study Plan

Use this worksheet to:

1. **Define Content Areas:** List the most important content areas for your test as defined in chapter 1.
2. **Determine Strengths and Weaknesses:** Identify your strengths and weaknesses in each content area.
3. **Identify Resources:** Identify the books, courses, and other resources you plan to use for each content area.
4. **Study:** Create and commit to a schedule that provides for regular study periods.

Praxis Test Name (Test Code): \_\_\_\_\_

Test Date: \_\_\_\_\_

Content covered	Description of content	How well do I know the content? (scale 1–5)	What resources do I have/need for this content?	Where can I find the resources I need?	Dates I will study this content	Date completed

(continued on next page)



## 6. Study Topics

*Detailed study topics with questions for discussion*

### Using the Study Topics That Follow

The Chemistry: Content Knowledge test is designed to measure the knowledge and skills necessary for a beginning teacher.

This chapter is intended to help you organize your preparation for the test and to give you a clear indication of the depth and breadth of the knowledge required for success on the test.

Virtually all accredited programs address the topics covered by the test; however, you are not expected to be an expert on all aspects of the topics that follow.

You are likely to find that the topics below are covered by most introductory textbooks. Consult materials and resources, including lecture and laboratory notes, from all your coursework. You should be able to match up specific topics and subtopics with what you have covered in your courses.

Try not to be overwhelmed by the volume and scope of content knowledge in this guide. Although a specific term may not seem familiar as you see it here, you might find you can understand it when applied to a real-life situation. Many of the items on the actual test will provide you with a context to apply to these topics or terms.

### Discussion Areas

Interspersed throughout the study topics are discussion areas, presented as open-ended questions or statements. These discussion areas are intended to help test your knowledge of fundamental concepts and your ability to apply those concepts to situations in the classroom or the real world. Most of the areas require you to combine several pieces of knowledge to formulate an integrated understanding and response. If you spend time on these areas, you will gain increased understanding and facility with the subject matter covered on the test. You may want to discuss these areas and your answers with a teacher or mentor.

Note that this study companion *does not provide answers for the discussion area questions*, but thinking about the answers to them will help improve your understanding of fundamental concepts and will probably help you answer a broad range of questions on the test.

## Study Topics

An overview of the areas covered on the test, along with their subareas, follows.

### I. Basic Principles of Matter and Energy; Thermodynamics

#### A. Matter and Energy

1. Organization of matter
  - a. pure substances (elements and compounds)
  - b. mixtures (homogeneous, heterogeneous, solutions, suspensions)
  - c. states of matter (solid, liquid, gas, plasma)
2. Particulate structure of matter
  - a. atoms, ions, molecules
3. Differences between chemical and physical properties and chemical and physical changes
  - a. chemical versus physical properties
  - b. chemical versus physical changes
  - c. intensive versus extensive properties
4. Conservation of energy and the conservation of matter in chemical processes
  - a. law of conservation of energy
  - b. law of conservation of matter
5. Different forms of energy
  - a. kinetic and potential
  - b. chemical, electrical, electromagnetic, nuclear, and thermal energy
  - c. conversions between different forms of energy within chemical systems

#### Discussion areas: Matter and Energy

- Test tubes contain three colorless liquids: alcohol, water, and a weak solution of ammonia. What properties could be used to identify the liquids?
- What are some examples of the different types of mixtures?
- What is a cation?
- In their standard state, which of the following elements are diatomic: bromine, chlorine, argon, and helium?
- What are some examples of chemical properties?
- Describe a process that involves both a chemical change and a physical change?

- Is balancing a chemical equation an application of the law of conservation of energy or the law of conservation of matter?
- List in order of increasing energy (or decreasing wavelength) the following forms of electromagnetic radiation: gamma rays, microwaves, x-rays, visible light, ultraviolet, and infrared).
- What is an example of the conversion of chemical energy to electrical energy?

#### B. Thermodynamics in Chemistry

1. Temperature, thermal energy, and heat capacity, including temperature scales, units of energy, and calculations involving these concepts
  - a. temperature and temperature scales
  - b. thermal energy and units of energy
  - c. heat transfer
  - d. heat capacity and specific heat
  - e. calorimetric calculations
2. Concepts and calculations involving phase transitions between the various states of matter
  - a. phase transitions and diagrams
  - b. heats of vaporization, fusion, and sublimation
  - c. heating curves
3. Kinetic molecular theory and ideal gas laws
  - a. assumptions of the kinetic molecular theory
  - b. ideal gases and the ideal gas laws (e.g., applications, calculations)
  - c. real gas behavior
4. Energetics of chemical reactions
  - a. exothermic and endothermic reactions
  - b. bond energy; Hess's law
5. How the laws of thermodynamics relate to chemical reactions and phase changes
  - a. laws of thermodynamics
  - b. spontaneous/reversible processes
  - c. change in enthalpy, entropy, and Gibbs energy in chemical/physical processes

#### Discussion areas: Thermodynamics in Chemistry

- Convert 350 K to degrees Celsius.
- Which of the following are units of energy: ergs, joules, electron volts, ohms?

- If a substance has high heat capacity, will its temperature increase faster as heat is absorbed than for a substance with lower heat capacity absorbing the same amount of heat?
  - How much heat is absorbed as 10 g of ice melts at the freezing point?
  - What is the boiling point of water at high altitudes compared to sea level and why is it different?
  - When a gas expands from 5 L to 10 L as its temperature increases from 300 K to 500 K, what is the change in the pressure of the gas?
  - What are the major differences between an ideal gas and a real gas?
  - Given the heats of formation of  $\text{H}_2\text{O}$ ,  $\text{CO}_2$ , and  $\text{CH}_4$ , calculate the heat of combustion of  $\text{CO}_4$
  - Is the combustion of  $\text{CH}_4$  an exothermic or endothermic process?
  - Based on the first and second laws of thermodynamics, predict whether a reaction is spontaneous.
  - Describe some processes in which the entropy of the system is increasing.
3. Radioactivity
    - a. characteristics of alpha particles, beta particles, and gamma radiation
    - b. radioactive decay processes; half life
    - c. fission, fusion, and other nuclear reactions
    - d. balancing nuclear reactions and identifying products of nuclear reactions
  4. How the electronic absorption and emission spectra of elements are related to electron energy levels
    - a. electronic energy transitions in atoms (e.g., ground state, excited states, emission/absorption of energy)
    - b. energy of electronic absorption/emission spectral lines in various regions of the electromagnetic spectrum

### Discussion areas: Atomic and Nuclear Structure

## II. Atomic and Nuclear Structure

1. Current model of atomic structure
    - a. description of atomic model (e.g., subatomic particles, orbitals, quantum numbers)
    - b. experimental basis (e.g., cathode ray tube, gold foil experiment, spectral lines)
    - c. isotopes (mass number, average atomic mass)
  2. Electron configuration of the elements based on the periodic table
    - a. Aufbau principle, Hund's rule, Pauli exclusion principle
    - b. correlation between electron configuration and periodic table
    - c. relationship between electron configuration and chemical and physical properties
- How are isotopes of the same element alike? How are they different?
  - An element has three isotopes, each with a different mass. Explain why the mass number for the element that is listed on the periodic table is not equal to the mass of any of the isotopes.
  - What are the electron configurations for atoms of sodium and sulfur?
  - Based on their electron configurations, what is the formula of the compound that forms in the reaction of sodium and sulfur?
  - Give an example of Hund's rule.
  - Given that the half-life of carbon-14 is 5,730 years, estimate the age of a piece of charcoal that has a carbon-14 content equal to 12.5% of that in living matter.
  - How is fission different than fusion or radioactive decay?
  - What is the wavelength of the energy emitted for an electronic transition in a hydrogen atom from  $n = 3$  to  $n = 2$  electronic energy level?
  - What part of the electromagnetic spectrum are electron emission spectral lines?

### III. Nomenclature; Chemical Composition; Bonding and Structure

#### A. Nomenclature and Chemical Composition

- Systematic names and chemical formulas of simple inorganic compounds
  - binary compounds
  - acids, bases, and salts
  - hydrates
- Names of common organic compounds based on their functional groups
  - alkanes, alkenes, and alkynes
  - alcohols, ethers, ketones, aldehydes, amines
- Mole concept and how it applies to chemical composition
  - Avogadro's number, molar mass, and mole conversions
  - calculation of empirical and molecular formulas
  - percent composition

#### B. Bonding and Structure

- Common properties of bonds
  - relative bond lengths
  - relative bond strengths
- Bond types
  - ionic bonding
  - covalent bonding (polar, nonpolar, hybridization)
  - metallic bonding
- Structural formulas and molecular geometry (shape)
  - Lewis structures including formal charges
  - resonance structures
  - molecular geometry (shape and approximate bond angles)
- Identify polar and nonpolar molecules
  - analysis of bonding in the molecule
  - symmetry of molecular structure
- Intermolecular interactions
  - hydrogen bonding
  - London forces (instantaneous induced dipole-dipole)
  - dipole-dipole
  - dipole-induced dipole
- How bonding and structure correlate with physical properties
  - boiling points and melting points
  - solubility
  - equilibrium vapor pressure

#### Discussion areas: Nomenclature; Chemical Composition; Bonding and Structure

- What are the IUPAC names for the following compounds:  $\text{HClO}_4$ ,  $\text{CaSO}_4 \cdot 2 \text{H}_2\text{O}$ , and  $\text{CuCl}_2$ ?
- Write the molecular formula for each of the following compounds: acetone, ethanol, ethanal, and formic acid.
- What is the number of moles of oxygen atoms in 5 moles of  $\text{CaSO}_4 \cdot 2 \text{H}_2\text{O}$ ?
- What is the molecular formula of a compound that has the empirical formula  $\text{C}_2\text{H}_4\text{O}$  and a molar mass of 88 g?
- Which of the following molecules has the shortest bond length: HF, HCl,  $\text{N}_2$ , or  $\text{O}_2$ ?
- Which type of bonding is found in each of the following solids: KCl,  $\text{NaSO}_4$ , and Cu?
- What is the difference between a pi bond and a sigma bond?
- Why is the geometry of  $\text{NH}_3$  trigonal pyramidal?
- What are the Lewis dot and the structural formulas for  $\text{CH}_4$ ?
- What are the resonance structures for the carbonate ion?
- Does  $\text{CO}_2$  have any polar bonds? Is it a polar molecule? Why?
- What is the predominate intermolecular force involved between two  $\text{PCl}_3$  molecules?
- Correlate the relative boiling points of the following compounds with their molecular structure and intermolecular interactions:  $\text{H}_2\text{O}$ ,  $\text{Cl}_2$ ,  $\text{Br}_2$ , HCl, and  $\text{H}_2$ .

## IV. Chemical Reactions; Periodicity

### A. Periodicity

1. Basis of the periodic table and general layout
  - a. arranged in groups and periods
  - b. atomic number and mass
  - c. symbols of the elements
  - d. metals, nonmetals, metalloids
  - e. transition elements
2. Periodic trends in physical and chemical properties of the elements
  - a. atomic/ionic radius
  - b. ionization energy
  - c. electron affinity
  - d. electronegativity
  - e. physical properties (e.g., boiling/melting points, conductivity)
  - f. chemical reactivity

### B. Chemical Reactions and Basic Principles

1. Balancing chemical equations
  - a. simple chemical equations
  - b. chemical equations involving oxidation-reduction
2. Stoichiometric calculations
  - a. simple calculations based on balanced chemical equations involving moles, mass, and volume
  - b. limiting reagent calculations and percent yield
3. Identify, write, and predict products of simple reaction types
  - a. combustion, neutralization
  - b. decomposition, dehydration
  - c. single and double replacement
  - d. oxidation-reduction
4. Chemical kinetics
  - a. rate laws, rate constants, and reaction order
  - b. activation energy and reaction mechanisms including catalysts
  - c. factors affecting reaction rate such as concentration, surface area, and temperature
5. Chemical reaction equilibrium
  - a. equilibrium constants
  - b. Le Châtelier's principle

6. Oxidation-reduction reactions and how to determine oxidation states
  - a. oxidation states
  - b. identify oxidation-reduction reactions and half reactions
  - c. standard reduction potentials
  - d. electrochemical reactivity series
  - e. electrochemical cells

### C. Biochemistry and Organic Chemistry

1. Important biochemical compounds
  - a. carbohydrates, including simple sugars
  - b. lipids
  - c. proteins and amino acids
  - d. DNA and RNA
  - e. products of photosynthesis and respiration
2. Common organic compounds (i.e., identify functional groups)
  - a. alcohols
  - b. ketones and aldehydes
  - c. alkanes, alkenes, and alkynes
  - d. ethers
  - e. carboxylic acids
  - f. amines
  - g. benzene

#### Discussion areas: Chemical reactions; Periodicity

- In what location of the periodic table are nonmetals generally found?
- List some examples of transition elements
- How do the atomic radii, ionization energies, and melting points change across period and down columns in the periodic table?
- Using the location of the elements on the periodic table, predict the formula of the compound that would exist containing Mg and O.
- What needs to be considered when balancing oxidation-reduction reactions that does not need to be accounted for when balancing a standard formation reaction such as:
 
$$2 \text{H}_2 + \text{O}_2 \rightarrow 2 \text{H}_2\text{O} ?$$
- At standard temperature and pressure, what is the ratio of the volumes of hydrogen gas and oxygen gas that react to form water?
- What is the limiting reagent in the reaction to form water, when 10 g of hydrogen is mixed with 32 g of oxygen?

- How is a decomposition reaction different from a dehydration reaction?
  - What is the effect of temperature and catalysts on reaction rates?
  - How are simple rate equations determined based on experimental data?
  - What changes will occur to chemical systems that are at equilibrium when pressure or concentration of one of the reactants or products is changed?
  - What is the effect of temperature on equilibrium constants?
  - Based on a table of standard reduction potentials, predict whether the following reaction will occur spontaneously:  
 $\text{Cu} + \text{FeCl}_2 \rightarrow \text{CuCl}_2 + \text{Fe}$  ?
  - What is the oxidation state of Mn in  $\text{KMnO}_2$  ?
  - What are the structures in the following types of molecules that distinguish them from other biochemical compounds: Carbohydrates, amino acids, and DNA?
  - Identify the functional group in each of the following compounds:  
 $\text{CH}_3\text{OCH}_3$ ,  $\text{CH}_3\text{NH}_2$ ,  $\text{CH}_3\text{OH}$ , and  $\text{CH}_3\text{COOH}$ .
3. Solution phenomena based on colligative properties
    - a. freezing point depression
    - b. boiling point elevation
    - c. vapor pressure effects
    - d. osmotic pressure
  4. Common applications of equilibrium in ionic solutions
    - a. solubility of ionic compounds (e.g., solubility rules, slightly soluble compounds)
    - b.  $K_{sp}$  calculations including percent dissociation and precipitation
    - c. common ion effect
    - d. electrolytes, nonelectrolytes, and electrical conductivity

## B. Acid-Base Chemistry

## V. Solutions and Solubility; Acid-Base Chemistry

### A. Solutions and Solubility

1. Solution terminology and calculations
  - a. dilute, concentrated
  - b. saturated, unsaturated, supersaturated
  - c. solvent, solute
  - d. concentration units (e.g., molarity, molality, mole fraction, parts per million (ppm), parts per billion (ppb), percent by mass or volume)
  - e. preparation of solutions of varying concentrations
2. Factors affecting solubility and dissolution rate
  - a. dissolution rate (i.e., temperature, pressure, surface area, agitation)
  - b. solubility and solubility curves (temperature and pressure dependent)

1. Define and identify acids and bases and know their properties
  - a. Arrhenius acids and bases
  - b. Brønsted-Lowry acids and bases
  - c. Lewis acids and bases
  - d. neutralization and equivalence point
2. The pH scale and calculations involving pH and pOH
  - a. pH scale
  - b. calculation of pH and pOH
  - c. calculation of  $[\text{H}^+]$  and  $[\text{OH}^-]$
  - d. knows the meaning of  $K_w$
3. Concepts and calculations involving acid-base titrations
  - a. use and selection of indicators (e.g., phenolphthalein, litmus paper)
  - b. endpoint determination
  - c. calculations based on titrations
4. Equilibrium relationships in acid-base chemistry
  - a. strong/weak acids and bases, including common examples
  - b. monoprotic and polyprotic acids
  - c.  $K_a$ ,  $K_b$ , and percent dissociation
  - d. hydrolysis (acidic and basic salts)
  - e. buffer solutions

### Discussion areas: Solutions and Solubility; Acid-Base Chemistry

- How many grams of solute are present in 1.5 L of 0.30 M  $\text{KNO}_3$  ?
- What is the difference between a 1 molar NaCl solution and a 1 molal NaCl solution?

- Is a very concentrated solution saturated, supersaturated, or unsaturated? What else do you need to know to answer the question?
- Why is ammonia gas very soluble in water while oxygen is only slightly soluble?
- What is the relationship between surface area and dissolution rate?
- Will increasing temperature increase the solubility of any substance?
- How will the vapor pressure, boiling point, and freezing point of water change when a nonvolatile solute is added to water?
- Compare the degree of dissociation of HCl and H<sub>2</sub>S in water.
- Write a chemical equation that illustrates the common ion effect.
- Is CCl<sub>4</sub> an electrolyte?
- When an aqueous solution of NaCl is mixed with an aqueous solution of AgNO<sub>3</sub> the precipitate AgCl forms. Why?
- Select an acid that is both a Brønsted-Lowry acid and a Lewis acid and explain why it fits both definitions.
- What is [H<sup>+</sup>] in an aqueous solution with pH = 5.5?
- What is the pOH of a solution with [H<sup>+</sup>] = 1 × 10<sup>-8</sup> M?
- Based on a titration curve, determine the pK<sub>a</sub> of the acid and the volume of base required to neutralize the acid.
- What indicator would be used in a titration involving a strong acid and a weak base and why?
- Is HF a strong acid? Why or why not?
- If Na<sub>2</sub>CO<sub>3</sub> is dissolved in water, will the solution be acidic, basic, or neutral?
- For an acid HA, K<sub>a</sub> = 1 × 10<sup>-8</sup>, what is the pH of 0.001 M HA?

## VI. Scientific Inquiry and Social Perspectives of Science

### A. History and Nature of Scientific Inquiry

1. Processes involved in scientific inquiry
  - a. formulating problems
  - b. forming and testing hypotheses
  - c. development of theories, models, and laws (postulates, assumptions)
  - d. process skills including observing, concluding, comparing, inferring, categorizing, and generalizing
2. Experimental design
  - a. testing hypotheses
  - b. significance of controls
  - c. use and identification of variables
  - d. data collection planning
3. Nature of scientific knowledge
  - a. subject to change
  - b. consistent with experimental evidence
  - c. reproducibility
  - d. unifying concepts and processes (e.g., systems, models, constancy and change, equilibrium, form and function)
4. Major historical developments in chemistry and the contributions of major historical figures
  - a. how current chemical principles and models developed over time
  - b. major developments in chemistry (e.g., atomic model, ideal gas behavior) including major historical figures

### B. Science, Technology, Society, and the Environment

1. Impact of chemistry and technology on society and the environment
  - a. pharmaceuticals
  - b. acid rain
  - c. medical imaging
  - d. air and water pollution
  - e. greenhouse gases
  - f. ozone layer depletion
  - g. waste disposal and recycling
  - h. nanotechnology
2. Applications of chemistry in daily life
  - a. plastics, soap, batteries, fuel cells, and other consumer products
  - b. water purification
  - c. chemical properties of household products

3. Advantages and disadvantages associated with various types of energy production
  - a. renewable and nonrenewable energy resources
  - b. conservation and recycling
  - c. pros and cons of power generation based on various sources such as fossil and nuclear fuel, hydropower, wind power, solar power, and geothermal power

#### **Discussion area: Scientific Inquiry and Social Perspectives of Science**

- What are the similarities and differences between laws, hypotheses, and theories?
- What is the difference between independent and dependent variables? Describe an experiment and identify the independent and the dependent variables.
- Describe something in chemistry that illustrates the relationship between form and function.
- What is Boyle's law and what is Charles's law?
- What was the role of Bohr's model of the atom in the development of modern atomic theory?
- What are the major contributors of acid rain?
- What are some of the reactions in the stratosphere that lead to ozone depletion?
- What are the acid-base properties of commonly used consumer products such as ammonia cleaner, vinegar, and orange juice?
- Describe the reverse osmosis process that is sometimes used for water purification.
- In what settings is solar power most effective?
- What are some examples of nonrenewable energy resources?

### **VII. Scientific Procedures and Techniques**

1. Collect, evaluate, manipulate, interpret, and report data
  - a. significant figures in collected data and calculations
  - b. organization and presentation of data
  - c. knows how to interpret and draw conclusions from data presented in tables, graphs, and charts (e.g., trends in data, relationships between variables, predictions and conclusions based on data)
2. Units of measurement, notation systems, conversions, and mathematics used in chemistry
  - a. standard units of measurement
  - b. unit conversion
  - c. scientific notation
  - d. measurement equipment
3. Basic error analysis
  - a. determining mean
  - b. accuracy and precision
  - c. identifying sources and effects of error
  - d. percent error
4. Appropriate preparation, use, storage, and disposal of materials in the laboratory
  - a. appropriate use and storage
  - b. safe disposal
  - c. preparation for classroom use
  - d. safe procedures and safety precautions
5. Appropriate use, maintenance, and calibration of laboratory equipment
  - a. appropriate use and storage
  - b. maintenance and calibration
  - c. preparation for classroom use
  - d. safety procedures and precautions when using equipment
6. Safety procedures and precautions for the high school chemistry laboratory
  - a. location and use of standard safety equipment such as eyewash and shower
  - b. laboratory safety rules for students
  - c. appropriate apparel and conduct in the laboratory, such as wearing goggles
  - d. emergency procedures

#### **Discussion areas: Scientific Procedures and Techniques**

- What is the uncertainty in volume measurements made when using a buret and how many significant figures should be included in the recorded volume?

- How many significant figures are in 0.1360 g?
- Determine the endpoint in an acid-base titration using a plot of pH versus the volume of base added to an acid.
- What is the mass in grams of a sample that has a mass of 20 mg?
- Express the number 0.000450 in scientific notation.
- What is the difference between the accuracy and the precision of a data set?
- How do you prepare 200 mL of 0.5 M  $\text{CaSO}_4$  from a stock solution of 2.0 M  $\text{CaSO}_4$ ?
- Can a very dilute solution of HCl acid be disposed of in a sink with running water?
- What are the following pieces of equipment used for in the laboratory: buret, pipet, Erlenmeyer flask, and volumetric flask?
- When and why is a fume hood needed in a chemistry laboratory?

## 7. Review Smart Tips for Success

### *Follow test-taking tips developed by experts*

Learn from the experts. Take advantage of the following answers to questions you may have and practical tips to help you navigate the *Praxis* test and make the best use of your time.

#### **Should I guess?**

Yes. Your score is based on the number of questions you answer correctly, with no penalty or subtraction for an incorrect answer. When you don't know the answer to a question, try to eliminate any obviously wrong answers and then guess at the correct one. Try to pace yourself so that you have enough time to carefully consider every question.

#### **Can I answer the questions in any order?**

You can answer the questions in order or skip questions and come back to them later. If you skip a question, you can also mark it so that you can remember to return and answer it later. Remember that questions left unanswered are treated the same as questions answered incorrectly, so it is to your advantage to answer every question.

#### **Are there trick questions on the test?**

No. There are no hidden meanings or trick questions. All of the questions on the test ask about subject matter knowledge in a straightforward manner.

#### **Are there answer patterns on the test?**

No. You might have heard this myth: the answers on tests follow patterns. Another myth is that there will never be more than two questions in a row with the correct answer in the same position among the choices. Neither myth is true. Select the answer you think is correct based on your knowledge of the subject.

#### **Can I write on the scratch paper I am given?**

Yes. You can work out problems on the scratch paper, make notes to yourself, or write anything at all. Your scratch paper will be destroyed after you are finished with it, so use it in any way that is helpful to you. But make sure to select or enter your answers on the computer.

### **Smart Tips for Taking the Test**

- 1. Skip the questions you find extremely difficult.** Rather than trying to answer these on your first pass through the test, you may want to leave them blank and mark them so that you can return to them later. Pay attention to the time as you answer the rest of the questions on the test, and try to finish with 10 or 15 minutes remaining so that you can go back over the questions you left blank. Even if you don't know the answer the second time you read the questions, see if you can narrow down the possible answers, and then guess. Your score is based on the number of right answers, so it is to your advantage to answer every question.

2. **Keep track of the time.** The on-screen clock will tell you how much time you have left. You will probably have plenty of time to answer all of the questions, but if you find yourself becoming bogged down, you might decide to move on and come back to any unanswered questions later.
3. **Read all of the possible answers before selecting one.** For questions that require you to select more than one answer, or to make another kind of selection, consider the most likely answers given what the question is asking. Then reread the question to be sure the answer(s) you have given really answer the question. Remember, a question that contains a phrase such as “Which of the following does NOT . . .” is asking for the one answer that is NOT a correct statement or conclusion.
4. **Check your answers.** If you have extra time left over at the end of the test, look over each question and make sure that you have answered it as you intended. Many test takers make careless mistakes that they could have corrected if they had checked their answers.
5. **Don’t worry about your score when you are taking the test.** No one is expected to answer all of the questions correctly. Your score on this test is not analogous to your score on the *GRE*® or other tests. It doesn’t matter on the *Praxis* tests whether you score very high or barely pass. If you meet the minimum passing scores for your state and you meet the state’s other requirements for obtaining a teaching license, you will receive a license. In other words, what matters is meeting the minimum passing score. You can find passing scores for all states that use the *Praxis* tests at [http://www.ets.org/s/praxis/pdf/passing\\_scores.pdf](http://www.ets.org/s/praxis/pdf/passing_scores.pdf) or on the web site of the state for which you are seeking certification/licensure.
6. **Use your energy to take the test, not to get frustrated by it.** Getting frustrated only increases stress and decreases the likelihood that you will do your best. Highly qualified educators and test development professionals, all with backgrounds in teaching, worked diligently to make the test a fair and valid measure of your knowledge and skills. Your state painstakingly reviewed the test before adopting it as a licensure requirement. The best thing to do is concentrate on answering the questions.

## 8. Check on Testing Accommodations

*See if you qualify for accommodations that may make it easier to take the Praxis test*

### What if English is not my primary language?

*Praxis* tests are given only in English. If your primary language is not English (PLNE), you may be eligible for extended testing time. For more details, visit [www.ets.org/praxis/register/plne\\_accommodations/](http://www.ets.org/praxis/register/plne_accommodations/).

### What if I have a disability or other health-related need?

The following accommodations are available for *Praxis* test takers who meet the Americans with Disabilities Act (ADA) Amendments Act disability requirements:

- Extended testing time
- Additional rest breaks
- Separate testing room
- Writer/recorder of answers
- Test reader
- Sign language interpreter for spoken directions only
- Perkins Braille
- Braille slate and stylus
- Printed copy of spoken directions
- Oral interpreter
- Audio test
- Braille test
- Large print test book
- Large print answer sheet
- Listening section omitted

For more information on these accommodations, visit [www.ets.org/praxis/register/disabilities](http://www.ets.org/praxis/register/disabilities).

**Note:** Test takers who have health-related needs requiring them to bring equipment, beverages, or snacks into the testing room or to take extra or extended breaks must request these accommodations by following the procedures described in the *Bulletin Supplement for Test Takers with Disabilities or Health-Related Needs* (PDF), which can be found at [http://www.ets.org/s/disabilities/pdf/bulletin\\_supplement\\_test\\_takers\\_with\\_disabilities\\_health\\_needs.pdf](http://www.ets.org/s/disabilities/pdf/bulletin_supplement_test_takers_with_disabilities_health_needs.pdf).

You can find additional information on available resources for test takers with disabilities or health-related needs at [www.ets.org/disabilities](http://www.ets.org/disabilities).

## 9. Do Your Best on Test Day

*Get ready for test day so you will be calm and confident*

You followed your study plan. You prepared for the test. Now it's time to prepare for test day.

Plan to end your review a day or two before the actual test date so you avoid cramming. Take a dry run to the test center so you're sure of the route, traffic conditions, and parking. Most of all, you want to eliminate any unexpected factors that could distract you from your ultimate goal—passing the *Praxis* test!

On the day of the test, you should:

- be well rested
- wear comfortable clothes and dress in layers
- eat before you take the test
- bring an acceptable and valid photo identification with you
- bring an approved calculator only if one is specifically permitted for the test you are taking (see Calculator Use, at [http://www.ets.org/praxis/test\\_day/policies/calculators](http://www.ets.org/praxis/test_day/policies/calculators))
- be prepared to stand in line to check in or to wait while other test takers check in

You can't control the testing situation, but you can control yourself. Stay calm. The supervisors are well trained and make every effort to provide uniform testing conditions, but don't let it bother you if the test doesn't start exactly on time. You will have the allotted amount of time once it does start.

You can think of preparing for this test as training for an athletic event. Once you've trained, prepared, and rested, give it everything you've got.

### What items am I restricted from bringing into the test center?

You cannot bring into the test center personal items such as:

- handbags, knapsacks, or briefcases
- water bottles or canned or bottled beverages
- study materials, books, or notes
- pens, pencils, scrap paper, or calculators, unless specifically permitted for the test you are taking (see Calculator Use, at [http://www.ets.org/praxis/test\\_day/policies/calculators](http://www.ets.org/praxis/test_day/policies/calculators))
- any electronic, photographic, recording, or listening devices

Personal items are not allowed in the testing room and will not be available to you during the test or during breaks. You may also be asked to empty your pockets. At some centers, you will be assigned a space to store your belongings, such as handbags and study materials. Some centers do not have secure storage space available, so please plan accordingly.

Test centers assume no responsibility for your personal items.

If you have health-related needs requiring you to bring equipment, beverages or snacks into the testing room or to take extra or extended breaks, you need to request accommodations in advance. Procedures for requesting accommodations are described in the [Bulletin Supplement for Test Takers with Disabilities or Health-related Needs \(PDF\)](#).

**Note:** All cell phones, smart phones (e.g., Android® devices, iPhones®, etc.), and other electronic, photographic, recording, or listening devices are strictly prohibited from the test center. If you are seen with such a device, you will be dismissed from the test, your test scores will be canceled, and you will forfeit your test fees. If you are seen *using* such a device, the device will be confiscated and inspected. For more information on what you can bring to the test center, visit [www.ets.org/praxis/test\\_day/bring](http://www.ets.org/praxis/test_day/bring).

### Are You Ready?

Complete this checklist to determine whether you are ready to take your test.

- Do you know the testing requirements for the license or certification you are seeking in the state(s) where you plan to teach?
- Have you followed all of the test registration procedures?
- Do you know the topics that will be covered in each test you plan to take?
- Have you reviewed any textbooks, class notes, and course readings that relate to the topics covered?
- Do you know how long the test will take and the number of questions it contains?
- Have you considered how you will pace your work?
- Are you familiar with the types of questions for your test?
- Are you familiar with the recommended test-taking strategies?
- Have you practiced by working through the practice questions in this study companion or in a study guide or practice test?
- If constructed-response questions are part of your test, do you understand the scoring criteria for these questions?
- If you are repeating a *Praxis* test, have you analyzed your previous score report to determine areas where additional study and test preparation could be useful?

If you answered “yes” to the questions above, your preparation has paid off. Now take the *Praxis* test, do your best, pass it—and begin your teaching career!

# 10. Understand Your Scores

*Understand how tests are scored and how to interpret your test scores*

Of course, passing the *Praxis* test is important to you so you need to understand what your scores mean and what your state requirements are.

## What are the score requirements for my state?

States, institutions, and associations that require the tests set their own passing scores. Visit [www.ets.org/praxis/states](http://www.ets.org/praxis/states) for the most up-to-date information.

## If I move to another state, will my new state accept my scores?

The *Praxis* tests are part of a national testing program, meaning that they are required in many states for licensure. The advantage of a national program is that if you move to another state that also requires *Praxis* tests, you can transfer your scores. Each state has specific test requirements and passing scores, which you can find at [www.ets.org/praxis/states](http://www.ets.org/praxis/states).

## How do I know whether I passed the test?

Your score report will include information on passing scores for the states you identified as recipients of your test results. If you test in a state with automatic score reporting, you will also receive passing score information for that state.

A list of states and their passing scores for each test are available online at [www.ets.org/praxis/states](http://www.ets.org/praxis/states).

## What your *Praxis* scores mean

You received your score report. Now what does it mean? It's important to interpret your score report correctly and to know what to do if you have questions about your scores.

Visit [http://www.ets.org/s/praxis/pdf/sample\\_score\\_report.pdf](http://www.ets.org/s/praxis/pdf/sample_score_report.pdf) to see a sample score report.

To access *Understanding Your Praxis Scores*, a document that provides additional information on how to read your score report, visit [www.ets.org/praxis/scores/understand](http://www.ets.org/praxis/scores/understand).

## Put your scores in perspective

Your score report indicates:

- Your score and whether you passed
- The range of possible scores
- The raw points available in each content category
- The range of the middle 50 percent of scores on the test

If you have taken the same *Praxis* test or other *Praxis* tests in the last 10 years, your score report also lists the highest score you earned on each test taken.

### Content category scores and score interpretation

Questions on the *Praxis* tests are categorized by content. To help you in future study or in preparing to retake the test, your score report shows how many raw points you earned in each content category. Compare your “raw points earned” with the maximum points you could have earned (“raw points available”). The greater the difference, the greater the opportunity to improve your score by further study.

### Score scale changes

ETS updates *Praxis* tests on a regular basis to ensure they accurately measure the knowledge and skills that are required for licensure. When tests are updated, the meaning of the score scale may change, so requirements may vary between the new and previous versions. All scores for previous, discontinued tests are valid and reportable for 10 years, provided that your state or licensing agency still accepts them.

These resources may also help you interpret your scores:

- *Understanding Your Praxis Scores* (PDF), found at [www.ets.org/praxis/scores/understand](http://www.ets.org/praxis/scores/understand)
- *The Praxis Passing Scores* (PDF), found at [www.ets.org/praxis/scores/understand](http://www.ets.org/praxis/scores/understand)
- State requirements, found at [www.ets.org/praxis/states](http://www.ets.org/praxis/states)

# Appendix: Other Questions You May Have

Here is some supplemental information that can give you a better understanding of the *Praxis* tests.

## What do the *Praxis* tests measure?

The *Praxis* tests measure the specific knowledge and skills that beginning teachers need. The tests do not measure an individual's disposition toward teaching or potential for success, nor do they measure your actual teaching ability. The assessments are designed to be comprehensive and inclusive but are limited to what can be covered in a finite number of questions and question types. Teaching requires many complex skills that are typically measured in other ways, including classroom observation, video recordings, and portfolios.

Ranging from Agriculture to World Languages, there are more than 80 *Praxis* tests, which contain selected-response questions or constructed-response questions, or a combination of both.

## Who takes the tests and why?

Some colleges and universities use the *Praxis* Core Academic Skills for Educators tests (Reading, Writing, and Mathematics) to evaluate individuals for entry into teacher education programs. The assessments are generally taken early in your college career. Many states also require Core Academic Skills test scores as part of their teacher licensing process.

Individuals entering the teaching profession take the *Praxis* content and pedagogy tests as part of the teacher licensing and certification process required by many states. In addition, some professional associations and organizations require *Praxis* Subject Assessments for professional licensing.

## Do all states require these tests?

The *Praxis* tests are currently required for teacher licensure in approximately 40 states and United States territories. These tests are also used by several professional licensing agencies and by several hundred colleges and universities. Teacher candidates can test in one state and submit their scores in any other state that requires *Praxis* testing for licensure. You can find details at [www.ets.org/praxis/states](http://www.ets.org/praxis/states).

## What is licensure/certification?

Licensure in any area—medicine, law, architecture, accounting, cosmetology—is an assurance to the public that the person holding the license possesses sufficient knowledge and skills to perform important occupational activities safely and effectively. In the case of teacher licensing, a license tells the public that the individual has met predefined competency standards for beginning teaching practice.

Because a license makes such a serious claim about its holder, licensure tests are usually quite demanding. In some fields, licensure tests have more than one part and last for more than one day. Candidates for licensure in all fields plan intensive study as part of their professional preparation. Some join study groups, others study alone. But preparing to take a licensure test is, in all cases, a professional activity. Because a licensure exam surveys a broad body of knowledge, preparing for a licensure exam takes planning, discipline, and sustained effort.

## Why does my state require the *Praxis* tests?

Your state chose the *Praxis* tests because they assess the breadth and depth of content—called the “domain”—that your state wants its teachers to possess before they begin to teach. The level of content knowledge, reflected in the passing score, is based on recommendations of panels of teachers and teacher educators in

each subject area. The state licensing agency and, in some states, the state legislature ratify the passing scores that have been recommended by panels of teachers.

### How were the tests developed?

ETS consulted with practicing teachers and teacher educators around the country during every step of the *Praxis* test development process. First, ETS asked them what knowledge and skills a beginning teacher needs to be effective. Their responses were then ranked in order of importance and reviewed by hundreds of teachers.

After the results were analyzed and consensus was reached, guidelines, or specifications, for the selected-response and constructed-response tests were developed by teachers and teacher educators. Following these guidelines, teachers and professional test developers created test questions that met content requirements and [\*ETS Standards for Quality and Fairness\*](#).\*

When your state adopted the research-based *Praxis* tests, local panels of teachers and teacher educators evaluated each question for its relevance to beginning teachers in your state. During this “validity study,” the panel also provided a passing-score recommendation based on how many of the test questions a beginning teacher in your state would be able to answer correctly. Your state’s licensing agency determined the final passing-score requirement.

ETS follows well-established industry procedures and standards designed to ensure that the tests measure what they are intended to measure. When you pass the *Praxis* tests your state requires, you are proving that you have the knowledge and skills you need to begin your teaching career.

### How are the tests updated to ensure the content remains current?

*Praxis* tests are reviewed regularly. During the first phase of review, ETS conducts an analysis of relevant state and association standards and of the current test content. State licensure titles and the results of relevant job analyses are also considered. Revised test questions are then produced following the standard test development methodology. National advisory committees may also be convened to review and revise existing test specifications and to evaluate test forms for alignment with the specifications.

### How long will it take to receive my scores?

Scores for tests that do not include constructed-response questions are available on screen immediately after the test. Scores for tests that contain constructed-response questions or essays aren’t available immediately after the test because of the scoring process involved. Official score reports are available to you and your designated score recipients approximately two to three weeks after the test date for tests delivered continuously, or two to three weeks after the testing window closes for other tests. See the test dates and deadlines calendar at [www.ets.org/praxis/register/centers\\_dates](http://www.ets.org/praxis/register/centers_dates) for exact score reporting dates.

### Can I access my scores on the web?

All test takers can access their test scores via My *Praxis* Account free of charge for one year from the posting date. This online access replaces the mailing of a paper score report.

The process is easy—simply log into My *Praxis* Account at [www.ets.org/praxis](http://www.ets.org/praxis) and click on your score report. If you do not already have a *Praxis* account, you must create one to view your scores.

**Note:** You must create a *Praxis* account to access your scores, even if you registered by mail or phone.

\*[\*ETS Standards for Quality and Fairness\*](#) (2014, Princeton, N.J.) are consistent with the [\*Standards for Educational and Psychological Testing\*](#), industry standards issued jointly by the American Educational Research Association, the American Psychological Association, and the National Council on Measurement in Education (2014, Washington, D.C.).

Your teaching career is worth preparing for, so start today!  
Let the *Praxis* Study Companion guide you.



To search for the *Praxis* test prep resources  
that meet your specific needs, visit:

[www.ets.org/praxis/testprep](http://www.ets.org/praxis/testprep)

To purchase official test prep made by the creators  
of the *Praxis* tests, visit the ETS Store:

[www.ets.org/praxis/store](http://www.ets.org/praxis/store)

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