GACE
Georgia Assessments for the Certification of Educators®

GACE® Study Companion

Engineering and Technology Education Assessment

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About the Assessment

Assessment Name	Engineering and Technology Education
Grade Level	EC–12
Test Code	Test I: 052 Test II: 053 Combined Test I and Test II: 552
Testing Time	Test I: 2 hours Test II: 2 hours Combined Test I and Test II: 4 hours
Test Duration	Test I: 2.5 hours Test II: 2.5 hours Combined Test I and Test II: 5 hours
Test Format	Computer delivered
Number of Selected-response Questions	Test I: 60 Test II: 60 Combined Test I and Test II: 120
Question Format	The test consists of a variety of short-answer questions such as selected-response questions, where you select one answer choice or multiple answer choices (depending on what the question asks for), questions where you enter your answer in a text box, and other types of questions. You can review the possible question types in the ***Guide to Taking a GACE Computer-delivered Test***.
Number of Constructed-response Questions	Test I: 0 Test II: 0 Combined Test I and Test II: 0

The GACE Engineering and Technology Education assessment is designed to measure the professional knowledge of prospective EC–12 Technology Education teachers in the state of Georgia.

This assessment includes two tests. You may take either test individually or the full assessment in a single session. The testing time is the amount of time you will have to answer the questions on the test. Test duration includes time for tutorials and directional screens that may be included in the test.

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The questions in this assessment assess both basic knowledge across content areas and the ability to apply principles.

The total number of questions that are scored is typically smaller than the total number of questions on the test. Most tests that contain selected-response questions also include embedded pretest questions, which are not used in calculating your score. By including pretest questions in the assessment, ETS is able to analyze actual test-taker performance on proposed new questions and determine whether they should be included in future versions of the test.

Content Specifications

Each test in this assessment is organized into content **subareas**. Each subarea is further defined by a set of **objectives** and their **knowledge statements**.

- The objectives broadly define what an entry-level educator in this field in Georgia public schools should know and be able to do.
- The knowledge statements describe in greater detail the knowledge and skills eligible for testing.
- Some tests also include content material at the evidence level. This content serves as descriptors of what each knowledge statement encompasses.

See a breakdown of the subareas and objectives for the tests in this assessment on the following pages.

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Test I Subareas

Subarea	Approx. Percentage of Test
I. Engineering Design and Application	40%
II. Engineering and Technology Teaching Practices	33%
III. Engineering Profession and Professional Growth	27%

Test I Objectives

Subarea I: Engineering Design and Application

Objective 1: Understand the engineering design process

The beginning Engineering and Technology Education teacher:

A. Demonstrates ability to apply the engineering design process to model and solve problems using engineering principles
B. Applies skills to use and maintain technological products and systems for engineering design
C. Assesses the impact of products and systems

Objective 2: Apply and use engineering principles in the engineering design process

The beginning Engineering and Technology Education teacher:

A. Is familiar with engineering principles within
    - medical technologies
    - agricultural and related biotechnologies
    - energy and power technologies
    - information and communication technologies
    - transportation technologies
    - manufacturing technologies
    - construction technologies
B. Understands the engineering design process, including iterative design, identifying realistic constraints, and applying decision making skills for selecting optimal solutions

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Subarea II: Engineering and Technology Teaching Practices

Objective 1: Understand and use a variety of effective teaching practices that enhance and extend learning of engineering technology

The beginning Engineering and Technology Education teacher:

A. Ensures that the space and physical arrangement of instructional facilities are conducive to effective instruction and safety
B. Develops instructional goals and objectives for the engineering and technology education curriculum that are clear, relevant, and meaningful and that can be assessed

Objective 2: Understand and be able to interpret, develop, and implement curriculums for engineering and technology education programs, including instructional methods of teaching for the classroom and engineering and technology education lab activities

The beginning Engineering and Technology Education teacher:

A. Implements a variety of teaching methods (e.g., production lab and classroom workspaces) to enhance student learning in engineering and technology education
B. Selects and uses appropriate materials and resources for effectively teaching subject material in engineering and technology education
C. Demonstrates and incorporates safe laboratory procedures in classroom, lab, and field environments
D. Uses standard and authentic assessment tools and strategies to monitor individual and group progress in achieving learning goals
E. Provides students with leadership opportunities and practical experience in engineering and technology-related fields through student organizations and professional organizations

Subarea III: Engineering Profession and Professional Growth

Objective 1: Understand the organizational structure and historical development of career and engineering education and practice and its relationship to American business, industry, and careers

The beginning Engineering and Technology Education teacher:

A. Describes how engineering and technology education literacy can assist individuals in participating in society's decisions regarding the use of technology
B. Identifies sources of information about regulations and guidelines for the construction and use of instructional facilities in engineering and technology education
C. Is familiar with engineering disciplines, such as
    - electrical engineering
    - chemical engineering
    - mechanical engineering

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- civil engineering
- industrial engineering
- aeronautical/aerospace engineering
- automotive engineering
- computer software engineering
- biomedical engineering

Objective 2: Work with business, industry, and labor in establishing school/business/community partnerships and advisory committees

The beginning Engineering and Technology Education teacher:

A. Can apply oral and written skills to effectively communicate engineering and technology design decisions
B. Can apply management skills for leading interdisciplinary teams of students to solve complex problems

Note: After clicking on a link, right click and select "Previous View" to go back to original text.

Test II Subareas

Subarea	Approx. Percentage of Test
I. The Nature of Technology and Society	33%
II. Abilities for a Technological World	33%
III. Design and Modeling	33%

Test II Objectives

Subarea I: The Nature of Technology and Society

Objective 1: Understand human, cultural, and social issues related to technology and practice legal and ethical behavior

The beginning Engineering and Technology Education teacher:

A. Explains the cultural, social, economic, and political effects of technology
B. Describes the advantages and disadvantages of technology on the environment and society
C. Recognizes the role of society in the development and use of technology

Objective 2: Demonstrate problem solving and construct knowledge about the fundamentals of technology

The beginning Engineering and Technology Education teacher:

A. Describes the characteristics and scope of technology
B. Identifies the core concepts of technology (STL2)
C. Explains the relationships among technologies and the connections between technology and other fields of study
D. Describes the influence of technology on history

Subarea II: Abilities for a Technological World

Objective 1: Demonstrate ability to use technological products and systems to support learning

The beginning Engineering and Technology Education teacher:

A. Understands and applies the universal systems model of technology
B. Distinguishes between the engineering design process and the universal systems model

Objective 2: Describe the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving in engineering and technology education

The beginning Engineering and Technology Education teacher:

A. Develops an understanding of the core concepts of invention and innovation
B. Develops an understanding of research and development as a specific problem-solving approach

Objective 3: Demonstrate an understanding of and be able to select and use various technologies

The beginning Engineering and Technology Education teacher:

A. Has an understanding of and uses
    - medical technologies
    - agricultural and related biotechnologies
    - energy and power technologies
    - information and communication technologies
    - transportation technologies
    - manufacturing technologies
    - construction technologies

Subarea III: Design and Modeling

Objective 1: Know how to implement technology across content areas to foster collaboration, communication, and innovation

The beginning Engineering and Technology Education teacher:

A. Demonstrates oral and written skills to effectively communicate engineering and technology design decisions
B. Demonstrates management skills for leading interdisciplinary teams to solve complex problems

Note: After clicking on a link, right click and select "Previous View" to go back to original text.

Objective 2: Determine the selection and application of tools to gather, evaluate, validate, and use information

The beginning Engineering and Technology Education teacher:

A. Identifies the attributes of design
B. Evaluates the results of the engineering design process
C. Uses and analyzes modeling and prototyping
    - Mathematical
    - Physical
    - Interpret data and report
    - Prototyping

Note: After clicking on a link, right click and select "Previous View" to go back to original text.

Practice Questions

The practice questions in this study companion are designed to familiarize you with the types of questions you may see on the assessment. While they illustrate some of the formats and types of questions you will see on the test, your performance on these sample questions should not be viewed as a predictor of your performance on the actual test. Fundamentally, the most important component in ensuring your success is familiarity with the content that is covered on the assessment.

To respond to a practice question, choose one of the answer options listed. Be sure to read the directions carefully to ensure that you know what is required for each question. You may find it helpful to time yourself to simulate actual testing conditions. A correct answer and a rationale for each sample test question are in the section following the practice questions.

Keep in mind that the test you take at an actual administration will have different questions, although the proportion of questions in each subarea will be approximately the same. You should not expect the percentage of questions you answer correctly in these practice questions to be exactly the same as when you take the test at an actual administration, since numerous factors affect a person's performance in any given testing situation.

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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.

1. If the universal systems model is applied to the transportation sector, which of the following groups of terms refer only to resources?

   A. People, time, and capital
   B. Feedback, monitoring, and impacts
   C. Information, outputs, and monitoring
   D. Inputs, outputs, and impacts

Answer and Rationale

2. Which of the following drawings show representations of a three-dimensional object on an imaginary plane having only width and height?

   A. Exploded
   B. Isometric
   C. Perspective
   D. Orthographic projection

Answer and Rationale

3. Which of the following types of design is primarily involved in the development of concepts and specifications that improve the functionality, value, and aesthetics of products for the benefit of both the user and the manufacturer?

   A. Universal design
   B. Ideation design
   C. Input design
   D. Industrial design

Answer and Rationale

Note: After clicking on a link, right click and select "Previous View" to go back to original text.

4. Which of the following components is present in both pneumatic and hydraulic systems?

   A. Exhaust
   B. Reservoir
   C. Compressor
   D. Control valve

Answer and Rationale

5. A student in the process of solving a fabrication problem in the manufacturing laboratory asks the teacher what assembly procedures should be used. The teacher's best response would be to

   A. give an opinion as to the best assembly procedure for the particular problem.
   B. suggest two or three possible assembly procedures and have the student select one.
   C. place the responsibility completely on the student for making the judgment.
   D. use leading questions to help the student review and analyze the relative merits of several assembly procedures.

Answer and Rationale

6. Which of the following should be the first step in designing or modifying a technology education laboratory?

   A. Develop or consult a curriculum plan
   B. Obtain the school board's approval
   C. Obtain adequate funding
   D. Prepare a floor plan

Answer and Rationale

Note: After clicking on a link, right click and select "Previous View" to go back to original text.

7. The most important consideration in designing successful messages to be transmitted through graphic communications is knowledge and understanding of

   A. current technologies.
   B. the capabilities of the designer.
   C. the limitations of the printer.
   D. the nature of the audience.

Answer and Rationale

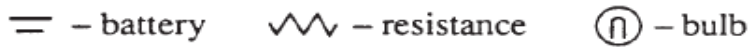
8. Which of the following is a renewable energy source?

   A. Wood
   B. Oil
   C. Natural gas
   D. Coal

Answer and Rationale

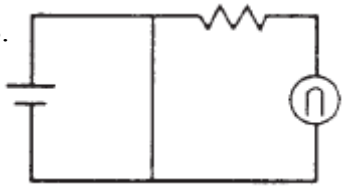
Note: After clicking on a link, right click and select "Previous View" to go back to original text.

9. In which of the following is the battery short-circuited?

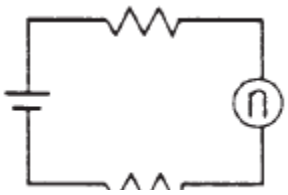


A.

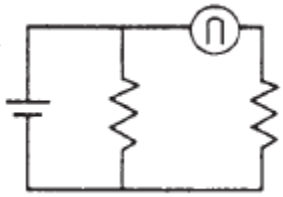
B.



C.



D.



Answer and Rationale

Note: After clicking on a link, right click and select "Previous View" to go back to original text.

10. Which of the following is generally the first step taken in a large scale commercial construction venture?

    A. Filing applications for building permits and variances
    B. Ordering the materials needed for the building foundation
    C. Drafting a contract that spells out the details of the building plan
    D. Holding a discussion between the developer and the designer/contractor about the scope of the construction

Answer and Rationale

11. Propulsion, suspension, guidance, control, and support are primary concepts taught in the study of

    A. manufacturing.
    B. transportation.
    C. biotechnical systems.
    D. integrated systems.

Answer and Rationale

12. Of the following objectives, which is most appropriate for a technology education program that has a goal of enabling students to develop creative technical solutions to present and future societal problems?

    A. Design and construct a three-dimensional model of a low-income, multifamily dwelling unit
    B. Describe several construction careers that are related to home building
    C. Categorize the components of a technical system
    D. Identify the major tools and equipment used in highway construction

Answer and Rationale

Note: After clicking on a link, right click and select "Previous View" to go back to original text.

13. Which of the following terms is used in the energy sector to describe changing an input into a required output using the universal systems model?

    A. Process
    B. Storage system
    C. Feedback loop
    D. Impact

Answer and Rationale

14. An external circuit has a resistance of 7.0 ohms and a current of 2.0 amperes. The potential difference across the circuit is which of the following?

    A. 14.0 volts
    B. 9.0 volts
    C. 3.5 volts
    D. 0.28 volts

Answer and Rationale

15. A person uses a remote control to change the volume level on a television. The signal that travels from the remote to the television is most likely encoded in with a

    A. visible light pulse.
    B. radio wave signal.
    C. series of infrared pulses.
    D. series of intense infrared beams.

Answer and Rationale

Note: After clicking on a link, right click and select "Previous View" to go back to original text.

16. When scanning a disk for viruses, it is typically important to check files having which of the following extensions?

    A. .jpg
    B. .pdf
    C. .wav
    D. .exe

Answer and Rationale

17. A committee of middle school teachers is meeting to begin the process of finding a software program to improve students' drafting skills. Which of the following steps should the committee take first in the process?

    A. Downloading a trial version of the most popular software for evaluation
    B. Conducting a survey to determine the importance of drafting skills in the classroom
    C. Defining the learning objectives they would like the software to meet
    D. Deciding what type of user interface would be most appropriate

Answer and Rationale

18. The primary advantage of using a vector program rather than a paint program for creating a graphic image is that

    A. the quality of an image created with a vector program will be maintained no matter how much it is enlarged or reduced.
    B. the number of options for selecting the color mode when creating an image with a vector program is greater.
    C. a vector program allows files to be saved in GIF and JPEG formats for use on the Web.
    D. a vector program provides greater flexibility when creating and working with layers in an image.

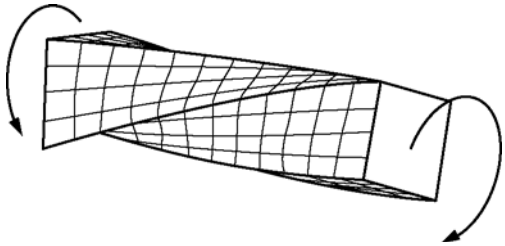
Answer and Rationale

Note: After clicking on a link, right click and select "Previous View" to go back to original text.

19. Which of the following strategies would be most effective in ensuring that a school Web page is accessible to visually impaired users?

A. Using alt tags to describe images
B. Using href tags for hyperlinks
C. Using image maps for navigation
D. Using automatic page refresh for all pages

Answer and Rationale



20. The vector arrow symbolizes which of the following types of mechanical stress?

A. Compression
B. Shear
C. Tension
D. Torsion

Answer and Rationale

Note: After clicking on a link, right click and select "Previous View" to go back to original text.

21. The USDOT safety placard indicates which of the following?

    A. Biohazard
    B. Corrosive substance
    C. Electrical hazard
    D. Recycling

Answer and Rationale

22. A car manufacturing factory is considering a new site for its next plant. Which of the following would community planners be most concerned with before allowing the plant to be built?

    A. The amount of materials stored in the plant
    B. The hours of operations of the new plant
    C. The effect the plant will have on the environment
    D. The work environment for the employees at the plant

Answer and Rationale

Note: After clicking on a link, right click and select "Previous View" to go back to original text.

23. Which of the following steps in the design of a dog house would be earliest?

    A. Acquiring all the tools necessary for the building
    B. Purchasing all the materials for building the structure
    C. Identifying the color, shape, and style of the exterior surface
    D. Accessing the measurement of the dog and all the interior materials

Answer and Rationale

24. Which of the following is the most effective way to evaluate the development of a student's drafting skills throughout the school year?

    A. Baseline assessment
    B. Portfolio assessment
    C. Short answer unit assessment
    D. Teacher created assessment

Answer and Rationale

Note: After clicking on a link, right click and select "Previous View" to go back to original text.

Answer Key and Rationales

Question Number	Correct Answer	Rationale
1	A	**Option A is correct.** The inputs of a system are the resources needed to begin the system. These resources are needed to make the system operate. There are several different types of resources, or inputs, which must be considered for a technological system to function properly. These resources include people, capital, knowledge and information, materials, energy, tools and machines, and time. Back to Question
2	D	**Option D is correct.** The question asks you about your understanding of how to organize and communicate the solution to a design problem by using three-dimensional representations. Orthographic projection is any projection of the features of an object onto an imaginary plane called a plane of projection. The projection of the features of the object is made by lines of sight that are perpendicular to the plane of projection. When a surface of the object is parallel to the plane of projection, the surface appears in its true size and shape on the plane of projection. In situations where the plane of projection is not parallel to the surface of the object, the resulting orthographic view is foreshortened, or shorter than true length. Back to Question
3	D	**Option D is correct.** Industrial design primarily involves developing concepts and specifications that improve manufactured products. Back to Question

Note: After clicking on a link, right click and select "Previous View" to go back to original text.

Question Number	Correct Answer	Rationale
4	D	**Option D is correct.** Both hydraulic and pneumatic systems share some of the same basic components. The components may look different, but they perform the same basic functions. Exhaust (option A) is only present in a pneumatic system. Hydraulic systems return fluid to a Reservoir (option B) to be recycled. Pneumatic systems use a Compressor (option C) to build and store air pressure to be used. Hydraulic systems use an electric pump to circulate the liquid. Both systems use a control valve. Back to Question
5	D	**Option D is correct.** One instructional goal of technology education is to offer opportunities for students to develop their problem-solving abilities. Option A (give an opinion as to the best assembly procedure for the particular problem) and option B (suggest two or three possible assembly procedures and have the student select one) are teacher centered, and option C (place the responsibility completely on the student for making the judgment) does not provide the guidance a student would need. Only option D (use leading questions to help the student review and analyze the relative merits of several assembly procedures) is a teaching method that requires the student to apply critical thinking skills in selecting the best solution to a problem. Back to Question
6	A	**Option A is correct.** The first step in designing or modifying a technology education laboratory is to consult national standards for the profession, such as the Standards for Technological Literacy, which will provide guidelines for developing a curriculum to be taught in the laboratory. Back to Question

Note: After clicking on a link, right click and select "Previous View" to go back to original text.

Question Number	Correct Answer	Rationale
7	D	**Option D is correct.** All options must be considered in producing a graphic communication, and failing to meet established criteria on any one could result in a given product being rejected. However, regardless of how well the product meets all other criteria, if it does not consider the nature of the audience, it will not communicate successfully. Back to Question
8	A	**Option A is correct.** Renewable energy sources are those that can be replaced by natural processes within the limits of the control of human beings. Oil (option B), natural gas (option C), and coal (option D) are fossil fuels and cannot be readily replaced. Only wood can be regrown. Back to Question
9	B	**Option B is correct.** A battery is inserted within the line on the far left side. A bulb is inserted within the line on the far right side. A resistance is inserted within the line on the top side to the right of the center line. In this diagram, the path of the circuit is such that current will be diverted from passing through the resistor and the bulb. When the part of a circuit with the most resistance is bypassed, and all of the current flows through the part with zero (negligible) resistance, a short circuit is said to exist. Back to Question

Note: After clicking on a link, right click and select "Previous View" to go back to original text.

Question Number	Correct Answer	Rationale
10	D	**Option D is correct.** A property owner or developer would need to meet with the designer or contractor to discuss the scope of the project before any other action is taken. Back to Question
11	B	**Option B is correct.** Transportation is the technology sector that deals with the efficient movement of goods or people from place to place. Applying the Universal Systems Model, propulsion, suspension, guidance, control, and support are all component subsystems of larger transportation systems. Back to Question
12	A	**Option A is correct.** A secondary instructional goal of technology education is that of forecasting future technological trends or possible problem solutions. Describing several construction careers that are related to home building (option B), categorizing the components of a technical system (option C), and identifying the major tools and equipment used in highway construction (option D) address only present construction solutions. Only designing and constructing a three-dimensional model of a low-income, multifamily dwelling unit (option A) would allow the student to be creative and explore new or future construction alternatives. Back to Question

Note: After clicking on a link, right click and select "Previous View" to go back to original text.

Question Number	Correct Answer	Rationale
13	A	**Option A is correct.** The question asks about your knowledge of how to apply the universal systems model to help solve problems related to the energy sector. System processes are the actions that convert the inputs into the desired outputs. All the inputs feed into the process portion of the universal systems model. During a process, inputs will be changed. The change will produce an output, or result. Back to Question
14	A	**Option A is correct.** The mathematical equation that describes this relationship is $I = \frac{V}{R}$, where *I* represents the current through the conductor in units of amperes, *V* is the potential difference measured across the conductor in units of volts, and R is the resistance of the conductor in units of ohms. Using the mathematical equation, *I* = 2; *R* = 7; and V is unknown. This would be illustrated as $2 = \frac{V}{7}$ or $V = 2 \text{ X } 7$. Back to Question
15	C	**Option C is correct.** When changing the channel on a television with a remote control, a precise communication is taking place through the use of infrared pulses. These pulses allow the one device to react, as opposed to interacting with multiple items. Back to Question

Note: After clicking on a link, right click and select "Previous View" to go back to original text.

Question Number	Correct Answer	Rationale
16	D	**Option D is correct.** Viruses have the capability of infecting any file; however, they will generally infect executable (.exe) files or data files. Back to Question
17	C	**Option C is correct.** There are many issues to consider when selecting educational software. The main consideration is given to the evidence of its effectiveness; its ability to align to a school, state, or district's standards; how it suits the students' needs and learning styles; and the overall cost of purchasing, maintaining, licensing, and upgrading, as well as the hardware and software needed. Of the options provided, defining the learning objectives the software would meet (option C) is the primary concern. Back to Question
18	A	**Option A is correct.** Vector images are made up of many individual, scalable objects. These objects are defined by mathematical equations rather than pixels, so they always render at the highest quality. Back to Question

Note: After clicking on a link, right click and select "Previous View" to go back to original text.

Question Number	Correct Answer	Rationale
19	A	**Option A is correct.** Alt text tags are used in conjunction with the graphics code to help interpret graphics to a person with limited vision. The use of the alt text tag is the most important element in making Web pages more accessible when graphical images are used within Web pages. Screen reader software cannot interpret a graphic unless an alt text tag has been associated with the graphic. Back to Question
20	D	**Option D is correct.** Compression is a force that is pushing against something. Shear is when a compression force is applied on a material in opposite directions across a perpendicular plane. Tension forces try to pull elements apart. This image reflects a mechanical stress that is twisted. Back to Question
21	B	**Option B is correct.** Biohazard is hazardous biological materials and organisms. The basic outline of the biohazard symbol is a plain trefoil, which is three circles overlapping each other equally like in a triple Venn diagram. Electrical hazard is any device that has the potential to injure or cause death to an individual by the direct or indirect exposure to an energized circuit. There are a myriad of warning and safety placards that can be used to warn of the potential dangers of electricity. Most of them use a universal symbol of a “lightning bolt.” The recycling symbol represents a Möbius loop consisting of three chasing arrows in the shape of a triangle with rounded vertices. Each arrow twists and turns itself, and all three arrows chase each other. It is a consummate representation of recycling. Corrosive substance is a graphic label showing drips of liquid from a lab tube eroding the symbol of an object or hand indicating that the contents are corrosive. Back to Question

Note: After clicking on a link, right click and select “Previous View” to go back to original text.

Question Number	Correct Answer	Rationale
22	C	**Option C is correct.** Reviewing the amount of materials stored in a plant, the hours of operation, and the employee work environment are business concerns. The effect of the new site on the environment would be a serious concern to the community as the environment affects the community as a whole. Back to Question
23	D	**Option D is correct.** All engineering and construction design processes use a "planning, gathering data, or research" step. Depending on the version used, the planning, gathering data, or research step would come before any steps that include acquiring all the tools necessary for the building (option A), purchasing all the materials for building the structure (option B), and identifying the color, shape, and style of the exterior surface (option C). Back to Question
24	B	**Option B is correct.** A portfolio assessment is typically used by the teacher to gauge a student's understanding of material as the student's skills develop. This type of assessment is designed so that the content of the assessment matches the content of the instruction. Back to Question

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Preparation Resources

The resources listed below may help you prepare for the GACE assessment in this field. These preparation resources have been identified by content experts in the field to provide up-to-date information that relates to the field in general. You may wish to use current issues or editions of these materials to obtain information on specific topics for study and review.

Guide to Taking a GACE Computer-delivered Assessment

This guide explains how to navigate through a GACE assessment and how to answer different types of test questions. This free download is available in the Test Preparation Resources section of the GACE website at ***www.gace.ets.org/prepare***.

Reducing Test Anxiety

This guide provides practical help for people who suffer from test anxiety. Designed specifically for GACE test takers, but useful to anyone who has to take tests, this guide reviews the major causes of test anxiety and offers practical advice for how to counter each one. Download this guide for free from the Test Preparation Resources section of the GACE website at ***www.gace.ets.org/prepare***.

Study Tips: Preparing for a GACE Assessment

This document contains useful information on preparing for selected-response and constructed-response tests. The instruction, tips, and suggestions can help you become a better-prepared test taker. See the Test Preparation Resources section of the GACE website at ***www.gace.ets.org/prepare*** for this free download.

Journals

Journal of Technology Education, Council on Technology Teacher Education and the International Technology Education Association.

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Online Resources

International Technology and Engineering Educators Association — ***www.iteea.org***

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