GACE® Study Companion

Special Education
Mathematics and Science Assessment

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About the Assessment

Assessment Name	Special Education Mathematics and Science
Grade Level	P–8
Test Code	088
Testing Time	2 hours 15 minutes
Test Duration	2 hours 45 minutes
Test Format	Computer delivered
Number of Selected-response Questions	80
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	0

The GACE Special Education Mathematics and Science assessment is designed to measure the professional knowledge of prospective teachers of Special Education Mathematics and Science in the state of Georgia.

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.

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

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 this assessment on the following pages.

Test Subareas

Subarea	Approx. Percentage of Test
I. Mathematics	50%
II. Science	50%

Test Objectives

Subarea I: Mathematics

Objective 1: Understands numbers and operations, including rational numbers, proportions, number theory, and estimation

The beginning Special Education Mathematics teacher:

A. Understands operations and properties of rational numbers

- Solves problems involving addition, subtraction, multiplication, and division of real numbers
- Describes the effect an operation has on a given number; e.g., adding a negative, dividing by a fraction
- Applies the order of operations
- Uses place value to read and write numbers in standard and expanded form
- Identifies or applies properties of operations on a number system; i.e., commutative, associative, distributive, identity
- Compares, classifies, and orders real numbers
- Performs operations involving exponents, including negative exponents
- Simplifies and approximates radicals
- Uses scientific notation to represent and compare numbers
- Selects the appropriate operation to use for a given problem

B. Understands the relationships among fractions, decimals, and percents

- Simplifies fractions to lowest terms
- Finds equivalent fractions
- Converts between fractions, decimals, and percents
- Represents fractions, decimals, and percents with various models
- Given a fraction, decimal, or percent, identifies a corresponding model, and vice versa

C. Knows how to use ratios and proportional relationships in solving problems

- Applies the concept of a ratio to describe a relationship between two quantities

- Recognizes and represents proportional relationships between two quantities

- Uses proportional relationships to solve problems; e.g., rates, scale factors

- Solves percent problems; e.g., discounts, taxes, tips, simple interest rates

D. Knows the basic concepts of number theory; e.g., primes, composites, factors, multiples

- Applies characteristics of prime and composite numbers

- Applies characteristics of odd and even numbers

- Solves problems involving factors, multiples, and divisibility

E. Knows how to use estimation to determine the reasonableness of results

- Recognizes the reasonableness of results within the context of a given problem

- Tests the reasonableness of results using estimation

- Demonstrates an understanding of estimation and rounding

- Recognizes appropriate uses of estimation and rounding

Objective 2: Understands algebra, functions, and graphs

The beginning Special Education Mathematics teacher:

A. Knows how to perform operations on algebraic expressions

- Adds, subtracts, factors, and expands linear algebraic expressions with rational coefficients

B. Knows how to translate verbal relationships into algebraic expressions and equations

- Translates verbal relationships into algebraic equations or expressions

C. Understands how to recognize and represent linear relationships algebraically

- Determines the equation of a line

- Recognizes and uses the basic forms of linear equations

- Converts among various forms of linear equations; e.g., slope-intercept, point-slope, standard

D. Understands how to solve equations and inequalities

- Solves one-variable linear equations and inequalities

- Represents solutions to inequalities on the number line

- Represents and solves systems of linear equations and inequalities with two variables

E. Knows how to recognize and represent simple sequences or patterns; e.g., arithmetic, geometric
- Evaluates, extends, or algebraically represents rules involving number patterns
- Describes or extends patterns involving shapes or figures
- Forms rules based on given patterns
- Identifies patterns based on given rules

F. Understands how to identify and evaluate functions
- Determines whether a relation is a function
- Evaluates functions for given input values; i.e., algebraically, graphically, tabular

G. Knows how to determine and interpret the set of inputs and their corresponding outputs for functions represented numerically, graphically, or algebraically
- Given a table of values, determines the sets of inputs and outputs
- Given the graph of a function, determines the sets of inputs and outputs
- Given a function that is represented algebraically, determines the sets of inputs and outputs
- Given a real-world setting, determines the sets of input and output values

H. Understands basic characteristics of linear functions; e.g., slope, intercepts
- Determines the slope of a given linear function
- Interprets slope as a constant rate of change
- Determines the x- and y-intercepts of a given linear function
- Interprets the x- and y-intercepts of a given linear function

I. Understands the relationships among functions, tables, and graphs
- Determines and interprets the x- and y-intercepts of a nonlinear function
- Given a graph (i.e., linear, quadratic, simple exponential), determines an equation that best represents the graph
- Identifies a graph of an equation for a linear, quadratic, or simple exponential function
- Identifies graphs showing key features for a given verbal description of a relationship
- Compares properties of two functions, each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions)

J. Knows how to analyze and represent functions that model given information
- Identifies which particular model (e.g., graph, equation, table) fits a given set of conditions
- Recognizes the relationship between two quantities by analyzing a particular mathematical model; e.g., graph, equation, table

Objective 3: Understands geometry and measurement, including points, lines, and figures of two and three dimensions

The beginning Special Education Mathematics teacher:

A. Understands how to solve problems involving perimeter and area of plane figures

- Calculates and interprets perimeter and area of plane figures that can be composed of triangles and quadrilaterals
- Calculates changes in perimeter and area as the dimensions of plane figures change

B. Knows how to solve problems involving surface area and volume of solids

- Calculates and interprets surface area and volume of solids; e.g., prisms, pyramids, cylinders, spheres
- Calculates changes in surface area and volume as the dimensions of a solid change
- Uses two-dimensional representations of three-dimensional objects to visualize and solve problems

C. Understands the concepts of similarity and congruence

- Determines whether two figures are similar or congruent
- Uses similarity and congruence to solve problems with plane figures; e.g., scale problems

D. Knows properties of and relationships between points, lines, line segments, rays, and angles

- Identifies points, lines, line segments, and rays
- Identifies parallel and perpendicular lines
- Solves problems involving parallel, perpendicular, and intersecting lines
- Applies angle relationships (e.g., supplementary, vertical, alternate interior) to solve problems

E. Knows how to solve problems involving circles

- Solves problems involving circumference and area of circles
- Solves problems involving diameter and radius of circles

F. Knows properties of polygons

- Solves problems involving sides (e.g., Pythagorean theorem) and angles in real-world and mathematical problems using two and three dimensions
- Recognizes characteristics of special triangles; e.g., isosceles, right, 30-60-90
- Identifies geometric properties of various quadrilaterals; e.g., parallelogram, trapezoid
- Recognizes the attributes and hierarchy of quadrilaterals
- Solves problems involving sides, angles, or diagonals of polygons

- Identifies the lines of symmetry in a polygon

- Explains a proof of the Pythagorean theorem

G. Knows how to interpret geometric relationships in the *xy*-plane; e.g., transformations, distance, midpoint

- Identifies the *x*-axis, *y*-axis, origin, and four quadrants in the coordinate plane

- Identifies and labels ordered pairs in the coordinate plane

- Uses coordinate geometry to represent and identify the properties of geometric shapes; e.g., Pythagorean theorem, area of a rectangle

- Determines the distance between two points

- Determines the midpoint between two points

- Interprets and solves problems involving transformations; i.e., translations, reflections, rotations, dilations

- Uses coordinates to compute perimeters of polygons and areas of triangles and rectangles

H. Understands systems of measurement

- Solves measurement and estimation problems involving time, length, volume, and mass in standard measurement systems

- Converts units within a measurement system

- Uses appropriate units of measurement in a given context

Objective 4: Understands probability, statistics, and discrete math, including data, central tendency, and inference

The beginning Special Education Mathematics teacher:

A. Understands how to interpret, analyze, and represent data presented in a variety of displays

- Analyzes and interprets various displays of data; e.g., box plots, histograms, scatterplots

- Draws conclusions based on data; e.g., misleading representation of data, line of best fit, interpolation, association

- Chooses appropriate graphs based on data; e.g., represents data accurately, chooses correct types of graphs

B. Understands concepts associated with measures of central tendency and dispersion

- Solves for the mean and weighted average of given sets of data

- Determines and interprets mean, median, and mode in a variety of problems

- Determines and interprets common features of sets of data; e.g., range and outliers

- Chooses appropriate measures of central tendency to represent given sets of data and justify the measures used

- Identifies correct statements regarding a given numerical data set
- Uses data to draw comparative inferences about two populations
- Distinguishes between random and biased sampling

C. Understands statistical processes and how to evaluate them

- Understands statistics as a process for making inferences about population parameters based on a random sample from that population
- Decides if a specified model is consistent with results from a given data-generating process; e.g., using simulation

D. Understands how to make inferences and justify conclusions from sample surveys, experiments, and observational studies

- Recognizes the purposes of and differences among sample surveys, experiments, and observational studies, and explains how randomization relates to each
- Uses data from a sample survey to estimate a population mean or proportion
- Draws inferences about populations based on collected data

E. Knows how to develop, use, and evaluate probability models

- Uses counting techniques (e.g., the counting principle, permutations, combinations) to answer questions involving a finite sample space
- Solves probability problems involving independent and dependent events

Subarea II: Science

Objective 1: Understands the nature of scientific inquiry and technology, and its relationship to society

The beginning Special Education Science teacher:

A. Understands methods of scientific inquiry and design

- Identifying problems based on observations
- Forming and testing hypotheses
- Theories, models, and laws
- Experimental design, including independent and dependent variables, controls, and sources of error
- Process skills, including observing, comparing, inferring, categorizing, generalizing, and concluding

B. Understands the history and nature of scientific knowledge

- Subject to change and consistent with evidence
- Based on reproducible evidence
- Unifying concepts and processes, such as systems, models, constancy and change, equilibrium, form and function

- Accepted principles and models develop over time
- Major developments in science, such as atomic theory and genetics
- Contributions of major historical figures, such as Darwin and Newton

C. Understands the processes involved in collecting and analyzing scientific data

- Common units of measurement (metric and English) including unit conversion and prefixes such as milli and kilo
- Organization and presentation of data
- Trends in data
- Relationships between variables
- Predictions and valid conclusions based on data
- Basic data and error analysis, including determining mean, accuracy, precision, and sources of error

D. Understands the procedures for safe and correct use of laboratory and field materials and equipment

- Appropriate and safe preparation, use, storage, and disposal of materials such as chemicals and lab specimens
- Appropriate and safe use of equipment such as glassware and microscopes
- Preparations for demonstrations, activities, or field use
- Basic use and maintenance of equipment such as microscopes and balances
- Use of standard safety equipment, such as eyewash stations and showers
- Laboratory safety rules for students
- Appropriate apparel and conduct in the laboratory
- Emergency procedures for events such as fires, chemical spills, and injuries

E. Understands that science and technology impact the environment and society

- Acid rain
- Air and water pollution
- Greenhouse gases
- Ozone layer depletion
- Waste disposal and recycling
- Green chemistry
- Irrigation
- Reservoirs and levees
- Depletion of aquifers
- Loss of biodiversity

F. Understands major issues associated with energy production and the management of natural resources

- Renewable and nonrenewable energy resources
- Conservation, recycling, and sustainability
- Pros and cons of power generation based on various sources, such as fossil and nuclear fuel, hydropower, wind power, solar power, and geothermal power
- Issues associated with the use and extraction of Earth's resources; e.g., mining, land reclamation, and deforestation

G. Understands applications of science and technology in daily life and public health

- Chemical properties of household products
- Communication technologies; e.g., wireless devices, GPS, satellites
- Science principles applied in commonly used consumer products; e.g., batteries, sunglasses
- Water purification
- Common agricultural practices, such as the use of insecticides, herbicides, and genetically modified crops
- Medical technologies such as medical imaging, X rays, and radiation therapy

Objective 2: Understands physical science, including matter, energy, reactions, forces, electricity, and magnetism

The beginning Special Education Science teacher:

A. Understands the organization of matter

- Elements, compounds, and mixtures
- Atoms, molecules, and ions
- Basic properties of solids, liquids, plasma, and gases
- Atomic structure, including nucleus, electrons, protons, and neutrons
- Atomic number, atomic mass, and isotopes
- Electron arrangements
- Nature of radioactive substances
- Chemical, electrical, and radioactive hazards

B. Understands basic concepts and relationships involving energy and matter

- Conservation of energy and conservation of matter
- Kinetic and potential energy
- Conversions between different forms of energy, such as thermal, chemical, and electrical

- Chemical and physical properties/changes
- Phase transitions and the energy changes involved, such as heat needed to melt solid
- Relationships between volume, pressure, and temperature of gases
- Temperature scales, such as Celsius and Fahrenheit
- Conduction, convection, and radiation
- Applications of energy and matter relationships in life and Earth/space science

C. Understands types of bonding and composition and the formulas of simple compounds

- Covalent and ionic bonding
- Recognize names and formulas of simple compounds such as water, carbon dioxide, and sodium chloride

D. Understands the organization of the periodic table and can use it to predict trends in physical and chemical properties

- Symbols of the elements
- Arrangement of the elements on the table
- Atomic number and atomic mass
- Trends in physical and chemical properties of elements, such as metals and nonmetals, based on their position on the table

E. Understands basic concepts involved in chemical reactions

- Balancing equations of simple chemical reactions
- Energy consumed or produced in reactions (endothermic and exothermic reactions)
- Factors that affect reaction rates, such as concentration, temperature, pressure, and catalysts
- Types of basic reactions

F. Understands solutions and simple acid-base chemistry

- Dilute, concentrated, saturated, unsaturated, and supersaturated solutions
- Effect of temperature, pressure, particle size, and agitation on the rate of dissolving
- Effect of temperature, pressure, and solvent on solubility
- Chemical and physical properties of acids and bases
- pH scale
- Neutralization

G. Understands basic concepts in mechanics

- Describe motion in terms of speed, velocity, acceleration, and displacement
- Newton's laws of motion
- Gravitational attraction and acceleration due to gravity

- Distinction between mass and weight

- Work, power, and energy

- Motion and forces in applications, such as inclined planes and pendulums

- Simple machines, such as the wedge, screw, and lever

- Forces and physical properties involving fluids, including buoyancy

- Balanced and unbalanced forces, such as friction, inertia, and gravity

H. Understands basic concepts in electricity and magnetism

- Electrostatic attraction and repulsion

- Conductors and insulators

- Direct current (DC) and alternating current (AC)

- Current, resistance, power, and voltage

- Basic series and parallel circuits

- Voltage sources, such as batteries and generators

- Magnetic attractive and repulsive force and magnetic poles

- Magnetic materials and electromagnets

I. Understands concepts involving waves and optics

- Nature of light and the electromagnetic spectrum, including visible, ultraviolet, infrared, microwave, and gamma

- Wave properties, such as frequency, amplitude, wavelength, speed, and energy

- Wave phenomena, such as reflection, refraction, diffraction, and polarization

- Sound properties, such as pitch/frequency, loudness/intensity, and resonance

- Perceived change in pitch of sound coming from a moving object (Doppler effect)

- Mirrors, lenses, and prisms and their applications, such as the human eye, microscope, and telescope

Objective 3: Understands life science, including cells, genetics, evolution, organisms, and ecology

The beginning Special Education Science teacher:

A. Understands the basic structure and function of cells and their organelles

- Structure and function of cell membranes

- Structure and function of animal and plant cell organelles

- Levels of organization (cells, tissues, organs, organ systems)

- Major features of common animal cell types

- Prokaryotes and eukaryotes

- Cell cycle
- Mitosis, meiosis, cytokinesis

B. Understands the basic biochemistry of life

- Cellular respiration
- Photosynthesis
- Biological molecules, such as DNA, carbohydrates, proteins, lipids, and enzymes

C. Understands basic genetics

- Structure and function of DNA and RNA
- Chromosomes, genes, and alleles
- Dominant and recessive traits
- Mendelian inheritance, including genotype, phenotype, use of the Punnett square, and pedigrees

D. Understands the theory and key mechanisms of evolution

- Mechanisms of evolution and natural selection
- Isolation mechanisms and speciation
- Supporting evidence, including the fossil record, comparative anatomy, and homologous structures

E. Understands the elements of the hierarchical classification scheme

- Classification schemes (taxonomy)
- Characteristics of bacteria, animals, plants, fungi, and protists
- Viruses

F. Understands the major structures of plants and their functions

- Characteristics of vascular and nonvascular plants
- Structure and function of roots, leaves, and stems
- Asexual and sexual reproduction
- Growth
- Uptake and transport of nutrients and water
- Responses to stimuli and homeostasis

G. Understands the basic anatomy and physiology of animals, including the human body

- Response to stimuli and homeostasis
- Systems that exchange with the environment, including respiratory, excretory, and digestive systems
- Internal transport and exchange, including the circulatory system
- Control systems, such as the nervous system and the endocrine systems

- Movement and support, including the skeletal and muscular systems
- Reproduction and development
- Immune system

H. Understands population dynamics

- Growth curves and carrying capacity
- Intraspecific relationships, such as mating systems, social systems, and competition

I. Understands community ecology

- Niche and habitat
- Species diversity
- Interspecific relationships, such as predator-prey and parasitism

J. Understands community ecology

- Biomes
- Stability and disturbances, such as glaciation, climate change, and succession
- Energy flow, such as trophic levels and food webs
- Biogeochemical cycles, including water, nitrogen, and carbon cycles and biotic/abiotic interaction

Objective 4: Understands Earth and space science, including geology, the hydrosphere, the atmosphere, and astronomy

The beginning Special Education Science teacher:

A. Understands the types and basic characteristics of rocks and minerals and their formation processes

- The rock cycle
- Characteristics of sedimentary, igneous, and metamorphic rocks and their formation processes
- Characteristics of minerals

B. Understands the processes involved in erosion, weathering, and deposition of Earth's surface materials and soil formation

- Erosion and deposition
- Chemical and physical weathering
- Characteristics and formation of soil
- Runoff and infiltration

C. Understands Earth's basic structure and internal processes

- Earth's layers, such as the crust, mantle, and core
- Earth's shape and size

- Geographical features
- Earth's magnetic field
- Plate tectonics
- Earthquakes and volcanoes

D. Understands historical geology

- Principle of uniformitarianism
- Basic principles of relative age dating, including superposition and fossil succession
- Geologic time scale
- Fossil record as evidence of the origin and development of life, including fossilization methods, mass extinctions, ice ages, and meteor impacts

E. Understands the characteristics and processes of Earth's oceans and other bodies of water

- The water cycle
- Distribution and location of Earth's water
- Seawater composition
- Tides, waves, and currents
- Estuaries, barrier islands, islands, and reefs
- Polar ice, icebergs, and glaciers
- Lakes, ponds, and wetlands
- Streams, rivers, and river deltas
- Groundwater, water table, wells, aquifers, geysers, and springs

F. Understands the basic composition of Earth's atmosphere and basic concepts of weather

- Layers and composition of atmosphere
- Atmospheric pressure and temperature
- Humidity, dew, and frost
- Wind
- Cloud types and formation
- Rain, snow, sleet, and hail
- Fronts, storms, and severe weather, such as hurricanes and tornadoes
- Basic development and movement of weather patterns

G. Understands the major factors that affect climate and seasons

- Effects of latitude, geographical location, and elevation
- Effects of atmospheric circulation, such as the jet stream

- Characteristics and locations of climate zones, such as the Tropics and the Arctic
- Effect of the tilt of Earth's axis on seasons
- Effects of natural phenomena, such as volcanic eruptions and solar radiation variations

H. Understands the major features of the solar system

- Structure of the solar system
- The laws of motion and gravity
- Characteristics of the Sun, Moon, and planets
- Characteristics of asteroids, meteoroids, comets, and dwarf/minor planets
- Theories of origin of the solar system

I. Understands the interactions of the Earth-Moon-Sun system

- Effect on seasons
- Effect on tides
- Earth's rotation and orbital revolution around the Sun
- Phases of the Moon
- Solar and lunar eclipses
- Time zones

J. Understands major features of the universe

- Galaxies
- Characteristics of stars and their life cycles
- Theories about the origin of the universe
- Contributions of space exploration and technology to our understanding of the universe

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.

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. A school district bought $42,500 worth of computer equipment and agreed to pay $12,500 upon delivery and the remaining amount in equal monthly payments of $1,500 each. Which of the following calculations can be used to determine the total number of monthly payments required?

   A. $\dfrac{42,500 - 1,500}{12,500}$

   B. $\dfrac{42,500 - 12,500}{1,500}$

   C. $\dfrac{42,500}{1,500} - 12,500$

   D. $\dfrac{42,500}{12,500} - 1,500$

Answer and Rationale

2.
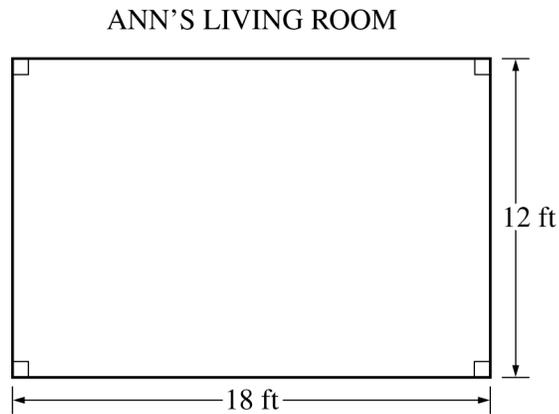
ANN'S LIVING ROOM

Ann plans to place a continuous wallpaper border on the walls of her living room, shown above. Each roll costs $6.47, and no partial rolls are sold. If each roll of border is 8 feet long, what is the minimum amount Ann can spend on rolls of border to complete her project?

A. $45.29
B. $51.76
C. $103.50
D. $174.69

Answer and Rationale

3.

> To make 36 five-inch pancakes, mix $4\frac{1}{2}$ cups of water with two pounds of pancake mix.

Last week Mark went shopping at the Food Warehouse and bought a large package of pancake mix, which contained the directions shown. If Mark wants to make 10 five-inch pancakes, how many cups of water should he use with the pancake mix?

A. $4\frac{1}{20}$

B. $1\frac{3}{4}$

C. $1\frac{1}{2}$

D. $1\frac{1}{4}$

Answer and Rationale

4. An electrician charges a flat fee of $42 per hour for work on weekdays and $63 per hour for work on Saturdays and Sundays. The electrician worked on a job for 6 hours last Friday, finished the job last Saturday, and charged a total of $504. How many hours did the electrician work on the job last Saturday?

A. 4
B. 6
C. 8
D. 12

Answer and Rationale

5.

$$-4x + 1 \geq 21$$

Which of the following options represents the solution set for the inequality shown?

A.

					●					
−10	−9	−8	−7	−6	−5	−4	−3	−2	−1	0

B.

					○					
−10	−9	−8	−7	−6	−5	−4	−3	−2	−1	0

C.

					●					
−10	−9	−8	−7	−6	−5	−4	−3	−2	−1	0

D.

|					○					
−10	−9	−8	−7	−6	−5	−4	−3	−2	−1	0
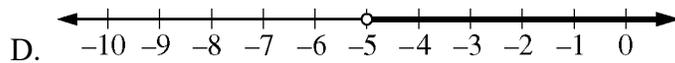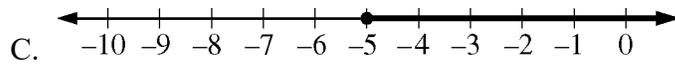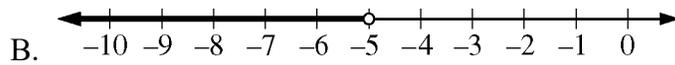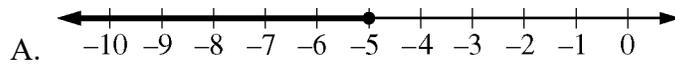
Answer and Rationale

6. What is the units digit of 3^{43} ?

A. 1
B. 3
C. 7
D. 9

Answer and Rationale

7. Which of the following graphs in the xy-plane represents the graph of a function?

A.
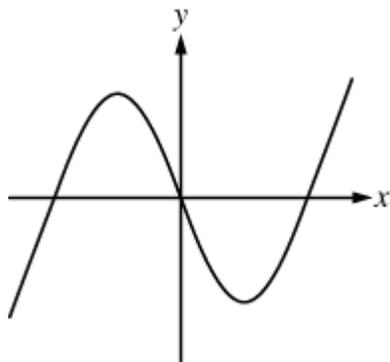
B.
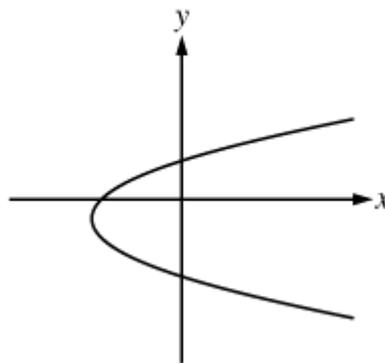
C.
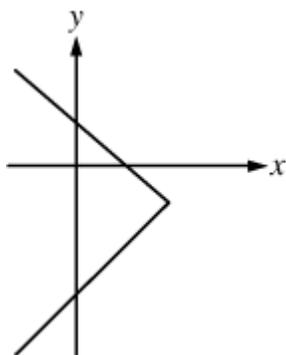
D.
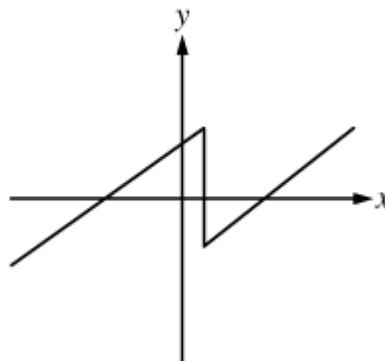
Answer and Rationale

8. What is the slope of a line that is perpendicular to the line with the equation $2x - 3y = 6$?

   A. $-\dfrac{3}{2}$

   B. $\dfrac{2}{3}$

   C. $\dfrac{3}{2}$

   D. 3

Answer and Rationale

9. A rectangular lawn is 40 feet wide and 65 feet long. If a bag of fertilizer covers 10,400 square feet, how many times can the lawn be completely fertilized using a single bag of fertilizer?

   A. 3
   B. 4
   C. 5
   D. 7

Answer and Rationale

10.
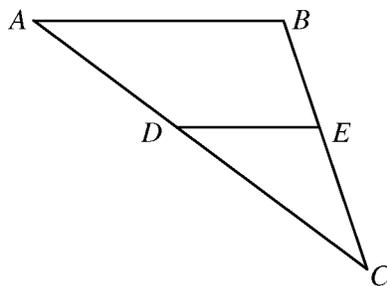
In the triangle ABC shown, $DC = 20$, $AB = 21$, $DE = 12$, and $\overline{AB}$ is parallel to $\overline{DE}$. What is the value of AC?

A. 29
B. 35
C. 41
D. 53

Answer and Rationale

11.
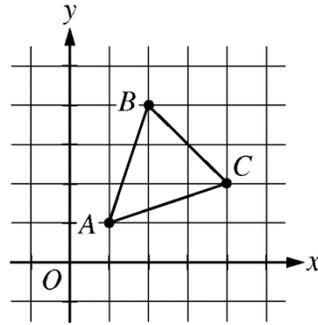
In the *xy*-plane, the triangle *ABC* is to be reflected about the *y*-axis to form triangle *A′B′C′*.

What will be the coordinates of *C′* ?

A. (−4, −2)
B. (−4, 2)
C. (−2, −4)
D. (−2, 4)

Answer and Rationale

12. Each of the integers in list *K* (not shown) is greater than 75. List *M* consists of the integers in list *K* and 4 additional integers that are each less than 75. Which of the following statements could be true?

Select <u>all</u> that apply.

A. The mean of the integers in list *M* is 75.
B. The median of the integers in list *M* is 75.
C. The mode of the integers in list *M* is 75.

Answer and Rationale

13.

Number of Hours Watched per Day	Number of People
$h < 1$	5
$1 \leq h < 2$	12
$2 \leq h < 3$	16
$3 \leq h < 4$	14
$h \geq 4$	3

In a survey, 50 people were asked how many hours per day (h) they watched television. The survey results are shown in the table. If a person is selected at random from those surveyed, what is the probability that the person selected will have watched at least 2 hours but less than 4 hours per day?

A. $\dfrac{3}{10}$

B. $\dfrac{8}{25}$

C. $\dfrac{1}{2}$

D. $\dfrac{3}{5}$

Answer and Rationale

14.

Time (days)	Average Height (cm) Treated Group	Average Height (cm) Untreated Group
1	3.0	2.5
3	3.6	3.0
4	4.7	3.9
5	5.6	4.6
7	6.2	5.0
9	6.9	5.4
10	7.4	5.8

A scientific experiment was conducted to determine the effect of a newly developed synthetic growth hormone, PGH, on pea seedlings. One group of seedlings was treated with PGH while another group of the same variety was left untreated. All environmental conditions were kept the same for both groups of seedlings. Data collected over 10 days are provided in the table above. Based on the results of the experiment, which of the following is the best conclusion about the effect of PGH?

A. PGH can be used to stimulate growth in many different agricultural crops
B. PGH is as effective as natural growth factors in pea plants
C. PGH can be used to increase the yield of peas per acre for this variety of peas
D. PGH stimulates growth in seedlings of this variety of peas

Answer and Rationale

15. Which of the following is an example of a renewable resource used for energy production?

    A. Uranium
    B. Petroleum
    C. Coal
    D. Solar energy

Answer and Rationale

16. When was the idea that matter is made up of tiny, indivisible particles (later called "atoms") first suggested?

    A. More than 2,000 years ago
    B. About 200 years ago
    C. About 100 years ago
    D. About 50 years ago

Answer and Rationale

17. Which of the following best describes a scientific hypothesis?

    A. It ensures that successful results will be obtained from an experiment.
    B. It must be accepted as true by the scientific community.
    C. It is a testable proposal that may lead to experimentation.
    D. It must be formulated by a renowned scientist.

Answer and Rationale

18. When a basic aqueous solution was mixed with an acidic aqueous solution, a neutral solution at 25°C resulted. Which of the following could be the pH of the resulting solution?

    A. 12
    B. 7
    C. 3
    D. 0

Answer and Rationale

19. If a feather and two stones of different weights were dropped simultaneously from a height of ten feet in a vacuum, which of the following would be observed?

   A. Both stones would hit the ground at the same time, but they would hit before the feather.
   B. The heavier stone would hit the ground first.
   C. The lighter stone would hit the ground first.
   D. All three objects would hit the ground at the same time.

Answer and Rationale

20. Two campers want to bake potatoes in a fire. They wrap two identical potatoes in aluminum foil. One camper, however, sticks a large nail through her potato. Which of the following is most likely to happen after the potatoes are placed in the fire?

   A. Both potatoes would cook at the same rate.
   B. Neither potato will cook because the foil will reflect the heat.
   C. The potato with the nail will cook faster because heat will be conducted into the potato.
   D. The potato with the nail will cook more slowly because heat will be conducted out of the potato.

Answer and Rationale

21. In which THREE of the following is the structural unit correctly matched with an organ in which it may be found?

   A. Neuron . . brain
   B. Nephron . . kidney
   C. Alveolus . . lung
   D. Cochlea . . heart

Answer and Rationale

22. Homeostasis in a living organism is regulated by feedback. This process is most similar to which of the following?

   A. An electric light switch
   B. An escalator between floors of a store
   C. The thermostat on a central heating system
   D. The gas pedal on an automobile

Answer and Rationale

23. Which of the following types of biological molecules is described as a double helix?

   A. Protein
   B. Fat
   C. Carbohydrate
   D. DNA

Answer and Rationale

24. Earth's solid outermost layer is called the

   A. mantle.
   B. outer core.
   C. magnetosphere.
   D. crust.

Answer and Rationale

25. Which of the diagrams below best depicts the Moon as viewed from Earth at the first quarter of the lunar cycle?

1   2   3   4
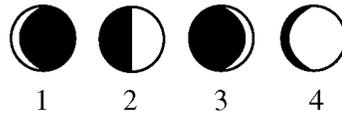
A. 1
B. 2
C. 3
D. 4

Answer and Rationale

26. Shooting stars that appear in the night sky are most likely to be

A. particles of exploding stars.
B. comets passing near Earth.
C. meteors passing into Earth's atmosphere.
D. northern or southern lights caused by magnetic storms on the Sun.

Answer and Rationale

Answer Key and Rationales

Question Number	Correct Answer	Rationale
1	B	**Option B is correct.** The school district bought $42,500 worth of computer equipment and agreed to pay $12,500 upon delivery, so the remaining amount to be paid is $42,500-12,500$. Since the school district agreed to pay $1,500 per month, the total number of monthly payments required is $\dfrac{42,500-12,500}{1,500}$. *Back to Question*
2	B	**Option B is correct.** The minimum length of wallpaper border needed to decorate the room is equal to the perimeter of Ann's living room. The perimeter is the sum of the lengths of the four walls of the room, or $18 + 18 + 12 + 12 = 60$ feet. The number of rolls of border needed is determined by dividing the perimeter by the length of each roll of border, and $\dfrac{60 \text{ feet}}{8 \text{ feet}} = 7.5$. Therefore, Ann needs a minimum of 7.5 rolls, and since no partial rolls are sold, she must buy 8 rolls. The cost of 8 rolls of the border is found by multiplying the cost of each roll, $6.47, by the number of rolls needed, so the final answer is $6.47 x 8 = $51.76. *Back to Question*

Question Number	Correct Answer	Rationale
3	D	**Option D is correct.** According to the recipe, the ratio of the number of five-inch pancakes to the required number of cups of water is $\dfrac{36}{4\frac{1}{2}}$, which simplifies to $\dfrac{36}{\frac{9}{2}} = \dfrac{72}{9} = \dfrac{8}{1}$. Since Mark is using the same recipe to make 10 five-inch pancakes, it is possible to set up the proportion $\dfrac{8 \text{ pancakes}}{1 \text{ cup of water}} = \dfrac{10 \text{ pancakes}}{x \text{ cups of water}}$. Cross multiplying gives $8x = 10$ or $x = \dfrac{10}{8} = \dfrac{5}{4} = 1\frac{1}{4}$. Mark should use $1\frac{1}{4}$ cups of water to make the 10 pancakes. ***Back to Question***

Question Number	Correct Answer	Rationale
4	A	**Option A is correct.** To find the number of hours that the electrician worked on the job last Saturday, first multiply the number of hours the electrician worked on the job on Friday, 6, by the hourly rate charged for work on Friday, $42, to find the amount the electrician charged for work on the job last Friday, $252. Then subtract this amount from the total amount the electrician charged, $504, to find the amount the electrician charged for work on the job last Saturday, $252. Finally, divide this amount by the hourly rate charged for work on Saturday, $63, to find the number of hours that the electrician worked on the job last Saturday, 4. *Back to Question*
5	A	**Option A is correct.** To determine which option represents the solution set for the inequality, subtract 1 from each side of the inequality and then divide each side of the inequality by −4. Remember that when multiplying or dividing both sides of an inequality by a negative number, the direction of the inequality symbol needs to be reversed. Thus, the equivalent inequality is $x \leq -5$. The option that represents the set of all real numbers less than or equal to −5 is option A. *Back to Question*

Question Number	Correct Answer	Rationale
6	C	**Option C is correct.** In order to solve this problem, the sequence of powers 3^n in relation to the exponent n needs to be examined.

n	3^n	Units Digit
0	1	1
1	3	3
2	9	9
3	27	7
4	81	1
5	243	3
6	729	9
7	2,187	7
8	6,561	1

Note that the units digit of 3^4 is 1, which is equal to the units digit of 3^0, and then the sequence of units digits repeats itself in sets of four, with the following pattern (where k is some positive integer):

• If n is of the form $n = 4k$, the units digit of 3^n is 1.

• If n is of the form $n = 4k + 1$, the units digit of 3^n is 3.

• If n is of the form $n = 4k + 2$, the units digit of 3^n is 9.

• If n is of the form $n = 4k + 3$, the units digit of 3^n is 7.

In the problem, the value of the exponent is 43, and since $43 = 4 \times 10 + 3$, the units digit of 3^{43} is the same as the unit digits of 3^3, which is 7.

Back to Question

Question Number	Correct Answer	Rationale
7	A	**Option A is correct.** The vertical line test can be used to see whether a graph in the *xy*-plane represents the graph of a function. The test consists of taking a vertical line and moving it across the graph in the *xy*-plane. If the vertical line touches the graph at only one point across the entire graph, then that graph is the graph of a function. As you move left to right over the graph in option A, a vertical line would only contact the graph at a single point across the entire graph, thus it is the graph of a function. As you move left to right over the graph in option B, a vertical line would touch at two points over most of the graph, hence it is not a function. Option C is not a function for the same reason that option B is not a function. Option D is not a function because of the vertical part of the graph to the right of the *y*-axis. ***Back to Question***

Question Number	Correct Answer	Rationale
8	A	**Option A is correct**. The slope of the given equation can be found by solving the equation for y, which gives the equation $y = \frac{2}{3}x - 2$. This equation is in slope-intercept form, so it can be determined that the slope is $\frac{2}{3}$ and the y-intercept is -2. A perpendicular line will have a slope that is the negative reciprocal of $\frac{2}{3}$, which is $-\frac{3}{2}$. since Thus, the slope of the line perpendicular to the given line is $-\frac{3}{2}$, since $\left(\frac{2}{3}\right)\left(-\frac{3}{2}\right) = -1$. *Back to Question*
9	B	**Option B is correct.** The area of the lawn is $(40)(65) = 2{,}600$ square feet. The number of times the lawn can be completely fertilized using a single bag of fertilizer is $\frac{10{,}400}{2{,}600} = 4$ times. *Back to Question*

Question Number	Correct Answer	Rationale
10	B	**Option B is correct.** Since $\overline{AB}$ is parallel to $\overline{DE}$, triangle *ABC* is similar to triangle *DEC*, which means the ratios of the lengths of corresponding sides of the two triangles are equal. Since the lengths of $\overline{DC}$, $\overline{AB}$, and $\overline{DE}$ are given, the proportion $\dfrac{AC}{DC} = \dfrac{AB}{DE}$ can be used to find the value of *AC*. Substituting into the proportion gives $\dfrac{AC}{20} = \dfrac{21}{12}$. Therefore, $12 \cdot AC = 20 \cdot 21 \Rightarrow 12 \cdot AC = 420 \Rightarrow AC = 35$. ***Back to Question***
11	B	**Option B is correct.** The coordinates of point *C* are $(4,2)$. When a point is reflected over the *y*-axis, the *x*-coordinate of the point changes to its opposite, but the *y*-coordinate remains the same, so $(4,2)$ is transformed to $(-4,2)$, which means the coordinates of *C′* are $(-4,2)$. ***Back to Question***

Question Number	Correct Answer	Rationale
12	A, B	**Options A and B are correct.** If list K consists of the integers 76, 77, 78, and 79, and list M consists of the integers 71, 72, 73, 74, 76, 77, 78, and 79, then the mean of the integers in list M is 75. Since an example where the mean of the integers in list M is 75 can be created, the statement in option A could be true. In addition, the median of the integers in list M is also 75 in this example, which means that the statement in option B could be true. However, because all of the integers in list M are either greater than 75 or less than 75, 75 cannot be the mode of those integers, so the statement in option C cannot be true. ***Back to Question***
13	D	**Option D is correct.** Based on the data in the table, a total of $16 + 14 = 30$ people surveyed watched at least 2 hours of television but less than 4 hours of television per day. If a person is selected at random from those surveyed, the probability that the person selected will have watched at least 2 hours but less than 4 hours per day is $\dfrac{30}{50} = \dfrac{3}{5}$. ***Back to Question***

Question Number	Correct Answer	Rationale
14	D	**Option D is correct.** The data show that for the particular variety of peas used in the experiment, seedlings treated with PGH were taller than the control group of seedlings each day that a measurement was made. The results do not suggest a mechanism by which PGH is stimulating growth. In addition, no other factors or types of plants were tested. *Back to Question*
15	D	**Option D is correct.** Solar energy is a renewable resource because it is replenished regularly by the Sun. *Back to Question*
16	A	**Option A is correct.** The concept of atoms was discussed by philosophers in Greece and India more than 2,000 years ago. *Back to Question*

Question Number	Correct Answer	Rationale
17	C	**Option C is correct.** A hypothesis is a best guess or a possible explanation of a scientific problem. Scientific experimentation can either support or fail to support the hypothesis. *Back to Question*
18	B	**Option B is correct.** An aqueous neutral solution at 25°C has a pH of 7. Acidic solutions have a pH less than 7, and basic solutions have a pH greater than 7. *Back to Question*
19	D	**Option D is correct.** In a vacuum, the only external force acting on each of the objects would be the gravitational force of Earth. This gravitational force is equal to $M \times g$, where M is the object's mass and g is the constant acceleration of gravity (9.8 meters per second squared). According to Newton's second law, the acceleration, a, of an object times its mass is equal to the external force acting on it. For this situation, Newton's second law gives $M \times a = M \times g$, or $a = g$. Thus, in a vacuum all objects fall freely with the same constant acceleration g, regardless of their mass. *Back to Question*

Question Number	Correct Answer	Rationale
20	C	**Option C is correct.** Although the aluminum foil will reflect radiant energy, it will not significantly reduce the flow of energy by conduction. Because a nail is a good thermal conductor, heat will flow through the nail and cook the potato from the inside as well as from the outside. Thus, the potato with the embedded nail will cook faster. *Back to Question*
21	A, B, C	**Options A, B, and C are correct.** A neuron is a specialized cell that processes and transmits electrical and chemical signals, and neurons are found in the nervous system which includes the brain. A nephron is the basic structural and functional unit of the kidney. An alveolus is a structure in the lungs that is a site of gas exchange with the blood. *Back to Question*

Question Number	Correct Answer	Rationale
22	C	**Option C is correct.** Homeostasis refers to any process that living things use to actively maintain fairly stable conditions necessary for survival. For example, the human body maintains levels of temperature and other vital conditions that are within an acceptable range. Internal conditions are monitored, and based on feedback received, adjustments are made to conditions to keep them within an acceptable range. This is very much like the manner in which a thermostat works. Air temperature is monitored by the thermostat and when the air temperature drops below a preset level, the thermostat signals the heater to turn on. When the air temperature returns to the preset level, the thermostat signals the heater to turn off. In this way a fairly stable level of air temperature is maintained. ***Back to Question***
23	D	**Option D is correct.** A DNA molecule consists of two strands that wind around each other, which is described as a double helix. ***Back to Question***

Question Number	Correct Answer	Rationale
24	D	**Option D is correct.** The crust is the outermost layer of Earth and the mantle and outer core are located below the crust. The magnetosphere is a region of space surrounding Earth, where the magnetic field of Earth is dominant. *Back to Question*
25	B	**Option B is correct.** At the first lunar quarter, the Sun, Earth, and Moon form a right triangle, with Earth at the right angle, so that the half of the moon facing Earth appears half lighted and half dark. *Back to Question*
26	C	**Option C is correct.** Shooting stars are meteors that have entered Earth's atmosphere where frictional heating has caused them to glow. *Back to Question*

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.

Calculator Use

An on-screen calculator is part of the testing software for this assessment.
A free tutorial is available so you can practice using the calculator prior to taking the assessment. Access the tutorial in Test Preparation section of the GACE website at *www.gace.ets.org/prepare/tutorials/calculator*.

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

American Biology Teacher, National Association of Biology Teachers

American Scientist, Sigma XI, the Scientific Research Society

ChemMatters, American Chemical Society

Geology Today, Geologist's Association

Mathematics Teacher, National Council of Teachers of Mathematics

Natural History, American Museum of Natural History

Nature, The Nature Publishing Group

Sky and Telescope, Sky Publishing

The Earth Scientist, National Earth Science Teacher's Association

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The Science Teacher, National Science Teachers Association

Other Resources

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Online Resources

American Association for the Advancement of Science — ***www.aaas.org***

American Association of Physics Teachers — ***www.aapt.org***

American Astronomical Society — ***www.aas.org***

American Chemical Society — ***www.acs.org***

American Institute of Biological Sciences — ***www.aibs.org***

American Physical Society — ***www.aps.org***

Assistive Technology: Strategies, Tools, Accommodations and Resources — ***www.atstar.org***

Burnett, Jane. "Critical Behaviors and Strategies for Teaching Culturally Diverse Students" — *www.eric.ed.gov/PDFS/ED435147.pdf*

Council for Exceptional Children. "Ethical Principles & Practice Standards" — *www.cec.sped.org/Content/NavigationMenu/ProfessionalDevelopment/ ProfessionalStandards/EthicsPracticeStandards/default.htm*

Georgia Department of Education — *www.doe.k12.ga.us*

National Association of Biology Teachers — *www.nabt.org*

National Association of Geoscience Teachers — *www.nagt.org*

National Dissemination Center for Children with Disabilities. *Transition Planning: A Team Effort* — *nichcy.org/wp-content/uploads/docs/ts10.pdf*

National Dissemination Center for Children with Disabilities. *Transition Services in the IEP* — *http://nichcy.org/schoolage/transitionadult/*

National Science Teachers Association — *www.nsta.org*

National Council of Teachers of Mathematics — *www.nctm.org*

The Geological Society of America — *www.geosociety.org*