GACE
Georgia Assessments for the Certification of Educators®

GACE® Study Companion

Science Assessment

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About the Assessment

Assessment Name	Science
Grade Level	6–12
Test Code	Test I: 024 Test II: 025 Combined Test I and Test II: 524
Testing Time	Test I: 2 hours and 10 minutes Test II: 2 hours and 10 minutes Combined Test I and Test II: 4 hours and 20 minutes
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: 80 Test II: 80 Combined Test I and Test II: 160
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 Science assessment is designed to measure the professional knowledge of prospective teachers of secondary school Science 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.

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

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.

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

Test I Subareas

Subarea	Approx. Percentage of Test
I. Scientific Inquiry, Processes, Technology, and Society	30%
II. Physical Science	70%

Test I Objectives

Subarea I: Scientific Inquiry, Processes, Technology, and Society

Objective 1: Understands the nature of scientific inquiry and processes, including the collection and analysis of data

The beginning Science teacher:

A. Understands methods of scientific inquiry and design
- Identifying problems based on observations
- Forming and testing hypotheses
- Development of 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
- Consistent with evidence
- Based on reproducible evidence
- Unifying concepts and processes, such as systems, models, constancy and change, equilibrium, form and function
- Peer review

C. Understands the major historical developments of science
- Accepted principles and models develop over time
- Major developments in science, such as atomic theory and plate tectonics
- Contributions of major historical figures such as Darwin and Newton

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D. Understands the processes involved in scientific data collection and manipulation
   - Common units of measurement (metric and English), including unit conversion and prefixes such as milli- and kilo-
   - Laboratory notebook practices
   - Scientific notation and significant figures in collected data
   - Organization, presentation, and communication of data, using appropriate tools
   - Basic data and error analysis, including determining mean, accuracy, precision, and sources of error

E. Understands how to interpret and draw conclusions from data presented in tables, graphs, maps, and charts
   - Trends in data
   - Relationships between variables
   - Predictions based on data
   - Drawing valid conclusions based on data

F. Understands the procedures for correct preparation, storage, use, and disposal of laboratory materials
   - Appropriate and safe use of materials, such as chemicals and lab specimens
   - Safe disposal of materials
   - Appropriate storage
   - Preparations for classroom or field use of materials, such as preparing solutions and staining slides

G. Understands how to use standard equipment in the laboratory and the field
   - Appropriate and safe use of equipment such as Bunsen burner, glassware, and microscopes
   - Appropriate storage of equipment such as pH probes and dissection equipment
   - Maintenance and calibration of equipment such as microscopes and balances
   - Preparation for classroom or field use, such as prelaboratory setup, classroom demonstrations, and field research

H. Understands safety and emergency procedures in the laboratory
   - Location and 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

Objective 2: Understands the relationship of science and technology to society and the environment

The beginning Science teacher:

A. 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

B. 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)

C. Understands applications of science and technology in daily life
   - Chemical properties of household products
   - Communication (e.g., wireless devices, GPS, satellites)
   - Science principles applied in commonly used consumer products such as batteries, lasers, polarized sunglasses, and fiber optic cables
   - Water purification
   - Common agricultural practices, such as the use of insecticides, herbicides, and genetically modified crops
   - DNA evidence in criminal investigations

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

D. Understands the impact of science on public health issues
   - Nutrition, disease, and medicine
   - Biotechnology, such as genetic engineering
   - Medical technologies, such as medical imaging, X rays, and radiation therapy

Subarea II: Physical Science

Objective 1: Understands the organization of matter, the atomic model, and relationships involving energy and matter

The beginning Science teacher:

A. Understands the organization of matter
   - Elements, compounds, and mixtures
   - Molecules, atoms, ions, and subatomic particles
   - Basic properties of solids, liquids, and gases

B. Understands the basic structure of the atom
   - Atomic models
   - Atomic structure, including nucleus, electrons, protons, and neutrons
   - Atomic number, atomic mass, and isotopes
   - Electron arrangements
   - Radioactive decay processes and half-life
   - Fission and fusion

C. Understands basic concepts and relationships involving energy and matter
   - Conservation of energy
   - Conservation of matter in chemical systems
   - Kinetic and potential energy
   - Conversions between different forms of energy, such as thermal, chemical, electrical, and mechanical
   - Chemical and physical properties/changes
   - Temperature scales, such as Celsius, Fahrenheit, and Kelvin
   - Conduction, convection, and radiation

D. Understands the states of matter and factors that affect phase changes
    - Basic assumptions of the kinetic theory of matter, such as the particles are in constant motion and the average speed of gas particles is related to temperature
    - Ideal gas laws
    - Phase transitions and the energy changes involved, such as heat of vaporization and heat of sublimation

E. Understands applications of energy and matter relationships
    - Matter cycling (carbon, nitrogen, water)
    - Energy flow in ecosystems
    - Convection currents in the atmosphere, ocean, and mantle
    - Conservation of mass in the rock cycle
    - Chemical and physical changes in rocks
    - Impact of solar radiation on Earth and life
    - Energy transformations in living systems, such as photosynthesis and cellular respiration

Objective 2: Understands chemistry, including periodic table, compounds, formulas, bonding, reactions, and solutions

The beginning Science teacher:

A. Understands how to name simple compounds and write their chemical formulas
    - Interpreting chemical formulas
    - Naming compounds based on formula
    - Writing formulas based on name
    - Structural formulas, such as electron dot and Lewis structures

B. Understands types of chemical interactions
    - Covalent bonding
    - Ionic bonding
    - Metallic bonding
    - Intermolecular forces such as hydrogen bonding

C. Understands the mole concept and its applications
    - Avogadro's number
    - Molar mass
    - Percent composition

D. Understands the organization of the periodic table and can use it to predict trends in physical and chemical properties
   - Elements arranged in groups and periods
   - Atomic number, atomic mass, and isotopic abundance
   - Symbols of the elements
   - Trends in physical properties based on position of elements on the periodic table
   - Trends in chemical reactivity based on position of elements on the periodic table

E. Understands basic concepts involved in chemical reactions
   - Balancing equations of simple chemical reactions
   - Simple stoichiometric calculations based on balanced equations
   - Endothermic and exothermic reactions
   - Factors that affect reaction rates, such as concentration, temperature, pressure, catalysts/enzymes, and activation energy
   - Factors that affect reaction equilibrium, including Le Chatelier's principle
   - Types of reactions, such as combustion, single or double replacement, decomposition, synthesis, and oxidation/reduction

F. Understands simple acid-base chemistry
   - Properties of acids and bases
   - pH scale
   - Neutralization
   - Acid-base indicators, such as phenolphthalein, pH paper, and litmus paper

G. Understands different types of solutions
   - Dilute and concentrated
   - Saturated, unsaturated, and supersaturated
   - Solvent and solute
   - Concentration terms such as molarity
   - Preparation of solutions of varying concentrations

H. Understands factors affecting the solubility of solids, liquids, and gases and the dissolving process

- Effect of temperature, pressure, particle size, and agitation on the rate of dissolving
- Effect of temperature and pressure on solubility, including solubility curves
- Polar versus nonpolar solvents and solutes
- Dissociation of ionic compounds such as salts in water (e.g., ionization, electrolytes)
- Precipitation
- Freezing point depression
- Osmotic pressure

Objective 3: Understands physics, including mechanics, electricity and magnetism, and wave properties

The beginning Science teacher:

A. Understands how to describe motion in one and two dimensions

- Speed and velocity
- Acceleration
- Displacement
- Linear momentum
- Vector and scalar quantities

B. Understands Newton's three laws of motion

- First law: inertia
- Second law: F = ma
- Third law: action-reaction forces

C. Understands the concepts of mass, weight, and gravity

- Distinction between mass and weight
- Gravitational attraction
- Acceleration due to gravity

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

D. Understands how to analyze motion and forces
   - Friction
   - Collisions and conservation of linear momentum
   - Circular motion
   - Center of mass
   - Conservation of energy
   - Work, energy, and power
   - Projectile motion
   - Inclined planes
   - Periodic motion, including pendulums, oscillating springs, planetary orbits, and satellites
   - Basic fluid mechanics, including buoyancy, density, and pressure

E. Understands simple machines
   - Mechanical advantage
   - Types of simple machines, such as the wedge, screw, and lever
   - Concept of torque

F. Understands the electrical nature of common materials
   - Electric charges
   - Electrostatic force (attraction and repulsion, Coulomb's law)
   - Conductivity, conductors, and insulators

G. Understands basic electrical concepts
   - Direct current (DC) and alternating current (AC)
   - Current, resistance, voltage, and power
   - Ohm's law (V = IR)
   - Basic series and parallel circuits
   - Voltage sources, such as batteries and generators

H. Understands the basic properties of magnetic fields and forces
   - Magnetic materials
   - Magnetic forces and fields, including magnetic poles, attractive and repulsive forces
   - Electromagnets

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

I. Understands the electromagnetic spectrum
   - Nature of light, including wave properties and photons
   - Visible spectrum and color
   - Electromagnetic spectrum, such as visible, ultraviolet, infrared, microwave, and gamma

J. Understands the basic characteristics and types of waves
   - Transverse and longitudinal
   - Frequency, amplitude, wavelength, speed, and energy

K. Understands basic wave phenomena
   - Reflection, refraction, diffraction, and dispersion
   - Absorption and transmission
   - Interference, scattering, and polarization
   - Total internal reflection
   - Doppler effect

L. Understands basic optics
   - Mirrors
   - Lenses and their applications, such as the human eye, microscope, and telescope
   - Prisms

M. Understands the basic characteristics and phenomena of sound
   - Pitch/frequency and loudness/intensity
   - Sound wave production, air vibrations, and resonance
   - Application of the Doppler effect to sound

Test II Subareas

Subarea	Approx. Percentage of Test
I. Life Science	60%
II. Earth and Space Science	40%

Test II Objectives

Subarea I: Life Science

Objective 1: Understands the structure of cells and basic cellular processes, including genetics

The beginning 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 and scale (molecules, cells, tissues, organs, organ systems)
- Major features of common animal cell types
- Prokaryotes and eukaryotes

B. Understands key aspects of cell reproduction and division
- Cell cycle
- Mitosis
- Meiosis
- Cytokinesis

C. Understands the basic biochemistry of life
- Cellular respiration (aerobic and anaerobic)
- Photosynthesis
- Structure and function of biological molecules, such as DNA, carbohydrates, proteins, lipids, and enzymes

D. 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 Punnett squares, and pedigrees

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

- Mutations, chromosomal abnormalities, and common genetic disorders

Objective 2: Understands mechanisms of evolution, characteristics of organisms, and principles of ecology

The beginning Science teacher:

A. Understands the theory and key mechanisms of evolution
   - Mechanisms of evolution
   - Isolation mechanisms and speciation
   - Supporting evidence, including the fossil record, comparative genetics, and homologous structures

B. Understands the elements of the hierarchical classification scheme
   - Classification schemes
   - Characteristics of bacteria, animals, plants, fungi, and protists
   - Characteristics of viruses

C. 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
   - Uptake and transport of nutrients and water
   - Tropisms: responses to stimuli

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

E. Understands population dynamics
   - Growth curves and carrying capacity
   - Behavior, such as territoriality
   - Intraspecific relationships, such as mating systems, social systems, and competition

F. Understands community ecology
   - Niche
   - Species diversity
   - Interspecific relationships, such as predator-prey and parasitism

G. Understands ecosystems
   - 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

Subarea II: Earth and Space Science

Objective 1: Understands geology, including Earth's structure, rocks, minerals, plate tectonics, and historical geology

The beginning 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 and their formation processes

B. Understands the processes involved in erosion, weathering, and sedimentation of Earth’s surface materials
   - Erosion and sedimentation
   - Chemical and physical weathering
   - Characteristics of soil
   - Porosity and permeability

C. Understands Earth’s basic structure and internal processes
   - Earth's layers, such as the crust, mantle, and core
   - Shape and size of Earth
   - Geographical features
   - Earth’s magnetic field

D. Understands plate tectonic theory
   - Folding and faulting

- Processes at plate boundaries, such as seafloor spreading
- Basic characteristics of various types of volcanoes
- Basic characteristics of earthquakes, including seismic waves and triangulation

E. Understands historical geology

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

Objective 2: Understands the hydrosphere and atmosphere, including water cycle, bodies of water, weather, and climate

The beginning Science teacher:

A. Understands the water cycle

- Evaporation and condensation
- Precipitation
- Runoff and infiltration
- Transpiration
- Properties of water that affect Earth systems such as density, changes on freezing, high heat capacity, and solvent properties

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

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

C. Understands the basic structure and composition of Earth's atmosphere
   - Layers
   - Composition of atmosphere
   - Atmospheric pressure and temperature

D. Understands basic concepts of weather development
   - Relative humidity
   - Dew point
   - Wind
   - Cloud types and formation
   - Types of precipitation
   - Air masses, fronts, storms, and severe weather, such as hurricanes and tornadoes
   - Development and movement of weather patterns

E. Understands the major factors that affect climate and seasons
   - Effects of latitude, geographical location, and elevation
   - Effects of atmospheric circulation, such as trade winds and jet streams
   - Effects of ocean circulation
   - 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
   - El Niño, La Niña, and monsoons

Objective 3: Understands astronomy, including solar system, stars, and other features of the universe

The beginning Science teacher:

A. Understands the major features of the solar system
   - Structure of the solar system
   - Effects of motion and gravity
   - Characteristics of the Sun, Moon, and planets
   - Characteristics of asteroids, meteoroids, comets, and dwarf/minor planets
   - Theories of the origin of the solar system

B. Understands the interactions of the Earth-Moon-Sun system
   - Effect on seasons

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

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

C. Understands major features of the universe

- Galaxies
- Characteristics of stars and their life cycles
- Dark matter
- Theories of the origin of the universe
- Technology and measurement techniques used to investigate the universe, such as telescopes, spectroscopes, and probes

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.

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

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. In an experiment to determine if a new gasoline additive will decrease the amount of pollutants generated by automobile engines, 1 g of the additive is added to each liter of regular gasoline, and the amount of pollutants that are produced by the car engine is measured. Which of the following additional steps is most appropriate for determining the effectiveness of the additive?

   A. Run the experiment again under identical conditions
   B. Add 2 g of additive to each liter of gasoline, and measure the amount of pollutants produced by the same engine
   C. Add 1 g of additive to each liter of premium gasoline, and measure the amount of pollutants produced by the same engine
   D. Use the regular gasoline without the additive in the same engine, and measure the amount of pollutants produced

Answer and Rationale

2. Four students measured the width of a desk every day for three days. Their measurements in centimeters are shown in the chart below.

Student	Day 1	Day 2	Day 3
1	90.40	92.40	94.40
2	91.3	91.5	91.4
3	92.2	92.1	92.2
4	90.5	91.4	92.3

   If the actual width of the desk is 91.4 cm, which of the following statements is true?

   A. Student 1's measurements are most precise.
   B. Student 2's measurements are most accurate and most precise.
   C. Student 3's measurements are most accurate.
   D. Student 4's measurements are most precise.

Answer and Rationale

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

3. Which of the following poses the greatest safety risk while being heated in a school laboratory?

   A. A mixture of iron and copper
   B. Mercury(II) oxide
   C. Sodium chloride
   D. Calcium carbonate

Answer and Rationale

4. Which of the following is most likely to cause a rise in the average temperature of Earth's atmosphere in the future?

   A. Atomic warfare
   B. CO_2 from fossil fuels
   C. Dust clouds from volcanoes
   D. Depletion of Earth's ozone layer

Answer and Rationale

5. A neutral atom of $^{197}_{79}Au$ has which of the following?

   A. 197 neutrons
   B. 79 neutrons
   C. 118 protons
   D. 79 electrons

Answer and Rationale

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

6. When a 20 g piece of iron with a temperature of 300°C is immersed in a pot containing 500 g of boiling water at 100°C, what will happen to the temperature of the water and of the iron?

   A. The water temperature will increase, and the temperature of the iron will not change.
   B. The water temperature will increase, and the temperature of the iron will decrease.
   C. The water temperature will remain the same, and the temperature of the iron will decrease.
   D. The temperature of both the water and the iron will remain the same.

Answer and Rationale

7. Which of the following is the formula of tin(IV) chloride?

   A. Ti_4Cl
   B. $TiCl_4$
   C. Sn_4Cl
   D. $SnCl_4$

Answer and Rationale

8. Which of the following is true of the elements in order from top to bottom of the first column of the periodic table?

   A. They increase in electronegativity.
   B. They decrease in atomic mass.
   C. They increase in ionization.
   D. They increase in atomic radius.

Answer and Rationale

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

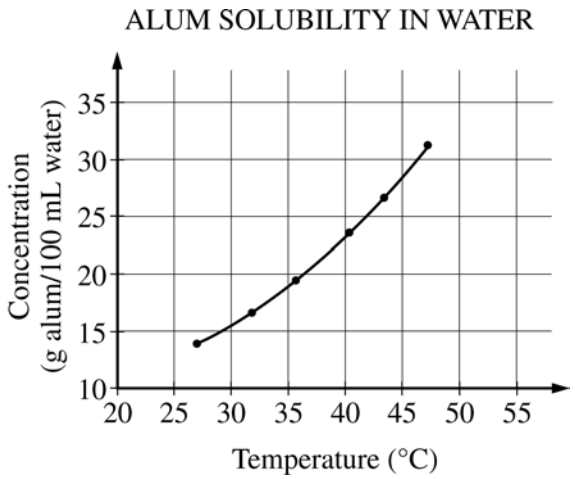
9. When the equation given below is balanced using the smallest whole-number coefficients possible, the coefficient for CO_2 is

$$C_4H_{10}(g) + O_2(g) \rightarrow CO_2(g) + H_2O(g)$$

A. 1
B. 5
C. 8
D. 13

Answer and Rationale

10. A solution contains 20 g of dissolved alum in 100 mL of water at 30°C.



On the basis of the solubility data above, this solution is

A. polyunsaturated.
B. unsaturated.
C. saturated.
D. supersaturated.

Answer and Rationale

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

11. In a tug-of-war, one teams pulls in one direction with a force of 800 newtons (N), and the other team pulls in the opposite direction with a force of 600 N. The magnitude of the resultant force is

    A. 1,400 N
    B. 800 N
    C. 600 N
    D. 200 N

Answer and Rationale

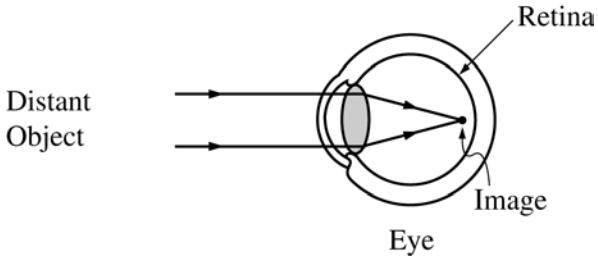
12. A circuit consists of two identical resistors connected in parallel to a 12 V battery. The current drawn from the battery is 2.4 A. What is the resistance of each resistor?

    A. 0.50 Ω
    B. 2.5 Ω
    C. 5.0 Ω
    D. 10 Ω

Answer and Rationale

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

13. In the condition known as nearsightedness, the image of a distant object focuses in front of the retina of the eye, as shown in the diagram below.



Which of the following lenses could be used to correct nearsightedness?

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.

14. Which of the following best describes the difference between fungal cells and animal cells?

    A. Fungal cells have mitochondria, while animal cells do not.
    B. Fungal cells are diploid, while animal cells are haploid.
    C. Fungal cells have a cell wall, while animal cells do not.
    D. Fungal cells are heterotrophic, while animal cells are autotrophic.

Answer and Rationale

15. At which stage of meiosis do homologous chromosomes segregate during the formation of gametes?

    A. Anaphase I
    B. Metaphase II
    C. Telophase II
    D. Prophase I

Answer and Rationale

16. In guinea pigs, black or chocolate fur color is determined by a pair of gene alleles, *B* for dominant black and *b* for recessive chocolate. According to Mendelian principles of inheritance, if a male guinea pig heterozygous for black fur (*Bb*) is mated to a female that is also heterozygous black, the percent of offspring that are expected to have chocolate fur is

    A. 0%
    B. 25%
    C. 50%
    D. 75%

Answer and Rationale

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

17. Scientists believe that a worldwide catastrophic event occurred during the late Cretaceous period and that the event likely caused which of the following?

    A. The movement of aquatic animals onto land
    B. The sudden demise of the dinosaurs
    C. The emergence of *Homo sapiens* on the grasslands of Africa
    D. The first appearance of mammals

Answer and Rationale

18. Which of the following is matched with its correct function?

    A. Ovule .. production of pollen
    B. Vascular cambium .. formation of apical meristem
    C. Xylem .. transport of sugars
    D. Guard cell .. regulation of transpiration rate

Answer and Rationale

19. In an organism with a complete digestive tract, which of the following processes predominates at the anterior end of the tract?

    A. Hydrolysis of proteins
    B. Mechanical digestion
    C. Absorption of nutrients
    D. Absorption of H_2O

Answer and Rationale

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

20. If each of the following meals provides the same number of calories, which meal requires the most land for its production?

    A. Red beans and rice
    B. Steak and a baked potato
    C. Corn tortilla and refried beans
    D. Lentil soup and brown bread

Answer and Rationale

21. Which of the following statements is correct about a trophic structure in which a leaf-eating grasshopper is eaten by a frog, which in turn is eaten by a snake?

    A. The frog is an herbivore.
    B. The snake is a secondary consumer.
    C. The grasshopper is a primary consumer.
    D. The snakes outnumber the grasshoppers in the community.

Answer and Rationale

22. The accumulation of stress along the boundaries of lithospheric plates leads to which of the following?

    A. Earthquakes
    B. Magnetic reversals
    C. Hurricanes
    D. Increased deposition of deep-sea sediments

Answer and Rationale

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

23. Of the following, the best method to use to determine Earth's age is to study the

    A. rate of increase in saline content of the oceans.
    B. ratio of uranium or thorium content to lead content in granite rock.
    C. percentage of radioactive carbon-14 in organic remains.
    D. rate of sedimentation characteristic of alluvial deposits.

Answer and Rationale

24. When cool air flows from a high mountain region to a region of lower elevation, the air will

    A. increase in moisture content.
    B. condense, forming large amounts of dew.
    C. undergo adiabatic warming.
    D. undergo adiabatic cooling.

Answer and Rationale

25. The surface currents of Earth's oceans are most likely created by which of the following?

    A. Density variations of the seawater
    B. Heat that escapes from Earth's mantle layer
    C. The prevailing winds of Earth's atmosphere
    D. The oxygen content of Earth's atmosphere

Answer and Rationale

26. The phases of the Moon are mainly determined by the

    A. distance of the Moon from the Sun.
    B. rotation of Earth on its axis.
    C. angle of the Moon's orbit relative to that of Earth's orbit.
    D. position of Earth and the Moon relative to the Sun.

Answer and Rationale

Answer Key and Rationales

Question Number	Correct Answer	Rationale
1	D	**Option D is correct.** The only way to determine whether the gasoline additive reduces pollution is to compare the amount of pollutants generated in the presence of the additive to the amount generated in its absence. Back to Question
2	B	**Option B is correct.** The average of the three measurements made by Student 2 is 91.4, which is the same as the actual width and hence is accurate. Also, the deviation from the actual width for each measurement is 0.1, 0.1, 0.0, respectively, with an average deviation of 0.0667, indicating that Student 2's measurements are the most precise. Student 4's measurements also average to 91.4, but they have a larger average deviation from the actual width, indicating less precision. Back to Question
3	B	**Option B is correct.** Mercury(II) oxide breaks down on heating into metallic mercury and oxygen. Mercury vapor that is given off is highly toxic when inhaled or absorbed through the skin, and exposure to mercury in a school should be greatly limited if not eliminated altogether. 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	B	**Option B is correct.** Increased carbon dioxide (greenhouse gas) in the atmosphere can contribute to a rise in atmospheric temperature. Atomic warfare would more likely result in a nuclear winter. Dust clouds from volcanoes would probably cause cooling due to high atmospheric dust absorbing the Sun's rays so they cannot reach the ground. The depletion of the ozone layer allows more ultraviolet radiation to reach Earth's surface, but in itself should not cause warming. Back to Question
5	D	**Option D is correct.** The atomic number of the atom is 79, as indicated by the subscript, and is equal to the number of protons. In a neutral atom, the number of protons equals the number of electrons. Hence, the number of electrons is 79. The superscript, 197, is the mass number and is equal to the number of protons plus the number of neutrons. Back to Question
6	C	**Option C is correct.** Heat from the iron, which is at 300ºC, will be transferred to the water, which is at a lower temperature, 100°C. However, the water will continue boiling and its temperature will remain constant as long as there is still liquid water present. The heat that was absorbed from the iron will be used in the process of converting liquid water to water vapor. (The amount of liquid water is much larger than the amount of iron and hence will not all vaporize as a result of absorbing heat from the iron.) The iron will cool to 100ºC, at which point it will be in thermal equilibrium with the water. 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.** The chemical symbol for tin is Sn. Tin(IV) indicates that tin is in the +4 oxidation state (Sn^{4+}). Since the chlorine in the compound is in a –1 oxidation state (Cl^-), the correct formula is $SnCl_4$. Back to Question
8	D	**Option D is correct.** Down a column in the periodic table, the succeeding elements have increasingly larger atomic radii. Back to Question
9	C	**Option C is correct.** The balanced equation is $2\ C_4H_{10}(g) + 13\ O_2(g) \rightarrow 8\ CO_2(g) + 10\ H_2O(g)$. Hence, the coefficient for CO_2 is 8. Back to Question
10	D	**Option D is correct.** Based on the graph, a saturated solution of alum at 30°C contains a little more than 15 g of dissolved alum in 100 mL of water. A solution that contains 20 g of dissolved alum in 100 mL of water at 30°C is supersaturated. 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
11	D	**Option D is correct.** The magnitude of the net force is equal to 800 N - 600 N = 200 N, since the two forces are pulling in opposite directions. Back to Question
12	D	**Option D is correct.** A circuit consisting of two identical resistors of resistance R connected in parallel to a battery is equivalent to a circuit consisting of a single resistor of resistance R_{eq} connected to the battery, where $1/R_{eq} = 1/R + 1/R = 2/R$, or $R_{eq} = R/2$. According to Ohm's law, the voltage $V = IR$, which in this case gives 12 V = (2.4 A)R_{eq} = (2.4 A)$R/2$. When the equation is solved for R, one obtains R = 10 Ω. Back to Question
13	B	**Option B is correct.** The proper corrective lens to use for nearsightedness is a lens placed between the object and the eye that will cause the parallel rays from the distant object to diverge slightly away from the optical axis before reaching the eye. The lens diverges the rays to such an extent that when the diverging rays are refocused by the eye, an image is produced directly on the retina. Of the lenses represented in the options, the lens in option B is the only diverging lens. 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
14	C	**Option C is correct.** One of the major structural differences between fungal cells and animal cells is the presence of cell walls only in fungi. Cells of both types of organisms have mitochondria and are diploid and heterotrophic. Back to Question
15	A	**Option A is correct.** During prophase I of meiosis, the chromosomes of each homologous pair undergo synapsis, which allows crossing-over to occur. The synapsed homologous pairs align on the equatorial plate during metaphase I and then separate/segregate during anaphase I. Back to Question
16	B	**Option B is correct.** Each of the guinea pigs has two alleles of the gene determining black or chocolate fur color. Because the guinea pigs are heterozygous for this gene, each has a dominant *B* allele and a recessive *b* allele. Only one allele is present in a haploid gamete, so it is expected that one half of the sperm produced by the male will contain a *b* allele and one half of the eggs produced by the female will contain a *b* allele. Progeny may have the genotypes *BB*, *Bb*, or *bb*. Because *b* is recessive, the progeny must receive two copies of *b* (*bb*) to have chocolate-colored fur. The chance that this will happen is $1/2 \times 1/2 = 1/4$ or 25%. 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
17	B	**Option B is correct** The sudden disappearance of 90 percent of the dinosaur species occurred about 60 million years ago. Recently discovered chemical evidence points to a catastrophic event, such as a large impact, occurring at that time. Back to Question
18	D	**Option D is correct.** Stomata open and close due to the changing shape of the guard cells that flank them. Transpiration refers to the evaporative loss of water through the stomata of the leaves and other aerial parts of a plant. Back to Question
19	B	**Option B is correct.** Mechanical digestion increases the surface area of food particles, so chemical digestion is facilitated in later sections of the tract. 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
20	B	**Option B is correct.** Energy is lost as matter is transferred from one trophic level to another. Plants are primary producers, while steaks are derived from herbivores that eat plants. It takes more land to produce the energy in steak than it does to produce the same amount of energy in food from plants. Back to Question
21	C	**Option C is correct.** The grasshopper is the herbivore and thus the primary consumer. In the trophic structure described, the frog is a secondary consumer and the snake is a tertiary consumer. Back to Question
22	A	**Option A is correct.** Earthquakes are the abrupt release of energy that occurs when a rock under stress fractures and displacement occurs. 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
23	B	**Option B is correct.** The decay of certain isotopes of uranium and thorium occurs at a fixed rate. Each of these elements has a half-life long enough (4.5 and 14 billion years for Th^{232} and U^{238}, respectively) to permit a reasonable estimation of the age of Earth. Back to Question
24	C	**Option C is correct.** When cool air flows from a high mountain region to a region of lower elevation, the air undergoes adiabatic warming. Adiabatic warming occurs as the pressure of the air increases as it descends. Back to Question
25	C	**Option C is correct.** The winds of Earth's atmosphere are the primary force that creates the surface currents of the oceans. Back to Question
26	D	**Option D is correct.** The Moon does not emit its own light but reflects light received from the Sun. It is the position of Earth and Moon relative to the Sun that determines the phase of the Moon. The half of the Moon that faces the Sun is always lighted, and the phases that are seen from Earth are determined by how much of the lighted half is visible. Back to Question

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

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

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

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

The Physics Teacher, American Association of Physics Teachers

The Science Teacher, National Science Teachers Association

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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***

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

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

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

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

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