



## SECTION 2

### TEST I SAMPLE QUESTIONS

This section of the Georgia Assessments for the Certification of Educators® (GACE™) Preparation Guide provides sample selected-response questions with an annotated answer key for you to review as part of your preparation for the test. The sample selected-response questions are designed to illustrate the nature of the test questions. Work through the questions carefully before referring to the annotated answer key, which follows the sample selected-response questions. The answer key provides the correct response to each question, describes why each correct response is the best answer, and lists the objective within the test framework to which each question is linked.

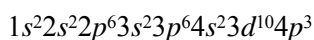
Please note that a periodic table and a set of constants and formulas are provided for this test. Please refer to these materials as needed in responding to the sample test questions and assignments. These materials are located in the Assessment Reference Materials section at the end of this preparation guide.

A scientific calculator may be used for this test as needed in responding to the sample test questions and assignments. Please refer to the current GACE registration bulletin for information about the use of calculators at the test administration.

## QUESTIONS

1. Use the information below to answer the question that follows.

The ground state electron configuration for an atom of arsenic (As) is shown below.



Which of the following characteristics is shared by all of the 1s, 2s, 3s, and 4s electrons?

- A. mean distance from the nucleus
  - B. average angular momentum
  - C. principal quantum number
  - D. direction of spin
2. Copper wire is a good conductor of electricity primarily because the copper atoms:
- A. are able to give up electrons from more than one energy level.
  - B. possess orbitals that are only partially filled by electrons.
  - C. have delocalized valence electrons surrounding the crystal lattice.
  - D. lose electrons to form ions with one of two different oxidation states.

3. A pale blue solution and a pale yellow solution are mixed together in a test tube. Which of the following changes would most likely indicate that a chemical reaction has occurred?

- A. an increase in the scattering of light
- B. the formation of a solid substance
- C. an increase in electrical conductivity
- D. the formation of convection currents

4. Which of the following is the most important factor involved in the miscibility of ethanol and water?

- A. the formation of hydrogen bonds between water molecules and ethanol molecules
- B. the attraction between the oxygen atoms in water molecules and the carbon atoms in ethanol
- C. the tendency of water molecules to create covalent bonds with polar substances like ethanol
- D. the ability of the carbon atoms in ethanol to preferentially attract the charged hydrogen atoms in water

5. The mutual repulsion of pairs of valence electrons in a compound consisting of nonmetallic atoms primarily affects the compound's:
- A. solubility in water.
  - B. molecular geometry.
  - C. heat of formation.
  - D. equilibrium vapor pressure.
6. **Use the information below to answer the question that follows.**
- $${}^{14}_6\text{C} \longrightarrow {}^{14}_7\text{N} + x$$
- The equation shown above illustrates the decay of carbon-14 into an isotope of nitrogen. Which of the following products of the decay of carbon-14 is represented by the  $x$  in the equation?
- A. an electron
  - B. a proton
  - C. a neutron
  - D. an alpha particle
7. The compound ethylene ( $\text{C}_2\text{H}_4$ ) contains which of the following combinations of bonds?
- A. 1  $\pi$ , 5  $\sigma$
  - B. 2  $\pi$ , 4  $\sigma$
  - C. 3  $\pi$ , 3  $\sigma$
  - D. 4  $\pi$ , 2  $\sigma$
8. The strength of dispersion forces between neutral atoms in a gas is typically greatest when the atoms have:
- A. a small number of electrons held closely by the nucleus.
  - B. a low atomic weight.
  - C. a large number of electrons spread over an appreciable volume.
  - D. a full outer shell.

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9. A bicycle tire appears slightly flat on a cold winter morning. The temperature of the air inside the tire is  $2^{\circ}\text{C}$  and the volume of air in the tire is 2.40 L. The pressure of the air inside the tire is 517 kPa. What will be the pressure of the air inside the tire if the temperature inside the tire increases to  $25^{\circ}\text{C}$  and the tire volume expands to 2.45 L?
- A. 527 kPa
  - B. 538 kPa
  - C. 549 kPa
  - D. 560 kPa
10. Two gases react to form a liquid. Which of the following describes the spontaneity of this reaction if thermal energy is released to the surroundings?
- A. always spontaneous
  - B. spontaneous at high temperatures
  - C. spontaneous at low temperatures
  - D. never spontaneous

## ANNOTATED ANSWER KEY

For question	The correct response is	Reason	Test Objective
1	B	The orbital names <i>s</i> , <i>p</i> , <i>d</i> , and <i>f</i> correlate to angular momentum quantum numbers of 0, 1, 2, and 3 respectively. The average angular momentum of an <i>s</i> electron is zero because <i>s</i> electrons are distributed within spherically shaped orbits. Because angular momentum numbers are a result of the shape of the electron orbitals, they would be the same for an <i>s</i> electron in any energy level and independent of the <i>s</i> electron's direction of spin.	0001
2	C	Copper wire is a good conductor of electricity because copper consists of a crystal lattice of neutral atoms. The outer electrons of the copper atoms in copper wire move from one atom to another even when a small electric potential difference is applied to the wire.	0002
3	B	The formation of a solid substance when the two solutions are mixed together is an indication that components of the soluble solutes, such as oppositely charged ions, have combined to form an insoluble solute. This change in solubility is an indication that a chemical change has occurred.	0003
4	A	Alcohols, including ethanol, contain OH groups attached to a carbon chain. In alcohols with relatively short carbon chains, such as ethanol and methanol, the polar OH group gives the molecule polar characteristics and the ability to form hydrogen bonds. Since water molecules are polar and attached to each other by hydrogen bonds, the polarity of the O—H bond in ethanol enables it to form hydrogen bonds with polar water molecules. The hydrogen bonding between an ethanol molecule and a water molecule is similar in magnitude to the hydrogen bonding that occurs between two water molecules and between two ethanol molecules. This makes ethanol completely miscible with water.	0004

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For question	The correct response is	Reason	Test Objective
5	B	Pairs of valence electrons play several roles in determining the geometry of a molecular structure. The number of valence electrons that each atom has determines the number and type of chemical bonds that form between atoms in the molecule. In addition, unshared pairs of electrons provide a repulsive force that acts on the electron clouds of atoms that have bonded with central atoms in molecular structures. This electrostatic repulsion affects the geometry of molecular structures.	0005
6	A	The mass number of the nitrogen-14 isotope and carbon-14 isotope remain the same. However, the atomic number of the nitrogen-14 isotope is 7, while the atomic number of carbon-14 is 6. This indicates that a neutron has been transformed into a proton. The neutron is transformed into a proton by emitting an electron in a process known as beta emission.	0006
7	A	One of the bonds in the double bond between the two carbon atoms in ethylene is a $\sigma$ bond as the $sp^2$ hybrid orbitals from each of the carbon atoms merge. The other bond between the two carbon atoms is a $\pi$ bond that results from the merging of $p$ orbitals. The bonds between hydrogen atoms that bond to carbon atoms are $\sigma$ bonds as $s$ orbitals from hydrogen atoms merge with $sp^2$ orbitals from carbon atoms. Since the compound $C_2H_4$ contains two carbon atoms and four hydrogen atoms in the structure, this results in an additional four $\sigma$ bonds.	0007
8	C	The dispersion forces between atoms are greatest when the atoms are easily polarized. In general, an atom with a large number of electrons located far from the nucleus is easier to polarize than an atom that has few electrons held tightly by the nucleus. In a gas containing neutral atoms, instantaneous dipoles develop due to the specific temporary positions of electrons surrounding a particular atom. The instantaneous dipole that briefly develops in an atom induces dipoles in each of its nearest neighbors, producing an attractive force between the atoms.	0008

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For question	The correct response is	Reason	Test Objective
9	C	<p>The combined gas law states that <math>\frac{VP}{T} = \frac{V'P'}{T'}</math>, where <math>T</math> is the temperature on the Kelvin scale. Reorganizing this equation to solve for <math>P'</math> gives <math>P' = \frac{(V)(P)(T')}{(T)(V')}</math>. Plugging the values given in the problem into this equation gives the pressure in the tire at the increased temperature and volume: <math>P' = \frac{(2.4 \text{ L})(517 \text{ kPa})(298 \text{ K})}{(275 \text{ K})(2.45 \text{ L})}</math>. Solving the equation shows that the pressure at the increased temperature and pressure is 549 kPa.</p>	0009
10	C	<p>The release of thermal energy by the reaction will result in a negative value for the change in enthalpy (<math>\Delta H</math>) during the reaction. The formation of a liquid product from gaseous reactants results in a decrease in entropy (<math>\Delta S</math>). However, at a low temperature (<math>T</math>), the mathematical product <math>T\Delta S</math> is sufficiently small to result in a negative value for Gibbs Free Energy in the formula <math>\Delta G = \Delta H - T\Delta S</math>, which is indicative of a spontaneous reaction.</p>	0010