

Individual Benchmark Specifications for Grade 10

This section of the FCAT *Science Test Item and Performance Task Specifications* describes how the benchmarks are assessed on the FCAT. The benchmarks are defined in the *Sunshine State Standards* at four developmental levels corresponding to the following grade ranges: PreK–2, 3–5, 6–8, and 9–12. FCAT Science is administered in Grades 5, 8, and 10.

BENCHMARK SC.A.1.4.1

Strand	A	The Nature of Matter
Standard	1	The student understands that all matter has observable, measurable properties.
Benchmark	SC.A.1.4.1	The student knows that the electron configuration in atoms determines how a substance reacts and how much energy is involved in its reactions.
Item Type(s)		MC, GR
Benchmark Clarification		The student identifies relationships between valence electrons and chemical reactivity in elements using the periodic table.
Content Limits		<p>Items will list both the name and the symbol for chemical elements and compounds.</p> <p>Items will NOT assess the student's knowledge of:</p> <ul style="list-style-type: none">• electron spin,• atomic radius,• ionization energy, or• other quantitative aspects of energy. <p>Items may use information from elements with atomic numbers 1 to 54.</p>
Stimulus Attributes		Items may provide the student with data on elements in chart or graph form.
Response Attributes		<p>Items will describe units in which the answer is to be given.</p> <p>Items may have responses listed as elements from distinctly different groups of the periodic table.</p> <p>Items may require the student to use the periodic table provided.</p>

BENCHMARK SC.A.1.4.2

Strand	A	The Nature of Matter
Standard	1	The student understands that all matter has observable, measurable properties.
Benchmark	SC.A.1.4.2	The student knows that the vast diversity of the properties of materials is primarily due to variations in the forces that hold molecules together. This benchmark also assesses SC.A.1.4.5. ¹
Item Type(s)		MC
Benchmark Clarification		The student identifies properties of compounds that are due to chemical bonds and the forces affecting those bonds.
Content Limits		<p>Items will list both the name and the symbol for chemical elements and compounds.</p> <p>Items will NOT require the student to memorize ionic or covalent compounds by name.</p> <p>Items will NOT require the student to quantify forces or properties.</p> <p>Items may address the strong force or the weak force.</p> <p>Items may require the student to use the periodic table provided.</p> <p>Items may require the student to determine if the bond between two substances is ionic or covalent using the periodic table.</p>
Stimulus Attributes		None specified.
Response Attributes		Items may have responses in the form of elements or compounds.

¹ The complete text for SC.A.1.4.5 is “The student knows that connections (bonds) form between substances when outer-shell electrons are either transferred or shared between their atoms, changing the properties of substances.”

Sample MC Item

Chemical reactivities and melting points are properties of compounds affected by the type of bond that exists between atoms. Ionic compounds exhibit much higher melting and boiling points. Of the compounds listed, which one has the **highest** melting point?

- A. ammonia (NH₃)
- B. carbon monoxide (CO)
- *C. sodium chloride (NaCl)
- D. sulfur dioxide (SO₂)

BENCHMARK SC.A.1.4.3

Strand	A	The Nature of Matter
Standard	1	The student understands that all matter has observable, measurable properties.
Benchmark	SC.A.1.4.3	The student knows that a change from one phase of matter to another involves a gain or loss of energy.
Item Type(s)		MC, GR
Benchmark Clarification		The student identifies phase changes and the energy transfer involved in those changes.
Content Limits		Items will NOT require the memorization of quantities of energy. Items will NOT address matter in plasma state.
Stimulus Attributes		Items may use phase-change diagrams or graphs.
Response Attributes		Items will describe units in which the answer is to be given. Items may require responses in the form of equations, graphics, or tables.
Sample MC Item		Anita is boiling an egg. The water in the pan boils, and steam is released. Which of the following happens as the water is converted into steam? <ul style="list-style-type: none"> A. Heat energy is given off by the water, and the steam absorbs the energy. B. Heat energy is absorbed after the water is vaporized, and the steam gives off heat. *C. Heat energy is absorbed by the water, and the increased kinetic energy causes the phase change. D. Heat energy is given off by the boiling water, and the increased kinetic energy causes the phase change.

Sample GR Item

Clarissa is generating steam by boiling a sample of distilled water that was initially at 90 degrees Celsius ($^{\circ}\text{C}$). She determines that the total heat needed to raise the temperature of the water from 90°C to 100°C and generate steam is 550 calories per gram. How many of the calories are required to complete the phase change for each gram of water?

Answer

540

	0	0	0	0
0	0	0	0	0
0	1	1	1	1
0	2	2	2	2
0	3	3	3	3
0	4	4	4	4
0	5	5	5	5
0	6	6	6	6
0	7	7	7	7
0	8	8	8	8
0	9	9	9	9

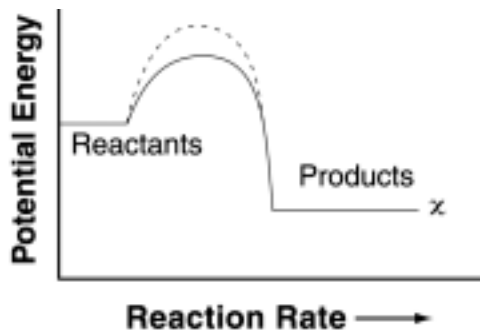
BENCHMARK SC.A.1.4.4

Strand	A	The Nature of Matter
Standard	1	The student understands that all matter has observable, measurable properties.
Benchmark	SC.A.1.4.4	The student experiments and determines that the rates of reaction among atoms and molecules depend on the concentration, pressure, and temperature of the reactants and the presence or absence of catalysts.
Item Type(s)		MC, GR, SR
Benchmark Clarification		The student identifies factors (e.g., surface area, pH) that affect the rate of reaction among atoms and molecules.
Content Limits		Items will list both the name and the symbol for chemical elements and compounds. Items will NOT address the reaction orders dependent on concentrations, such as a first-order reaction. Items may address the behavior of gases under changing pressure. Items may describe real-life experiments or scenarios in which a variable is altered to affect the rate of reaction.
Stimulus Attributes		Items may involve the use of reaction rate charts, diagrams, or graphs. Items may provide the student with data in equation form.
Response Attributes		Items will describe units in which the answer is to be given. Items may require responses in the form of equations, graphics, statements, or tables.

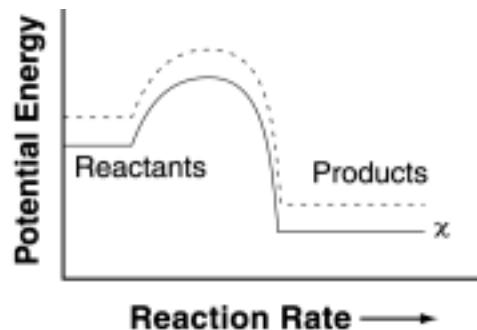
Sample MC Item

Catalysts may reduce the amount of activation energy required for a chemical reaction to occur. Platinum (Pt) is a catalyst that is used in catalytic converters in automobiles. In the graphs below, pathway *x* is a solid line representing the uncatalyzed reaction. The dotted line shows the catalyzed reaction. Which graph **best** illustrates the changes in a reaction when the catalyst reduces the amount of energy required?

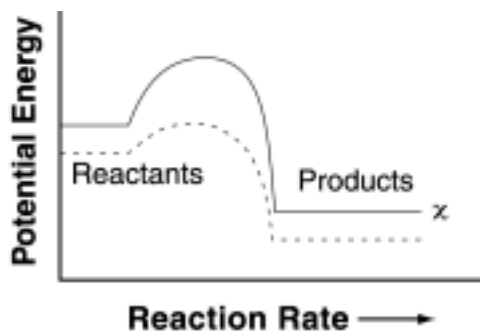
A.



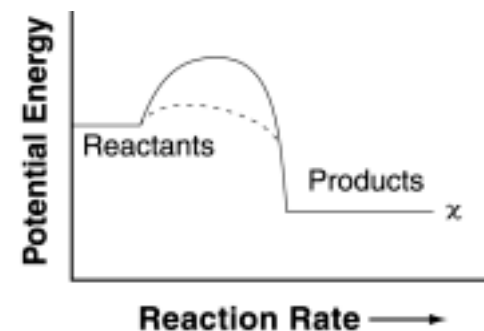
C.



B.

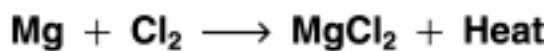


* D.



Sample SR Item

Magnesium (Mg) in solid form can chemically react with chlorine (Cl₂) gas to form magnesium chloride (MgCl₂). This reaction is exothermic.



In the reaction between Mg and Cl₂, what determines how quickly the reaction will occur? Explain your answer.

Correct and Complete Response

The rate of a reaction depends on the surface area of the Mg and the concentration of the Cl₂. Also, the pressure and temperature of the reactants will have an effect on the rate of reaction. The number of molecules interacting and the energy in those molecules will determine the rate of reaction.

BENCHMARK SC.A.2.4.1

Strand	A	The Nature of Matter
Standard	2	The student understands the basic principles of atomic theory.
Benchmark	SC.A.2.4.1	The student knows that the number and configuration of electrons will equal the number of protons in an electrically neutral atom and when an atom gains or loses electrons, the charge is unbalanced.
Item Type(s)		MC, GR
Benchmark Clarification		The student identifies the number of electrons in an electrically neutral atom and determines the charge that results when an atom gains or loses electrons.
Content Limits		Items will list both the name and the symbol for chemical elements and compounds. Items may use information from elements with atomic numbers from 1 to 54.
Stimulus Attributes		Items may provide the student with data on atoms in chart, drawing, equation, graph, or picture form.
Response Attributes		Items will describe units in which the answer is to be given. Items may require responses in the form of elements or number of electrons, neutrons, or protons. Items may require the student to use the periodic table provided.
Sample MC Item		In an atom, the number of protons equals the number of electrons. An oxygen ion is represented as O^{2-} . How is the oxygen ion different from an oxygen atom? A. The oxygen ion has lost two protons. B. The oxygen ion has lost two electrons. C. The oxygen ion has gained two protons. *D. The oxygen ion has gained two electrons.

Sample GR Item

Calcium (Ca) keeps your bones, muscles, and nerves healthy. It has 20 protons, 20 neutrons, and 20 electrons. How many electrons does Ca lose to become more stable when bonding?

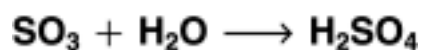
Answer

2

	0	0	0	
0	0	0	0	0
0	1	1	1	1
0	2	2	2	2
0	3	3	3	3
0	4	4	4	4
0	5	5	5	5
0	6	6	6	6
0	7	7	7	7
0	8	8	8	8
0	9	9	9	9

BENCHMARK SC.A.2.4.2

Strand	A	The Nature of Matter
Standard	2	The student understands the basic principles of atomic theory.
Benchmark	SC.A.2.4.2	The student knows the difference between an element, a molecule, and a compound.
Item Type(s)		MC
Benchmark Clarification		The student identifies atoms, compounds, elements, and molecules by their chemical formulas or their properties.
Content Limits		Items will list both the name and the symbol for chemical elements and compounds.
Stimulus Attributes		Items may provide the student with data in equation form.
Response Attributes		Items may require responses in the form of chemical formulas. Items may require the student to use the periodic table provided.
Sample MC Item		Clean air is essential for the survival of organisms. Burning coal can produce sulfuric acid (H ₂ SO ₄) that remains as mist in the atmosphere. This mist results in acid rain that can harm vegetation and eliminate aquatic life in various waterways. The following reaction occurs when coal burns:



Which term **best** defines H₂SO₄?

- A. atom
- * B. compound
- C. element
- D. isotope

BENCHMARK SC.A.2.4.3

Strand	A	The Nature of Matter
Standard	2	The student understands the basic principles of atomic theory.
Benchmark	SC.A.2.4.3	The student knows that a number of elements have heavier, unstable nuclei that decay, spontaneously giving off smaller particles and waves that result in a small loss of mass and release a large amount of energy. This benchmark also assesses SC.A.2.4.4. ²
Item Type(s)		MC
Benchmark Clarification		The student identifies properties of naturally occurring radioactive elements with unstable nuclei that spontaneously decay, including carbon 14, uranium 238, uranium 235, plutonium 239, and radium 226.
Content Limits		<p>Items will address products of alpha, beta, and gamma radiation.</p> <p>Items will NOT require calculations of mass or energy transformation.</p> <p>Items will NOT assess the student's understanding of specific steps or equations of radioactive decay.</p> <p>Items may address the fusion of atoms.</p>
Stimulus Attributes		Items may describe real-life sources or uses of radioactive material.
Response Attributes		None specified.

² The complete text for SC.A.2.4.4 is "The student knows that nuclear energy is released when small, light atoms are fused into heavier ones."

Sample MC Item

Archaeologists who wish to estimate the age of ancient artifacts sometimes use carbon-14 dating. Which of the following makes carbon 14 ideal for radioactive dating?

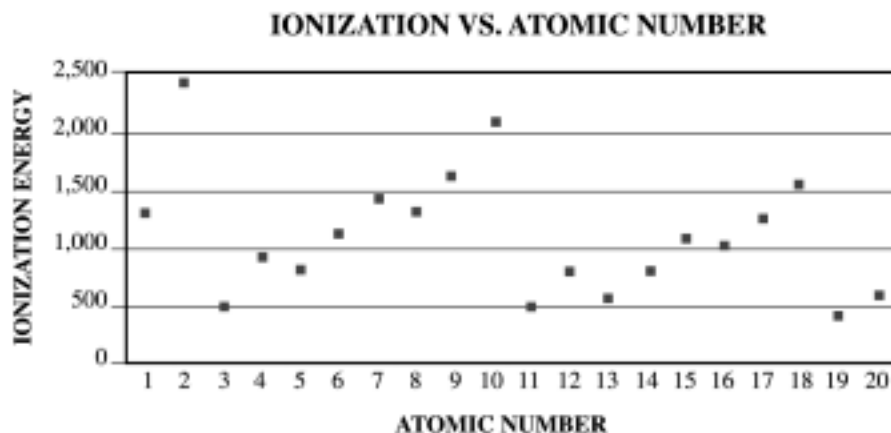
- * A. It is unstable and spontaneously decays at a regular rate.
- B. It is unstable and requires a significant energy input to decay.
- C. It is stable, and its quantity remains constant through time.
- D. It is unstable, and its quantity remains constant through time.

BENCHMARK SC.A.2.4.5

Strand	A	The Nature of Matter
Standard	2	The student understands the basic principles of atomic theory.
Benchmark	SC.A.2.4.5	The student knows that elements are arranged into groups and families based on similarities in electron structure and that their physical and chemical properties can be predicted.
Item Type(s)		MC
Benchmark Clarification		The student identifies chemical and physical similarities and differences between elements based on their location in the periodic table.
Content Limits		Items will list both the name and the symbol for chemical elements and compounds. Items will NOT require the student to quantify physical properties.
Stimulus Attributes		None specified.
Response Attributes		Items may have responses listed as elements from distinctly different groups of the periodic table. Items may require the student to use the periodic table provided.

Sample MC Item

Ionization energy is the energy required to remove an electron from an atom in the gas phase. In the graph below, the ionization energy is shown as a function of the atomic number for the first 20 elements of the periodic table.



The elements 3, 11, and 19 require the lowest amount of ionization energy. What do the elements with atomic numbers 3, 11, and 19 have in common?

- *A. They have one electron in their outer orbital.
- B. They lose a proton, which makes them neutral.
- C. They have seven electrons in their outer orbital.
- D. They have an extra proton, which makes them neutral.

BENCHMARK SC.A.2.4.6

Strand	A	The Nature of Matter
Standard	2	The student understands the basic principles of atomic theory.
Benchmark	SC.A.2.4.6	The student understands that matter may act as a wave, a particle, or something else entirely different with its own characteristic behavior.
Item Type(s)		MC
Benchmark Clarification		None specified.
Content Limits		Items will NOT assess the student's knowledge of the quantification of matter or energy. Items will NOT assess the student's knowledge of the uncertainty principle. Items may address the properties of electromagnetic radiation. Items may contain mathematical applications.
Stimulus Attributes		Items may provide the student with data on particles or waves in chart or graph form.
Response Attributes		None specified.
Sample MC Item		The electromagnetic spectrum includes X-rays, microwaves, radio waves, and visible light. Which property determines the differences between these types of waves? * A. frequency B. particle nature C. crest of the wave D. amplitude of the wave