2006

FCAT

Florida Comprehensive Assessment Test

TEACHER'S BOOKLET

SCIENCE

SCIENCE
SAMPLE ANSWER KEY

999-8243-67-X

FCAT Sample Test Materials

These sample test materials are designed to help students prepare to answer FCAT questions. These materials introduce them to the kinds of questions they will answer when they take FCAT and include hints for responding to the different kinds of FCAT questions. The FCAT Science sample test materials for Grade 11 are composed of the books described below:

☐ **Sample Test and Answer Book**
Includes a science sample test, a sample answer book, and instructions for completing the sample test. (Copies are available for all students in the tested grade.)

☑ **Sample Answer Key**
Includes answers and explanations for the questions in the sample test. (Copies are available for classroom teachers only.)

☑ = This book

FCAT Science Sample Answer Key

This book contains answers to the FCAT Science sample test questions. It also gives the *Sunshine State Standards* benchmark assessed by each item on the sample test. In addition, answer strategies or possible approaches to answering the questions are provided. Students may use approaches other than these and still receive credit if they also obtain a correct answer. For multiple-choice items, the reason an answer choice is incorrect (distractor rationale) is also provided.

Multiple-choice and gridded-response items are scored by awarding one point for each correct answer. The "Read, Inquire, Explain" questions allow partial credit for some answers, even if they are not 100 percent correct. Answers will be scored and points will be given based on the completeness and correctness of the answers. If a portion of an answer is correct, a portion of the points may be awarded. The scoring rubrics for the short-response questions and the extended-response questions are printed on pages 2 and 3 of this book.

READ
INQUIRE
EXPLAIN

Rubric for Short-Response Questions

2 points — A score of two indicates that the student has demonstrated a thorough understanding of the scientific concepts and/or procedures embodied in the task. The student has completed the task correctly, in a scientifically sound manner. When required, student explanations and/or interpretations are clear and complete. The response may contain minor flaws that do not detract from the demonstration of a thorough understanding.

1 point — A score of one indicates that the student has provided a response that is only partially correct. For example, the student may arrive at an acceptable conclusion or provide an adequate interpretation, but may demonstrate some misunderstanding of the underlying scientific concepts and/or procedures. Conversely, a student may arrive at an unacceptable conclusion or provide a faulty interpretation, but could have applied appropriate and scientifically sound concepts and/or procedures.

0 points — A score of zero indicates that the student has not provided a response or has provided a response that does not demonstrate an understanding of the scientific concepts and/or procedures embodied in the task. The student's explanation may be uninterpretable, lack sufficient information to determine the student's understanding, contain clear misunderstandings of the underlying scientific concepts and/or procedures, or may be incorrect.

Rubric for Extended-Response Questions

4 points	A score of four indicates that the student has demonstrated a thorough understanding of the scientific concepts and/or procedures embodied in the task. The student has completed the task correctly, used scientifically sound procedures, and provided clear and complete explanations and interpretations. The response may contain minor flaws that do not detract from a demonstration of a thorough understanding.
3 points	A score of three indicates that the student has demonstrated an understanding of the scientific concepts and/or procedures embodied in the task. The student's response to the task is essentially correct, but the scientific procedures, explanations, and/or interpretations provided are not thorough. The response may contain minor flaws that reflect inattentiveness or indicate some misunderstanding of the underlying scientific concepts and/or procedures.
2 points	A score of two indicates that the student has demonstrated only a partial understanding of the scientific concepts and/or procedures embodied in the task. Although the student may have arrived at an acceptable conclusion or provided an adequate interpretation of the task, the student's work lacks an essential understanding of the underlying scientific concepts and/or procedures. The response may contain errors related to misunderstanding important aspects of the task, misuse of scientific procedures/ processes, or faulty interpretations of results.
1 point	A score of one indicates that the student has demonstrated a very limited understanding of the scientific concepts and/or procedures embodied in the task. The student's response is incomplete and exhibits many flaws. Although the student's response has addressed some of the conditions of the task, the student has reached an inadequate conclusion and/or provided reasoning that is faulty or incomplete. The response exhibits many flaws or may be incomplete.
0 points	A score of zero indicates that the student has not provided a response or has provided a response that does not demonstrate an understanding of the scientific concepts and/or procedures embodied in the task. The student's explanation may be uninterpretable, lack sufficient information to determine the student's understanding, contain clear misunderstandings of the underlying scientific concepts and/or procedures, or may be incorrect.

1 **The correct answer is C ($\overline{RS}$).**

Strand: A—The Nature of Matter

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. (Also assesses SC.B.1.4.3 knows that temperature is a measure of the average translational kinetic energy of motion of the molecules in an object.)

Knowledge of phase changes and energy transfer is needed to answer this question. The heating curve shows the changes in phase as heat is added to solid water (ice). Water changes from liquid to gas at its boiling point 100°C. This phase change is shown in the diagram by $\overline{RS}$.

Distractor Rationale

A. $\overline{PQ}$ represents water at 0°C. At this temperature, water changes from a solid to a liquid.

B. $\overline{QR}$ represents water between 0°C and 100°C. In this temperature range, water exists in the liquid state.

D. $\overline{ST}$ represents water above 100°C. At this temperature, water exists as a gas.

2 **The correct answer is I (Nitrogen atoms are similar in shape and size to carbon atoms).**

Strand: A—The Nature of Matter

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.

Knowledge of the periodic table is needed to answer this question. Nitrogen is positioned next to carbon on the periodic table. Because of this positioning, the two atoms would be expected to have similar properties, including shape and size.

Distractor Rationale

F. Elemental nitrogen (N_2) is colorless, but this property does not explain why nitrogen is able to occupy spaces in a diamond crystal. It is the size of nitrogen, not the color, that allows nitrogen to fit into a diamond crystal.

G. Nitrogen is a plentiful substance, but its abundance does not explain why nitrogen atoms can occupy spaces in a diamond crystal. The abundance of nitrogen on Earth is not related to its reactivity or its size, which allows it to occupy a diamond crystal.

H. Nitrogen is a gas at room temperature. This state has nothing to do with the formation of diamonds, which occurs under extraordinary heat and pressure.

3 **The correct answer is A (The energy has been released into the surroundings).**

Strand: B—Energy

Benchmark: SC.B.1.4.1 The student understands how knowledge of energy is fundamental to all the scientific disciplines (e.g., the energy required for biological processes in living organisms and the energy required for the building, erosion, and rebuilding of the Earth). (Also assesses SC.B.1.4.2 understands that there is conservation of mass and energy when matter is transformed.)

An understanding of energy transfer is needed to answer this question. Objects in motion stay in motion unless acted upon by a force. For objects in real situations, friction with air or other objects will create forces that change an object's motion and energy. Friction between the ball, air, and the court will cause some of the ball's kinetic energy to be changed into thermal energy. This thermal energy is transferred from the basketball to the surrounding environment.

Distractor Rationale

B. Energy is not recycled into motion. It is transferred from one form to another. The horizontal motion is independent of the bounce height.

C. The ball falls because of gravity, but the energy does not disappear. Energy is never destroyed, only changed from one form (energy of motion) into another (thermal energy).

D. The energy is not an action and is not balanced with a reaction. This statement of Newton's law applies to forces, not energy.

4 **The correct answer is 14.7 newtons (14.7 N).**

Strand: C—Force and Motion

Benchmark: SC.C.2.4.1 The student knows that acceleration due to gravitational force is proportional to mass and inversely proportional to the square of the distance between the objects.

The formula for determining the weight of an object is given in the stem (weight = mg). F is the force or weight in newtons; m is the mass in grams; and g is acceleration due to gravity in m/s^2.

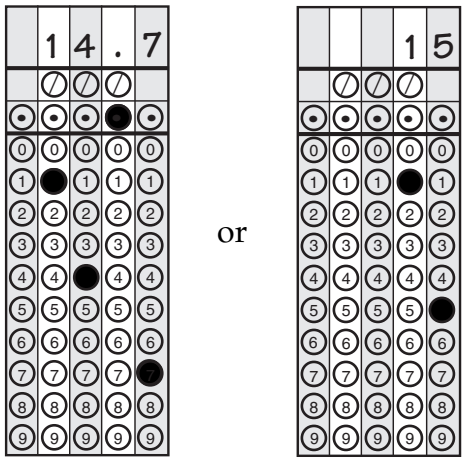
The formula is used to find the weight of the sledgehammer on Earth.

$$\frac{9.8\ m}{s^2} \times 9.0\ kg = 88.2\ kg\,\frac{m}{s^2} \text{ or } 88.2\ N$$

On the Moon, the acceleration due to gravity is one-sixth that of Earth.

$$\frac{1}{6} \times 88.2\ N = 14.7\ N \text{ on the Moon}$$

Note: The use of significant figures results in another correct response of 15.



5 **The correct answer is H (The water spraying outward produces an opposite force on the sprinkler arms).**

Strand: C—Force and Motion

Benchmark: SC.C.1.4.1 The student knows that all motion is relative to whatever frame of reference is chosen and that there is no absolute frame of reference from which to observe all motion. (Also assesses SC.C.1.4.2 know that any change in velocity is an acceleration; and SC.C.2.4.6 explains that all forces come in pairs commonly called action and reaction.)

An understanding of action and reaction forces is needed to answer this question. The sprinkler operates in accordance with Newton's third law: for every action there is an equal and opposite reaction. As the water is sprayed outward from the ends of the curved sprinkler arms, the sprinkler arms are forced to move in the opposite direction.

Distractor Rationale

F. The released water does not counteract the gravitational force.

G. Water in the liquid state does not expand.

I. Water leaves the sprinkler arms continuously, with no opportunity for air to enter the sprinkler.

6 **The correct answer is A (It increases the amount of rainfall).**

Strand: D—Processes that Shape the Earth

Benchmark: SC.D.1.4.1 The student knows how climatic patterns on Earth result from an interplay of many factors (Earth's topography, its rotation on its axis, solar radiation, the transfer of heat energy where the atmosphere interfaces with lands and oceans, and wind and ocean currents).

Knowledge of climatic patterns is needed to answer this question. Warm, moist air contains water vapor that can condense to form precipitation. As weather conditions change, warm, moist air associated with the Gulf Stream provides a source of moisture for rainfall and increases the amount of rainfall.

Distractor Rationale

B. Air currents, not the Gulf Stream, cause winds.

C. Humidity, or the amount of water vapor in the air, increases in areas near the Gulf Stream.

D. Moist air would be more likely to cause skies to cloud up and storm rather than to clear.

7 **The correct answer is I (positions 2 and 4).**

Strand: E—Earth and Space

Benchmark: SC.E.1.4.1 The student understands the relationships between events on Earth and the movements of the Earth, its moon, the other planets, and the sun. (Also assesses SC.E.1.4.2 knows how the characteristics of other planets and satellites are similar to and different from those of the Earth; and SC.E.1.4.3 knows the various reasons that Earth is the only planet in our Solar System that appears to be capable of supporting life as we know it.)

Knowledge of the positional relationships among Earth, the Sun, and the Moon is needed to answer this question. Tides are caused by the gravitational force exerted by the Moon on Earth's oceans. The side of Earth nearest the Moon will have the most pull exerted by the Moon. Spring tides will occur when the Sun and the Moon are in line with Earth and their gravitational attraction acts in the same direction. Neap tides are the lowest tides and occur when the Sun, the Moon, and Earth are at right angles, like in positions 2 and 4.

Distractor Rationale

F. Position 1 will produce a high tide.

G. Positions 1 and 3 will produce the highest tides or spring tides.

H. Position 3 will produce a high spring tide.

8 **The correct answer is B (main sequence).**

Strand: E—Earth and Space

Benchmark: SC.E.2.4.1 The student knows that the stages in the development of three categories of stars are based on mass: stars that have the approximate mass of our sun, stars that are two-to-three-stellar masses and develop into neutron stars, and stars that are five-to-six-stellar masses and develop into black holes.

Knowledge of the characteristics of our Sun as a star is needed to answer this question. The Sun is a medium-sized main sequence star. Since the Sun produces helium from hydrogen fusion, it is understood that other main sequence stars can have similar reactions.

Distractor Rationale

A. The Sun is not a blue supergiant; it does not have enough mass.

C. Red shift is used to determine the motion of stars.

D. Stellar nebulae are groups of stars, not a stage in star development.

9 **The correct answer is H (Enzymes present in the bacteria can tolerate the harsh springs environment).**

Strand: F—Processes of Life

Benchmark: SC.F.1.4.1 The student knows that the body processes involve specific biochemical reactions governed by biochemical principles. (Also assesses SC.F.1.4.3 knows that membranes are sites for chemical synthesis and essential energy conversions; and SC.F.1.4.5 knows that complex interactions among the different kinds of molecules in the cell cause distinct cycles of activity governed by proteins.)

An understanding of biochemical actions in bacteria is needed to answer this question. Since bacteria can survive at these temperatures, they must have some adaptation that allows for survival. Since enzyme breakdown limits the survival of most organisms at high temperatures, it is likely that bacteria have enzymes that can tolerate the high temperatures of the springs.

Distractor Rationale

F. Bacteria cannot spontaneously change their genetic material. Heat will not change the genetic makeup of living bacteria.

G. Enzymes have a narrow pH range of activity that does not depend on temperature.

I. Enzymes or heat can speed up chemical reactions; bacteria do not speed up a chemical reaction.

10 **The correct answer is shown below.**

READ
INQUIRE
EXPLAIN

Strand: F—Processes of Life

Benchmark: SC.F.2.4.3 The student understands the mechanisms of change (e.g., mutation and natural selection) that lead to adaptations in a species and their ability to survive naturally in changing conditions and to increase species diversity. (Also assesses SC.D.1.4.4 knows that Earth's systems and organisms are the result of a long, continuous change over time; and SC.F.1.4.2 knows that body structures are uniquely designed and adapted for their function.)

Example of a Top-Score Response

An understanding of the development of resistance through adaptation in a species is needed to answer this question.

An explanation similar to the one provided below would receive full credit.

The insecticide originally killed the ants that were susceptible to it. The ants that were resistant survived and passed on their genes to their offspring. As time passed and the insecticide was used repeatedly, this cycle continued. More and more of the resistant ants survived until they dominated the population, and the insecticide was no longer effective.

To receive full credit (2 points) for this question, the response should include information about the resistance to the insecticide being evident in the original population of ants and becoming the more dominant trait as the insecticide was used repeatedly. Partially correct answers will receive a score of 1 point.

11 The correct answer is D (It will have the highest concentration in the large secondary consumers).

Strand: G—How Living Things Interact with Their Environment

Benchmark: SC.G.1.4.1 The student knows of the great diversity and interdependence of living things. (Also assesses SC.G.1.4.2 understands how the flow of energy through an ecosystem made up of producers, consumers, and decomposers carries out the processes of life and that some energy dissipates as heat and is not recycled.)

An understanding of organism interdependency is needed to answer this question. Secondary consumers must take in more food than organisms lower on a food chain take in because of energy loss. Since secondary consumers take in more food, more toxins are concentrated in those organisms as well. Also, larger organisms need more energy and must consume more than smaller organisms. Because of this, the concentration of the methylmercury would be highest in large secondary consumers. This increase in the concentration of methylmercury from one link in a food chain to another is called biomagnification.

Distractor Rationale

A. Some organisms would retain more of the toxin than others because of their location and patterns of consumption (or food source). Larger animals would receive more of the toxin than smaller ones.

B. Filter feeders are not the only organisms that would have a buildup of the toxin; those who eat the filter feeders would also retain it.

C. Producers and herbivores will absorb or consume methylmercury, but the methylmercury will be passed along the food chain to other consumers when the producers and herbivores are used as food by other organisms.

12 **The correct answer is F (Contains chloroplasts).**

Strand: G—How Living Things Interact with Their Environment

Benchmark: SC.G.1.4.1 The student knows of the great diversity and interdependence of living things. (Also assesses SC.G.1.4.2 understands how the flow of energy through an ecosystem made up of producers, consumers, and decomposers carries out the processes of life and that some energy dissipates as heat and is not recycled.)

An understanding of the characteristics of plants and their roles as producers in ecosystems is needed to answer this question. Plants use specialized structures called chloroplasts that capture the sunlight needed in the process of photosynthesis. Through photosynthesis, plants use energy from sunlight for growth and reproduction. This energy is passed to other organisms in an ecosystem when plants are consumed as food.

Distractor Rationale

G. Plants contain rigid cell walls that provide structure for plant cells, but photosynthesis does not occur in cell walls.

H. The roots of plants are generally underground and do not receive the sunlight necessary for photosynthesis. Plant roots do not carry out photosynthesis.

I. Some plants have a waxy outer covering for protection and water retention, but photosynthesis does not occur in the waxy outer covering.

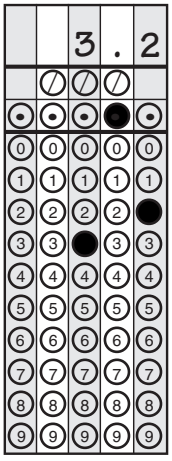
13 **The correct answer is 3.2 °C.**

Strand: H—The Nature of Science

Benchmark: SC.H.1.4.1 The student knows that investigations are conducted to explore new phenomena, to check on previous results, to test how well a theory predicts, and to compare different theories. (Also assesses SC.H.1.2.1 knows that it is important to keep accurate records and descriptions to provide information and clues on causes of discrepancies in repeated experiments; SC.H.1.2.2 knows that a successful method to explore the natural world is to observe and record, and then analyze and communicate the results; SC.H.2.4.2 knows that scientists control conditions in order to obtain evidence, but when that is not possible for practical or ethical reasons, they try to observe a wide range of natural occurrences to discern patterns; SC.E.2.4.6 knows the various ways in which scientists collect and generate data about our universe [e.g., X-ray telescopes, computer simulations of gravitational systems, nuclear reactions, space probes, and supercollider simulations]; and SC.E.2.4.7 knows that mathematical models and computer simulations are used in studying evidence from many sources to form a scientific account of the universe.)

An understanding of the use of data to explore new phenomena and data analysis is needed to answer this question. From 1694 until 1980, the chart shows that the ppm of methane mixed with air in the ice core went from 0.68 ppm to 1.48 ppm. The difference between those is 0.80 ppm for that time period. The question states that for every 0.1 ppm of atmospheric methane, the average temperature would increase by 0.4 °C. Dividing 0.80 ppm by 0.10 ppm and multiplying by 0.4 °C gives a change in temperature of about 3.2 °C.

$$(1.48\ \text{ppm} - 0.68\ \text{ppm}) \times \left(\frac{0.4\ ^\circ\text{C}}{0.1\ \text{ppm}}\right) = 3.2\ ^\circ\text{C}$$



14 **The correct answer is shown below.**

READ
INQUIRE
EXPLAIN

Strand: H—The Nature of Science

Benchmark: SC.H.1.4.1 The student knows that investigations are conducted to explore new phenomena, to check on previous results, to test how well a theory predicts, and to compare different theories. (Also assesses SC.H.1.2.1 knows that it is important to keep accurate records and descriptions to provide information and clues on causes of discrepancies in repeated experiments; SC.H.1.2.2 knows that a successful method to explore the natural world is to observe and record, and then analyze and communicate the results; SC.H.2.4.2 knows that scientists control conditions in order to obtain evidence, but when that is not possible for practical or ethical reasons, they try to observe a wide range of natural occurrences to discern patterns; SC.E.2.4.6 knows the various ways in which scientists collect and generate data about our universe [e.g., X-ray telescopes, computer simulations of gravitational systems, nuclear reactions, space probes, and supercollider simulations]; and SC.E.2.4.7 knows that mathematical models and computer simulations are used in studying evidence from many sources to form a scientific account of the universe.)

Example of a Top-Score Response

Knowledge of how scientists collect and generate information about our universe is needed to answer this question. Astronomers use instruments such as telescopes, spectroscopes, and computers to gather information about stars. Astronomers publish their data and conclusions so other astronomers can check their observations by repeating experiments and comparing data from one set of observations with another.

An explanation similar to the one provided below would receive full credit.

Part A Astronomers would use instruments such as telescopes, spectroscopes, and computers to observe and analyze stars and planets that are many light years away from Earth. In order to challenge the discovery of the planet, other scientists would need to take the data from the original astronomers and compare it to previously collected data from distant planets and sunspots. From this, the scientists could determine that the object was not really a planet at all, but the pattern was more similar to a sunspot.

Part B When the later scientists checked the data against previously collected sunspot data and the additional observations they made, they found that a giant moving sunspot was much better represented. The reason that the scientists were able to disprove the discovery was probably because the original astronomers kept very accurate records. The other scientists were able to go back and compare the old data with the new to create a better hypothesis. The original data were probably published for easy access.

To receive full credit for this question (4 points), the response should include the instruments used by astronomers, the kind of research the second set of scientists probably did, what might lead a scientist to disagree with previous findings, and how scientists might find earlier data and observations. Partially correct answers will receive a score of 1, 2, or 3 points.

15 **The correct answer is A (The melting point is independent of density).**

Strand: H—The Nature of Science

Benchmark: SC.H.2.4.1 The student knows that scientists assume that the universe is a vast system in which basic rules exist that may range from very simple to extremely complex, but that scientists operate on the belief that the rules can be discovered by careful, systemic study.

An understanding of how scientists apply basic rules of the universe in drawing conclusions is needed to answer this question. The chart shows four different metals with their melting points and densities. An analysis of the various densities and melting points of the four substances does not show any correlation. Copper has the lowest density. Silver has the lowest melting point. Platinum has the highest melting point and highest density. Gold and silver have similar densities but very different melting points. Gold and copper have very similar melting points but very different densities.

Distractor Rationale

B. Copper and gold have similar melting points, but there is no correlation between their densities and their melting points.

C. The densest material (platinum) does not have the lowest melting point. Silver has the lowest melting point.

D. Platinum does have the highest density and the highest melting point. This correlation does not hold true for gold, which has the next highest density, but a lower melting point than copper, which has the least density of all the materials in the chart.

Notes

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