



**pennsylvania**  
DEPARTMENT OF EDUCATION

# The Pennsylvania System of School Assessment

## Science Item and Scoring Sampler



**2022–2023**  
**Grade 8**

## SCIENCE TEST DIRECTIONS

### Directions:

On the following pages are the Science questions. There are two types of questions.

#### Multiple-Choice Questions:

Some questions will ask you to select an answer from among four choices. These questions will be found in your test booklet.

For the multiple-choice questions:

- Read each question, and choose the best answer.
- Record your choice in the answer booklet.
- Only one of the answers provided is the correct response.

#### Open-Ended Questions:

Other questions will require you to write your response. These questions will be found in your answer booklet.

For the open-ended questions:

- Be sure to read the directions carefully.
- If the question asks you to do two tasks, be sure to complete both tasks.
- If the question asks you to compare, be sure to compare. Also, if the question asks you to explain, describe, or identify, be sure to explain, describe, or identify.

## General Description of Scoring Guidelines for Science Open-Ended Items

### 2 Points

- The response demonstrates a *thorough* understanding of the scientific content, concepts, and procedures required by the task(s).
- The response provides a clear, complete, and correct response as required by the task(s). The response may contain a minor blemish or omission in work or explanation that does not detract from demonstrating a *thorough* understanding.

### 1 Point

- The response demonstrates a *partial* understanding of the scientific content, concepts, and procedures required by the task(s).
- The response is somewhat correct with *partial* understanding of the required scientific content, concepts, and/or procedures demonstrated and/or explained. The response may contain some work that is incomplete or unclear.

### 0 Points

- The response provides *insufficient* evidence to demonstrate any understanding of the scientific content, concepts, and procedures as required by the task(s) for that grade level.
- The response may show only information copied or rephrased from the question or *insufficient* correct information to receive a score of 1.

## MULTIPLE-CHOICE QUESTIONS

1. The germ theory of disease states that diseases are caused by microorganisms. These organisms are too small to be seen by a human eye unless they are magnified by a microscope. The spread of disease results from these organisms entering a host. Which statement **best** explains how this theory is different from an opinion?
- A. The germ theory of disease was made by scientists, but opinions are made by nonscientists.
  - B. The germ theory of disease does not change, but opinions can change when new discoveries are made.
  - C. The germ theory of disease is a group of ideas that scientists believe are true, but only nonscientists believe opinions are true.
  - D. The germ theory of disease is supported by evidence collected by many scientists over time, but opinions can be made without evidence.

Item Information	
Alignment	S8.A.1.1.1
Answer Key	D
Depth of Knowledge	2
p-value A	8%
p-value B	17%
p-value C	10%
p-value D	65% (correct answer)
Option Annotations	<p>A. Anyone can form an opinion.</p> <p>B. A theory may be changed if it can be supported with scientific evidence.</p> <p>C. A theory must be supported by scientific evidence; it cannot be based on personal beliefs or opinions.</p> <p>D. Key: The germ theory is a valid theory because it is supported by scientific evidence. An opinion can be made without scientific evidence.</p>

## 2. Use the information below to answer the question.

Heart Rate Investigation

Student	Heart Rate at Rest (beats per minute)	Heart Rate after Exercise (beats per minute)
W	70	87
X	64	106
Y	83	123
Z	66	91

Which statement is an inference that is **best** supported by the data shown in the chart?

- A. The students' heart rates increase with exercise.
- B. Student X's heart rate is higher after exercise than at rest.
- C. Student Y's heart rate is higher at rest than student Z's at rest.
- D. The students' heart rates during exercise are greater than after exercise.

Item Information	
Alignment	S8.A.1.1.3
Answer Key	A
Depth of Knowledge	2
p-value A	68% (correct answer)
p-value B	9%
p-value C	12%
p-value D	11%
Option Annotations	<p>A. Key: Heart rate was measured at rest and after exercise. The heart rates were higher after exercise than when at rest, indicating that the heart rates increased during exercise.</p> <p>B. Student X's heart rate is higher after exercise than at rest; this is the actual evidence and not an inference drawn from the evidence.</p> <p>C. Student Y's heart rate is higher at rest than student Z's heart rate at rest. As with option B, this is actual evidence rather than an inference drawn from the evidence.</p> <p>D. Without data collected during exercise, it cannot be determined whether the heart rates would be greater than, less than, or equal to the rates taken immediately after exercise.</p>

## 3. Use the information below to answer the question.

## Crinoids



living crinoid



crinoid stem fossil

Crinoids look like flowers. However, crinoids are animals related to sea stars and sea urchins. Crinoids first appeared on Earth about 490 million years ago. Today, they still live in the ocean.

A fossil collector found crinoid fossils. The collector did some research and read the information shown. What can the collector **best** infer about the area where the fossil was found?

- A. The area may once have been the site of an ocean.
- B. The rocks in the area most likely formed in the last 1,000 years.
- C. The area was most likely also a habitat for sea stars and sea urchins.
- D. The rocks in the area may have been moved from a different location.

Item Information	
Alignment	S8.A.1.3.2
Answer Key	A
Depth of Knowledge	2
p-value A	56% (correct answer)
p-value B	11%
p-value C	26%
p-value D	7%
Option Annotations	<p>A. Key: Crinoids are marine animals, so it can be inferred that the area where the fossils were found was the site of an ocean.</p> <p>B. Fossils take at least 10,000 years to form; therefore, it is not likely that the rocks in the area formed in the last 1,000 years.</p> <p>C. It cannot be determined whether the area was a habitat for sea stars and sea urchins until fossils of these animals are found.</p> <p>D. The evidence presented does not suggest that the rocks had been moved from a different location.</p>

## 4. Use the information below to answer the question.

**Lemonade Ingredients**

5 cups of sugar 5 cups of lemon juice 20 cups of water
--

A student follows a recipe using the ingredients shown to make lemonade. Which statement describes a relationship between ingredients in this recipe?

- A. There should be 20 cups of water for every 10 cups of sugar.
- B. There should be 5 cups of lemon juice for every cup of sugar.
- C. There should be 4 cups of water for every cup of lemon juice.
- D. There should be 1 cup of sugar for every 5 cups of lemon juice.

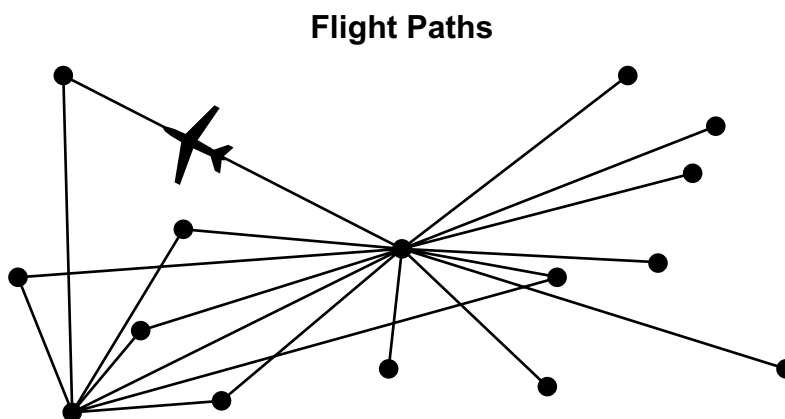
Item Information	
Alignment	S8.A.2.1.1
Answer Key	C
Depth of Knowledge	2
p-value A	10%
p-value B	13%
p-value C	67% (correct answer)
p-value D	10%
Option Annotations	<p>A. There should be 20 cups of water for every 5 cups of sugar rather than 10 cups of sugar.</p> <p>B. There should be 5 cups of lemon juice for every 5 cups of sugar rather than 1 cup of sugar.</p> <p>C. Key: Four cups of water for every cup of lemon juice is equivalent to 20 cups of water for every 5 cups of lemon juice.</p> <p>D. There should be 5 cups of sugar rather than 1 cup of sugar for every 5 cups of lemon juice.</p>

5. Based on trophic levels, which classification of organisms is one degree of order higher than herbivores?
- A. primary producers
  - B. tertiary consumers
  - C. primary consumers
  - D. secondary consumers

Item Information	
Alignment	S8.A.3.1.2
Answer Key	D
Depth of Knowledge	2
p-value A	17%
p-value B	21%
p-value C	33%
p-value D	29% (correct answer)
Option Annotations	<p>A. Producers are classified as the base or bottom level of energy pyramids.</p> <p>B. Tertiary consumers eat herbivores as well as secondary consumers that eat herbivores.</p> <p>C. Herbivores eat producers only and are therefore classified as primary consumers.</p> <p>D. Key: Herbivores are primary consumers; therefore, secondary consumers are one degree of order higher than herbivores. Secondary consumers eat primary consumers.</p>



6. Use the diagram below to answer the question.



The diagram shows flight paths between several cities. What does this system **best** represent?

- A. a positive feedback loop
- B. a hub-and-spoke system
- C. a negative feedback loop
- D. a symmetrical truss system

Item Information	
Alignment	S8.A.3.3.1
Answer Key	B
Depth of Knowledge	1
p-value A	22%
p-value B	45% (correct answer)
p-value C	14%
p-value D	19%
Option Annotations	<p>A. A positive feedback loop occurs when an increase in the amount of product increases the progress of the reaction or process that resulted in the product.</p> <p>B. Key: The diagram shows a hub-and-spoke system, in which a hub acts as a central location that connects to multiple points in a spoke pattern.</p> <p>C. A negative feedback loop occurs when an increase in the amount of product decreases the progress of the reaction or process that resulted in the product.</p> <p>D. A symmetrical truss system uses beams to form equal-sized triangular shapes. The shapes connect at joints to form a frame that can be used to support structures such as bridges and roofs.</p>

7. Some organisms, such as mammals, have closed blood circulation systems. In mammals, blood is moved throughout the body inside blood vessels. Other organisms, such as insects, have open blood circulation systems. In insects, blood is moved to large spaces inside the body, where it comes into contact with tissue. Despite working in different ways, these blood circulation systems have similar purposes. Which statement correctly describes one of the purposes they share?
- A. Both systems move materials throughout the organism's body.
  - B. Both systems remove harmful waste products from the organism's body.
  - C. Both systems transmit signals from the organism's muscles to its nervous system.
  - D. Both systems change food into useful nutrients and energy for the organism's cells.

Item Information	
Alignment	S8.B.1.1.2
Answer Key	A
Depth of Knowledge	2
p-value A	54% (correct answer)
p-value B	15%
p-value C	16%
p-value D	15%
Option Annotations	<p>A. Key: The main function of blood (circulatory system) is to move materials, such as essential nutrients, oxygen, and carbon dioxide, to and from cells inside the body.</p> <p>B. Waste is removed from the body by the excretory system (e.g., urine).</p> <p>C. Nerve cells transmit signals from the muscles to the nervous system.</p> <p>D. Organs of the digestive system, such as the stomach and intestines, change food into useful nutrients and energy.</p>

## 8. Use the list below to answer the question.

## Characteristics of a Biome

- extremely cold climate
- low level of organism diversity
- simple plant structures
- limited water drainage
- short growing season
- large population changes

Which biome is **best** described by these characteristics?

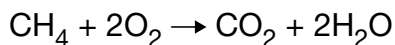
- A. desert
- B. tundra
- C. tropical forest
- D. deciduous forest

Item Information	
Alignment	S8.B.3.1.2
Answer Key	B
Depth of Knowledge	2
p-value A	7%
p-value B	72% (correct answer)
p-value C	8%
p-value D	13%
Option Annotations	<p>A. A desert biome is characterized by high temperatures.</p> <p>B. Key: A tundra biome is characterized by very low temperatures, simple vegetation such as shrubs, mosses, and lichens, and limited water drainage due in part to the presence of permafrost.</p> <p>C. A tropical forest biome is characterized by a warm climate and a high level of organism diversity.</p> <p>D. A deciduous forest biome is characterized by a moderate climate with four distinct seasons, with warm summers and cool winters. It contains a wide diversity of plant species, from mosses to large trees.</p>

9. Fires during dry seasons in the savanna (grassland) biome maintain community health. Some consumer organisms, like insects and mice, are killed by these fires, while other consumers, like birds, eat organisms affected by the fires. How does this pattern **best** illustrate the effect of diversity?
- A. It reduces the frequency of negative environmental events.
  - B. It allows organisms to adapt more rapidly to changing local conditions.
  - C. It helps maintain overall ecosystem health and efficiency of resource use.
  - D. It prevents selection pressure from affecting organisms within the environment.

Item Information	
Alignment	S8.B.3.2.2
Answer Key	C
Depth of Knowledge	3
p-value A	10%
p-value B	20%
p-value C	52% (correct answer)
p-value D	18%
Option Annotations	<p>A. This seasonal fire pattern does not change the frequency of other environmental events that could occur in the savanna.</p> <p>B. The community of organisms living in this biome is already adapted to the seasonal cycles. The fires do not change the rate at which the organisms are able to adapt.</p> <p>C. Key: The cyclical occurrence of the fires helps restore balance to the community by controlling the growth of some populations of organisms and making resources available to other populations of organisms.</p> <p>D. Natural selection pressures within organism populations will be present with or without the seasonal fires.</p>

10. Use the reaction below to answer the question.

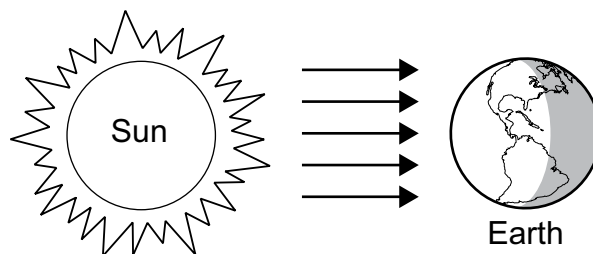


Which statement correctly describes the reactants in the reaction shown?

- A.  $\text{CH}_4$  and  $\text{O}_2$  are the reactants because they combine to form new compounds.
- B.  $\text{CH}_4$  and  $\text{O}_2$  are the reactants because they have the highest number of atoms.
- C.  $\text{CO}_2$  and  $\text{H}_2\text{O}$  are the reactants because they are formed following an initial reaction.
- D.  $\text{CO}_2$  and  $\text{H}_2\text{O}$  are the reactants because they both exist as gases at room temperature.

Item Information	
Alignment	S8.C.1.1.3
Answer Key	A
Depth of Knowledge	2
p-value A	55% (correct answer)
p-value B	10%
p-value C	26%
p-value D	9%
Option Annotations	<p>A. Key: Methane and oxygen react and combine to yield carbon dioxide and water.</p> <p>B. The number of atoms does not determine whether a substance is a reactant or a product.</p> <p>C. Carbon dioxide and water are products in the reaction shown.</p> <p>D. Carbon dioxide and water are products in the reaction shown. Also, reactants can exist in a liquid, solid, or gaseous state at room temperature.</p>

11. Use the diagram below to answer the question.

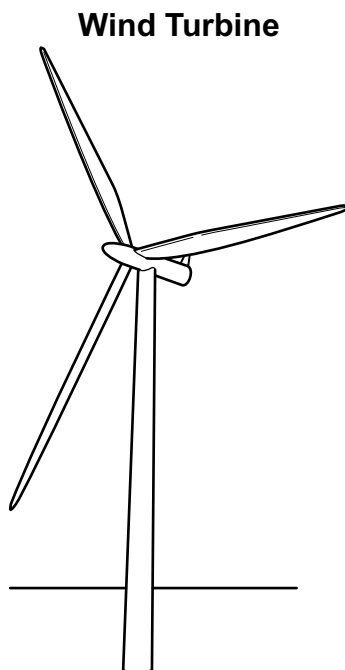


Which process of heat transfer is shown in the diagram?

- A. convection
- B. conduction
- C. insulation
- D. radiation

Item Information	
Alignment	S8.C.2.1.2
Answer Key	D
Depth of Knowledge	2
p-value A	12%
p-value B	9%
p-value C	5%
p-value D	73% (correct answer)
Option Annotations	<p>A. Convection is the transfer of heat through a fluid (e.g., water, air) from an area of high temperature to an area of low temperature.</p> <p>B. Conduction is the transfer of heat between two objects that are in direct contact with one another.</p> <p>C. Insulation is not a form of heat transfer. Insulation is an action that slows the transfer of heat.</p> <p>D. Key: Radiation is the transfer of heat through electromagnetic waves. The diagram illustrates heat in the form of electromagnetic waves traveling through space from the Sun to Earth.</p>

12. Use the drawing below to answer the question.



Energy from the wind is used to rotate the blades of the wind turbine. Which sequence shows the conversion of energy that occurs at a wind turbine?

- A. solar energy → mechanical energy → electrical energy
- B. kinetic energy → mechanical energy → electrical energy
- C. chemical energy → potential energy → mechanical energy
- D. potential energy → gravitational energy → chemical energy

Item Information	
Alignment	S8.C.2.1.3
Answer Key	B
Depth of Knowledge	2
p-value A	28%
p-value B	60% (correct answer)
p-value C	5%
p-value D	7%
Option Annotations	<p>A. The wind turbine would require a solar panel to convert solar energy into mechanical energy.</p> <p>B. Key: The motion of the wind (kinetic energy) moves the blades, which use mechanical energy to move internal parts, which in turn are used to generate electrical energy.</p> <p>C. Kinetic energy from the wind, not chemical energy, is being converted in the turbine.</p> <p>D. The gravitational potential energy of the blades above the ground would have to be converted to kinetic energy before it could be converted to chemical energy.</p>



13. Which example provides the **best** description of a system that is gaining more potential energy than kinetic energy?
- A. A hammer strikes a nail.
  - B. A soccerball rolls across a field.
  - C. A marshmallow rests on a toy catapult.
  - D. A rubber band stretches between two fingers.

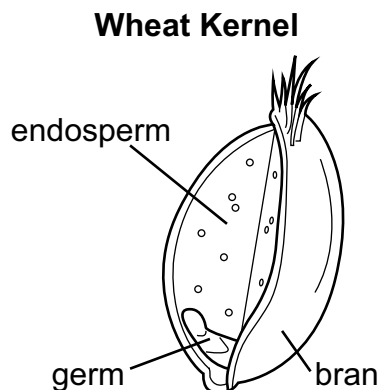
Item Information	
Alignment	S8.C.3.1.2
Answer Key	D
Depth of Knowledge	2
p-value A	18%
p-value B	14%
p-value C	23%
p-value D	44% (correct answer)
Option Annotations	<p>A. The hammer is moving as it strikes the nail, so it is gaining more kinetic energy than potential energy.</p> <p>B. The ball is moving, which indicates that it has more kinetic energy than potential energy.</p> <p>C. The marshmallow contains potential energy but is neither gaining nor losing it because the marshmallow is not changing or moving.</p> <p>D. Key: The rubber band is gaining more elastic potential energy than kinetic energy as it is stretched.</p>

14. Which statement **best** explains how sedimentary rock can be formed from igneous rock?

- A. Sandstone rock subducts and melts into magma.
- B. Magma cools and hardens after flowing onto Earth's surface.
- C. Layers of lava rock are buried and exposed to heat and pressure.
- D. Broken pieces of pumice are deposited, cemented, and compacted.

Item Information	
Alignment	S8.D.1.1.1
Answer Key	D
Depth of Knowledge	2
p-value A	18%
p-value B	29%
p-value C	26%
p-value D	27% (correct answer)
Option Annotations	<p>A. Sandstone is sedimentary rock that can be melted into magma that can cool to form igneous rock.</p> <p>B. Cooled magma forms igneous rocks.</p> <p>C. Heat and pressure can change igneous lava rock into metamorphic rock.</p> <p>D. Key: Pumice is porous igneous rock that, when deposited, cemented, and compacted, can form sedimentary rock.</p>

15. Use the diagram below to answer the question.

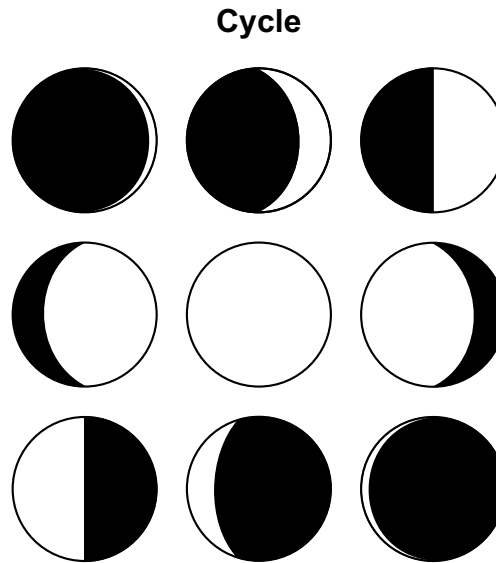


The three parts of the wheat plant's kernel are used for food. Which list correctly orders the steps for getting wheat-based food products to people so that people can use the products in their homes?

- A. grinding at the mill, packaging products, harvesting from the field, transporting to grocery stores
- B. harvesting from the field, grinding at the mill, packaging products, transporting to grocery stores
- C. grinding at the mill, harvesting from the field, transporting to grocery stores, packaging products
- D. harvesting from the field, grinding at the mill, transporting to grocery stores, packaging products

Item Information	
Alignment	S8.D.1.2.1
Answer Key	B
Depth of Knowledge	2
p-value A	5%
p-value B	82% (correct answer)
p-value C	6%
p-value D	7%
Option Annotations	<p>A. The process begins with harvesting wheat from the field.</p> <p>B. Key: The steps for getting wheat to market begin with harvesting it from the field, then grinding it at a mill, packaging it to be sent to stores, and then transporting it to stores to be sold to consumers.</p> <p>C. Harvesting from the field happens before grinding at the mill, and packaging products happens before transporting to stores.</p> <p>D. Packaging products happens before transporting to stores.</p>

16. Use the drawing below to answer the question.



The drawing shows a cycle that repeats regularly. Which factor primarily determines the length of this cycle?

- A. the tilt of Earth on its axis
- B. the Moon's rate of rotation on its axis
- C. the distance between Earth and the Sun
- D. the Moon's rate of revolution around Earth

Item Information	
Alignment	S8.D.3.1.1
Answer Key	D
Depth of Knowledge	2
p-value A	14%
p-value B	30%
p-value C	8%
p-value D	49% (correct answer)
Option Annotations	<p>A. The tilt of Earth on its axis is a primary reason why Earth has seasons.</p> <p>B. The rate of the Moon's rotation does not determine the part that is seen as illuminated from Earth.</p> <p>C. The length of the lunar cycle is a measure of the Moon's orbit around Earth.</p> <p>D. Key: The diagram shows the lunar cycle, which causes a portion of the Moon to be illuminated when viewed from Earth relative to its position in completing an orbit around Earth.</p>

## OPEN-ENDED ITEM

17. Use the table below to answer the question.

Distance and Orbital Velocity of Planets

	Venus	Earth	Mars	Saturn	Neptune
Distance from the Sun ( $10^6$ km)	108	149	228	1,434	4,495
Orbital Velocity (km/s)	35	30	24	10	5

**Part A:** Describe the relationship between the distance from the Sun and the orbital velocity of the planets in the table.

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**Part B:** State a hypothesis describing how gravity affects the relationship in Part A.

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## SCORING GUIDE

## #17 Item Information

Alignment	S8.A.2.1.1	Depth of Knowledge	2	Mean Score	0.75
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## Item-Specific Scoring Guideline

Score	Description
2	<p>The response demonstrates a <i>thorough</i> understanding of how to use evidence, observations, or a variety of scales (e.g., mass, distance, volume, temperature) to describe relationships by</p> <ul style="list-style-type: none"> <li>describing the relationship between the distance from the Sun and the orbital velocity of the planets in the table</li> </ul> <p><b>AND</b></p> <ul style="list-style-type: none"> <li>stating a hypothesis describing how gravity affects the relationship in Part A.</li> </ul> <p>The response is clear, complete, and correct.</p>
1	<p>The response demonstrates a <i>partial</i> understanding of how to use evidence, observations, or a variety of scales (e.g., mass, distance, volume, temperature) to describe relationships by</p> <ul style="list-style-type: none"> <li>describing the relationship between the distance from the Sun and the orbital velocity of the planets in the table</li> </ul> <p><b>OR</b></p> <ul style="list-style-type: none"> <li>stating a hypothesis describing how gravity affects the relationship in Part A.</li> </ul> <p>The response may contain some work that is incomplete or unclear.</p>
0	<p>The response provides <i>insufficient</i> evidence to demonstrate any understanding of the concept being tested.</p>

**Note: No deductions should be taken for misspelled words or grammatical errors.**

**Responses that will receive credit:****Part A (1 point):**

- As an object's distance from the Sun increases, its orbital velocity decreases. OR
- There is an inverse relationship between a planet's distance from the Sun and its orbital velocity. OR
- As the distance from the Sun decreases, orbital velocity increases.

**Part B (1 point):**

- If an object is close to the Sun, there will be a stronger gravitational attraction than if it were farther away, and a stronger gravitational attraction results in a greater orbital speed. OR
- If an object moves away from the Sun, then its orbital velocity decreases because the gravitational attraction between the object and the Sun decreases. OR
- If an object moves toward the Sun, then its orbital velocity increases because the gravitational attraction between the object and the Sun increases.

## STUDENT RESPONSE

Response Score: 2 points

17. Use the table below to answer the question.

Distance and Orbital Velocity of Planets

	Venus	Earth	Mars	Saturn	Neptune
Distance from the Sun (10 <sup>6</sup> km)	108	149	228	1,434	4,495
Orbital Velocity (km/s)	35	30	24	10	5

**Part A:** Describe the relationship between the distance from the Sun and the orbital velocity of the planets in the table.

The planets that are closer to the sun move around the sun at greater speeds rather than the ones that are farther away, which move at slower speeds.

**Part B:** State a hypothesis describing how gravity affects the relationship in Part A.

If a planet is closer to the sun then the planet will have greater gravitational pull, causing the planet to move faster.

This response demonstrates a *thorough* understanding of how to use evidence, observations, or a variety of scales to describe relationships. In Part A, the response correctly describes the relationship between the distance from the Sun and the orbital velocity of the planets in the table (either description is correct for credit: *closer to the sun move around the sun at greater speeds* or *the ones that are farther away, which move at slower speeds*). In Part B, the response correctly states a hypothesis describing how gravity affects the relationship in Part A (*If a planet is closer to the sun then the planet will have greater gravitational pull, causing the planet to move faster*). The response is clear, complete, and correct.



## STUDENT RESPONSE

Response Score: 1 point

17. Use the table below to answer the question.

Distance and Orbital Velocity of Planets

	Venus	Earth	Mars	Saturn	Neptune
Distance from the Sun (10 <sup>6</sup> km)	108	149	228	1,434	4,495
Orbital Velocity (km/s)	35	30	24	10	5

**Part A:** Describe the relationship between the distance from the Sun and the orbital velocity of the planets in the table.

*As the distance from the sun increases the orbital velocity decreases*

**Part B:** State a hypothesis describing how gravity affects the relationship in Part A.

*An increase in gravity would cause an increase in orbital velocity.*

This response demonstrates a *partial* understanding of how to use evidence, observations, or a variety of scales to describe relationships. In Part A, the response correctly describes the relationship between the distance from the Sun and the orbital velocity of the planets in the table (*As the distance from the sun increases the orbital velocity decreases*). In Part B, the response (*An increase in gravity would cause an increase in orbital velocity*) is an incomplete hypothesis describing how gravity affects the relationship in Part A (missing distance) and receives no credit.

## STUDENT RESPONSE

Response Score: 0 points



Question 17

Use the table below to answer the question.

	Venus	Earth	Mars	Saturn	Neptune
distance from the Sun ( $10^6$ km)	108	149	228	1,434	4,495
orbital velocity (km/s)	35	30	24	10	5

**Part A:** Describe the relationship between the distance from the Sun and the orbital velocity of the planets in the table.

The distance would change if the orbital velocity wasn't there.

63 / 1000

**Part B:** State a hypothesis describing how gravity affects the relationship in Part A.

Gravity holds the planets in the solar system.

46 / 1000

Review/End Test Pause Flag Options Next

This response provides *insufficient* evidence to demonstrate any understanding of how to use evidence, observations, or a variety of scales to describe relationships. In Part A, the response (*distance would change if the orbital velocity wasn't there*) does not describe the relationship between the distance from the Sun and the orbital velocity of the planets in the table and receives no credit. In Part B, the response (*Gravity holds the planets in the solar system*) is an incorrect hypothesis describing how gravity affects the relationship in Part A and receives no credit.

## OPEN-ENDED ITEM

18. A student noticed that a can of carbonated beverage had lost most of its fizziness after being left open for one hour in a warm room with a temperature set at 25°C (77°F). The student hypothesized that a carbonated beverage would lose more carbon dioxide (CO<sub>2</sub>) in a warm environment than in a colder environment.

**Part A:** Identify the independent variable to test this hypothesis and describe how it could be changed.

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**Part B:** Identify **one** variable that should be held constant to accurately test the hypothesis.

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**AFTER YOU HAVE CHECKED YOUR WORK, CLOSE YOUR ANSWER BOOKLET AND TEST BOOKLET SO YOUR TEACHER WILL KNOW YOU ARE FINISHED.**



## SCORING GUIDE

## #18 Item Information

Alignment	S8.A.2.1.3	Depth of Knowledge	3	Mean Score	0.72
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## Item-Specific Scoring Guideline

Score	Description
2	<p>The response demonstrates a <i>thorough</i> understanding of how to design a controlled experiment by specifying how the independent variables will be manipulated, how the dependent variable will be measured, and which variables will be held constant by</p> <ul style="list-style-type: none"> <li>identifying the independent variable to test this hypothesis and describing how it could be changed</li> </ul> <p><b>AND</b></p> <ul style="list-style-type: none"> <li>identifying <b>one</b> variable that should be held constant to accurately test the hypothesis.</li> </ul> <p>The response is clear, complete, and correct.</p>
1	<p>The response demonstrates a <i>partial</i> understanding of how to design a controlled experiment by specifying how the independent variables will be manipulated, how the dependent variable will be measured, and which variables will be held constant by</p> <ul style="list-style-type: none"> <li>identifying the independent variable to test this hypothesis and describing how it could be changed</li> </ul> <p><b>OR</b></p> <ul style="list-style-type: none"> <li>identifying <b>one</b> variable that should be held constant to accurately test the hypothesis.</li> </ul> <p>The response may contain some work that is incomplete or unclear.</p>
0	<p>The response provides <i>insufficient</i> evidence to demonstrate any understanding of the concept being tested.</p>

**Note: No deductions should be taken for misspelled words or grammatical errors.**

**Responses that will receive credit (responses are not limited to these examples):**

**Part A (1 point):**

- The independent variable to test this hypothesis is environmental temperature, and the student could change this variable by placing the carbonated beverage in a refrigerator.

**Part B (1 point):**

- One variable that should be held constant to accurately test this hypothesis is the type of carbonated beverage used in each environment.
- One variable that should be held constant to accurately test this hypothesis is the size of the can of carbonated beverage used in each environment.
- One variable that should be held constant to accurately test this hypothesis is the amount of time that carbon dioxide is collected from each can in each environment.

## STUDENT RESPONSE

Response Score: 2 points



Question 18  
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Item ID ?

A student noticed that a can of carbonated beverage had lost most of its fizziness after being left open for one hour in a warm room with a temperature set at 25°C (77°F). The student hypothesized that a carbonated beverage would lose more carbon dioxide (CO<sub>2</sub>) in a warm environment than in a colder environment.

**Part A:** Identify the independent variable to test this hypothesis and describe how it could be changed.

The independent variable would be the temperature of the room. The student could change the temperature to hot, cold, or somewhere in between to test his hypothesis.

165 / 1000

**Part B:** Identify **one** variable that should be held constant to accurately test the hypothesis.

The type of carbonated beverage should be kept the same so that it has the same amount of carbonation each experiment.

118 / 1000

Review/End Test Pause Flag Options Next

This response demonstrates a *thorough* understanding of how to design a controlled experiment by specifying how the independent variables will be manipulated, how the dependent variable will be measured, and which variables will be held constant. In Part A, the response correctly identifies the independent variable to test this hypothesis (*temperature*) and describes how it could be changed (*change the temperature to hot, cold, or somewhere in between*). In Part B, the response correctly identifies one variable that should be held constant to accurately test the hypothesis (*type of carbonated beverage*). The response is clear, complete, and correct.

## STUDENT RESPONSE

## Response Score: 1 point

18. A student noticed that a can of carbonated beverage had lost most of its fizziness after being left open for one hour in a warm room with a temperature set at 25°C (77°F). The student hypothesized that a carbonated beverage would lose more carbon dioxide (CO<sub>2</sub>) in a warm environment than in a colder environment.

**Part A:** Identify the independent variable to test this hypothesis and describe how it could be changed.

The independent variable is the tempurature that the beverage sits in. This can be changed by putting it in different environments, like a fridge or freezer

**Part B:** Identify **one** variable that should be held constant to accurately test the hypothesis.

The tempurature of where the beverage sits in should be held constant.

This response demonstrates a *partial* understanding of how to design a controlled experiment by specifying how the independent variables will be manipulated, how the dependent variable will be measured, and which variables will be held constant. In Part A, the response correctly identifies the independent variable to test this hypothesis (*tempurature*) and describes how it could be changed (*putting it in different environments, like a fridge or freezer*). In Part B, the response (*tempurature of where the beverage sits*) incorrectly identifies a variable that should be held constant to accurately test the hypothesis and receives no credit.

## STUDENT RESPONSE

## Response Score: 0 points

18. A student noticed that a can of carbonated beverage had lost most of its fizziness after being left open for one hour in a warm room with a temperature set at 25°C (77°F). The student hypothesized that a carbonated beverage would lose more carbon dioxide (CO<sub>2</sub>) in a warm environment than in a colder environment.

**Part A:** Identify the independent variable to test this hypothesis and describe how it could be changed.

The dependant variable is Co2.

**Part B:** Identify **one** variable that should be held constant to accurately test the hypothesis.

The variable is 77°F

This response provides insufficient evidence to demonstrate any understanding of how to design a controlled experiment by specifying how the independent variables will be manipulated, how the dependent variable will be measured, and which variables will be held constant. In Part A, the response identifies an incorrect variable as the independent variable (Co<sub>2</sub>). Additionally, no explanation of how it could be changed is provided, and Part A receives no credit. In Part B, the response (77°F) incorrectly identifies the independent variable and not the variable that should be held constant to accurately test the hypothesis and receives no credit.



## SAMPLE ITEM SUMMARY

## Multiple-Choice

Sample Number	Alignment	Answer Key	Depth of Knowledge	p-value A	p-value B	p-value C	p-value D
1	S8.A.1.1.1	D	2	8%	17%	10%	65%
2	S8.A.1.1.3	A	2	68%	9%	12%	11%
3	S8.A.1.3.2	A	2	56%	11%	26%	7%
4	S8.A.2.1.1	C	2	10%	13%	67%	10%
5	S8.A.3.1.2	D	2	17%	21%	33%	29%
6	S8.A.3.3.1	B	1	22%	45%	14%	19%
7	S8.B.1.1.2	A	2	54%	15%	16%	15%
8	S8.B.3.1.2	B	2	7%	72%	8%	13%
9	S8.B.3.2.2	C	3	10%	20%	52%	18%
10	S8.C.1.1.3	A	2	55%	10%	26%	9%
11	S8.C.2.1.2	D	2	12%	9%	5%	73%
12	S8.C.2.1.3	B	2	28%	60%	5%	7%
13	S8.C.3.1.2	D	2	18%	14%	23%	44%
14	S8.D.1.1.1	D	2	18%	29%	26%	27%
15	S8.D.1.2.1	B	2	5%	82%	6%	7%
16	S8.D.3.1.1	D	2	14%	30%	8%	49%

## Open-Ended

Sample Number	Alignment	Points	Depth of Knowledge	Mean Score
17	S8.A.2.1.1	2	2	0.75
18	S8.A.2.1.3	2	3	0.72