MASSACHUSETTS
Department of Elementary
and Secondary Education

Release of Spring 2023 MCAS Test Items

from the

Grade 5 Science and Technology/Engineering Paper-Based Test

June 2023
Massachusetts Department of Elementary and Secondary Education

MASSACHUSETTS
Department of Elementary
and Secondary Education

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Overview of Grade 5 Science and Technology/Engineering Test

The spring 2023 grade 5 Science and Technology/Engineering (STE) test was a next-generation assessment that was administered in two formats: a computer-based version and a paper-based version. Most students took the computer-based test. The paper-based test was offered as an accommodation for eligible students who were unable to use a computer. More information can be found on the MCAS Test Administration Resources page at www.doe.mass.edu/mcas/admin.html.

Most of the operational items on the grade 5 STE test were the same, regardless of whether a student took the computer-based version or the paper-based version. In places where a technology-enhanced item was used on the computer-based test, an adapted version of the item was created for use on the paper test. These adapted paper items were multiple-choice or multiple-select items that tested the same STE content and assessed the same standard as the technology-enhanced item.

This document displays released items from the paper-based test. Released items from the computer-based test are available on the MCAS Resource Center website at mcas.pearsonsupport.com/released-items.

Test Sessions and Content Overview

The grade 5 STE test was made up of two separate test sessions. Each session included selected-response questions and constructed-response questions. On the paper-based test, the selected-response questions were multiple-choice items and multiple-select items, in which students select the correct answer(s) from among several answer options.

Standards and Reporting Categories

The grade 5 STE test was based on learning standards in the four major content strands in the 2016 *Massachusetts Science and Technology/Engineering Curriculum Framework*. The Framework is available on the Department website at www.doe.mass.edu/frameworks/current.html. The four content strands are listed below.

- Earth and Space Science
- Life Science
- Physical Science
- Technology/Engineering

Science and Technology/Engineering test results are reported under four MCAS reporting categories, which are identical to the four framework content strands listed above.

Most items on the grade 5 STE test are also reported as aligning to one of three MCAS Science and Engineering Practice Categories. The three practice categories are listed below.

- Practice Category A: Investigations and Questioning
- Practice Category B: Mathematics and Data
- Practice Category C: Evidence, Reasoning, and Modeling

More information about the practice categories is available on the Department website at www.doe.mass.edu/mcas/tdd/practice-categories.html.

The tables at the conclusion of this document provide the following information about each released and unreleased operational item: reporting category, standard covered, science and engineering practice category covered (if any), item type, and item description. The correct answers for released selected-response questions are also displayed in the released item table.

Reference Materials

Each student taking the paper-based version of the grade 5 STE test was provided with a plastic ruler. An image of the ruler is not reproduced in this document. Each student also had sole access to a calculator.

During both STE test sessions, the use of bilingual word-to-word dictionaries was allowed for current and former English learner students.

Grade 5
Science and Technology/Engineering
SESSION 1

This session contains 8 questions.

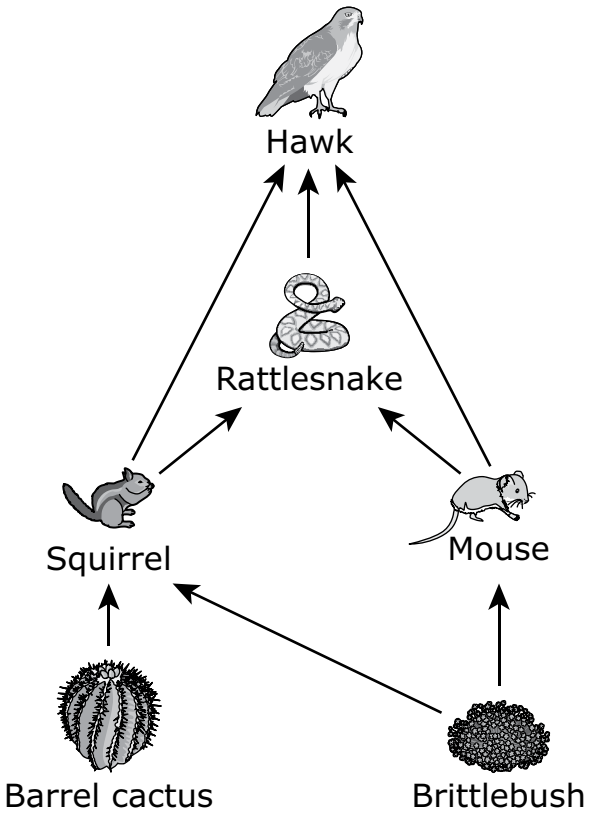
Directions

Read each question carefully and then answer it as well as you can. You must record all answers in this Test & Answer Booklet.

For some questions, you will mark your answers by filling in the circles in your Test & Answer Booklet. Make sure you darken the circles completely. Do not make any marks outside of the circles. If you need to change an answer, be sure to erase your first answer completely.

If a question asks you to show or explain your work, you must do so to receive full credit. Write your response in the space provided. Only responses written within the provided space will be scored.

1 A desert food web is shown.



Which of the following would most likely happen if the rattlesnakes were removed from the ecosystem?

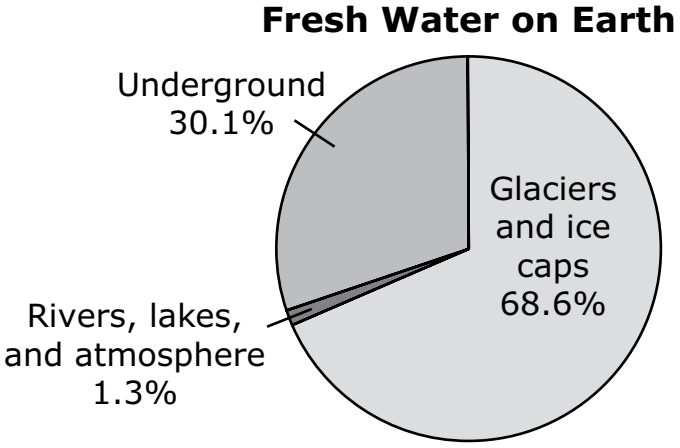
Ⓐ Mice would eat less brittlebush.

Ⓑ Barrel cactus would be eaten by hawks.

Ⓒ Squirrels would not have a food source.

Ⓓ Hawks would eat more squirrels and mice.

2 The circle graph shows where fresh water is found on Earth.



Which of the following best explains why only a small percentage of the fresh water on Earth is available for human use?

Ⓐ Most fresh water is stored deep underground.

Ⓑ Most fresh water is frozen in glaciers and ice caps.

Ⓒ Most fresh water is trapped in the air as water vapor.

Ⓓ Most fresh water is found in lakes in areas that are hard to reach.

3 A house is currently powered by electricity from a coal-burning power plant. The owner wants to add solar panels and a small wind turbine to generate electricity for the house.

The energy resource that produces the electricity the house currently uses is a

Ⓐ nonrenewable resource.

Ⓑ renewable resource.

Which of the following describes sunlight and wind?

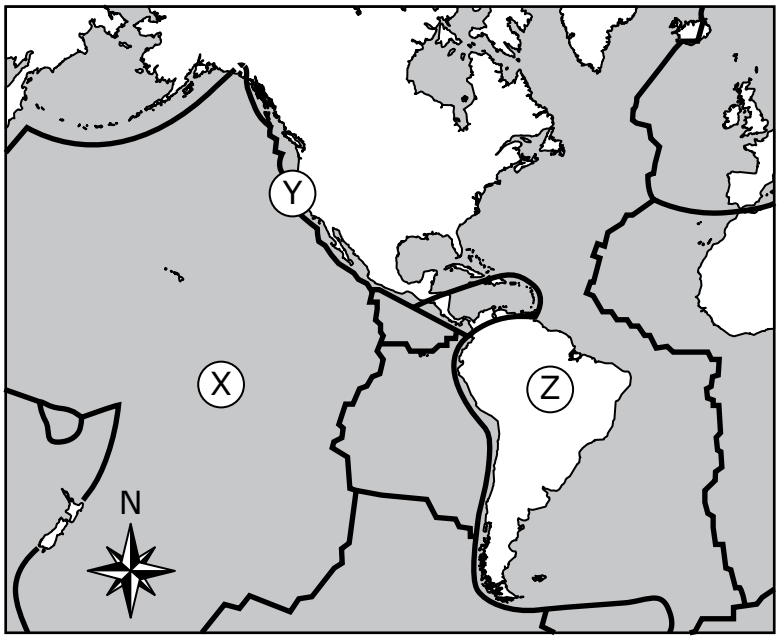
Ⓐ Sunlight and wind are both renewable resources.

Ⓑ Sunlight and wind are both nonrenewable resources.

Ⓒ Sunlight is a renewable resource and wind is a nonrenewable resource.

Ⓓ Sunlight is a nonrenewable resource and wind is a renewable resource.

4 The map shows three locations labeled X, Y, and Z.



Key
= Ocean
= Continent
= Plate boundary

Which location is more likely to experience earthquakes and volcanoes?

Ⓐ location X

Ⓑ location Y

Ⓒ location Z

This location is more likely to experience earthquakes and volcanoes because it is

Ⓐ on a plate boundary.

Ⓑ in the middle of the ocean.

Ⓒ in the middle of a continent.

This question has three parts. Write your response on the next page. Be sure to label each part of your response.

5 Two students designed a game that involves throwing balls into holes in a box to earn points. The students drew two diagrams to represent the game design, as shown. One of the balls from the game is also shown in each diagram.

Diagram 1

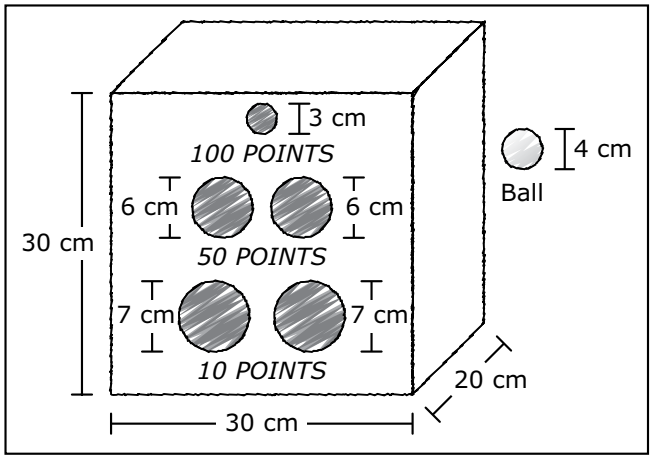
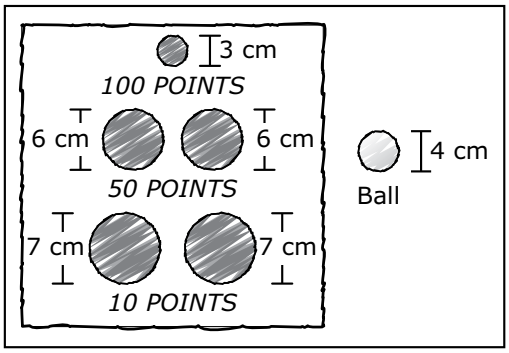


Diagram 2



A. The students will build a prototype of the game.

Identify the **best** diagram for the students to use to build the prototype. Explain why the students should use this diagram.

B. The students tested the prototype and realized they had made a mistake in their design. Players were supposed to be able to earn 10, 50, or 100 points with a single throw of the ball, but this was not possible.

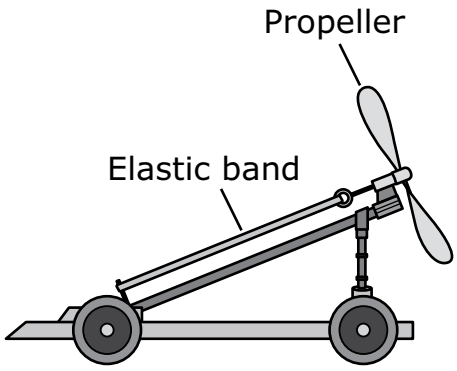
Describe one change to the game design that could be made to correct this mistake. Be sure to use specific details of the change to the design in your answer.

C. After the students corrected the mistake, they decided to test the game. The students placed the prototype on a table and played the game. They found that balls that did not go through the holes fell on the floor during the game.

Describe one change to the prototype that would stop balls from falling on the floor.

5

6 A student builds a toy car like the one shown in the diagram. The student turns the propeller, which twists the elastic band. When the student releases the car on a flat surface, the propeller spins and the car moves forward.



Which of the following changes could be made to test how the amount of stored energy affects the distance the car travels?

Ⓐ use different sizes of wheels

Ⓑ release the car on different surfaces

Ⓒ place objects of different masses on the car

Ⓓ turn the propeller different numbers of times

This question has two parts. Write your response on the next page. Be sure to label each part of your response.

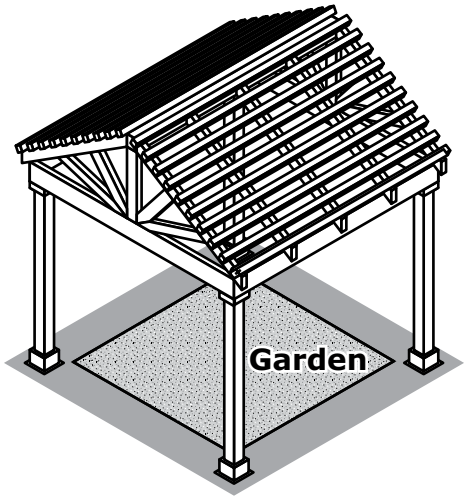
7 A student investigated the growth of bean plants under different conditions. She had ten bean plants, each in an identical pot, with the same amount of soil in each pot. The student measured the height of each plant. Then she separated the plants into two groups of five plants each. The student placed one group in a dark room and the other group in an area that had light. She gave each plant the same amount of water twice a week. After four weeks, the student measured the height of each plant again.

A. Explain why the student measured the height of each plant before she separated the plants into two groups.

B. Identify which group of plants most likely grew more in height over the four weeks. Explain your reasoning. In your explanation, be sure to include the process that plants use to help them grow.

7

8 A class wants to build the structure shown for an outdoor garden at school.



Which of the following problems would **best** be solved by building this structure?

Ⓐ plants being eaten by insects

Ⓑ water draining from soil too quickly

Ⓒ soil eroding when sprayed with a hose

Ⓓ plants turning brown from too much sunlight

Grade 5
Science and Technology/Engineering
SESSION 2

This session contains 12 questions.

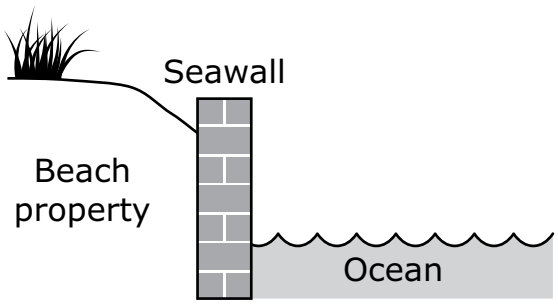
Directions

Read each question carefully and then answer it as well as you can. You must record all answers in this Test & Answer Booklet.

For some questions, you will mark your answers by filling in the circles in your Test & Answer Booklet. Make sure you darken the circles completely. Do not make any marks outside of the circles. If you need to change an answer, be sure to erase your first answer completely.

If a question asks you to show or explain your work, you must do so to receive full credit. Write your response in the space provided. Only responses written within the provided space will be scored.

9 A town is planning to build a seawall to protect beach property from erosion caused by ocean waves. An example of a seawall is shown.



Which of the following is the most important factor to consider when choosing the best design solution for the seawall?

Ⓐ the temperature of the ocean water

Ⓑ the height of the highest ocean waves

Ⓒ the number of plants on the beach property

Ⓓ the types of buildings on the beach property

10 A scientist is studying a plant species with different-sized flowers. The scientist separates the plants into three groups for breeding. One group has plants with large flowers, one has plants with small flowers, and one has plants with both large and small flowers.

The scientist breeds plants that have similar-sized flowers with each other. The results from the breedings are shown in the table.

Breeding Group	Average Size of Parent Flower (cm)	Average Size of Offspring Flower (cm)
large flowers only	3.2	3.4
small flowers only	2.8	2.7
mix (control)	3.0	3.0

Based on this information, what can be concluded about flower size in this plant species?

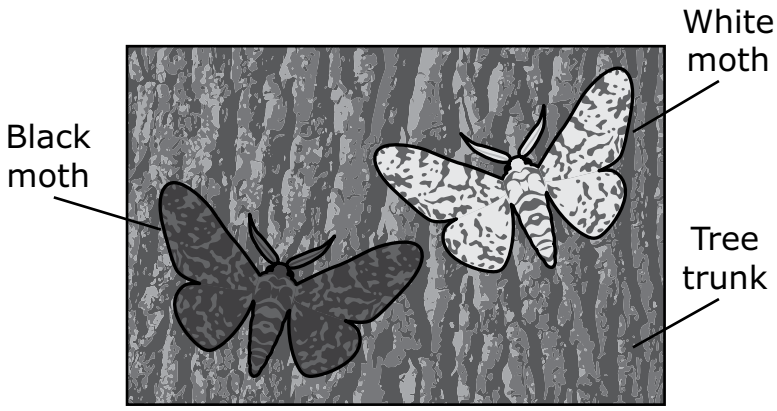
Ⓐ Flower size occurs randomly.

Ⓑ Flower size is an inherited trait.

Ⓒ Flower size always changes as the plants grow.

Ⓓ Flower size is determined only by the environment.

11 A type of moth is active at night and rests on dark-colored tree trunks during the day. These moths can be black or mostly white. The diagram shows two of the moths on a tree trunk.



A population of birds moves into the area where the moths live, and the birds begin to eat the moths. Which of the following best describes the moth population many generations after the birds move into the area?

Ⓐ The population will have the same number of black moths and white moths because color is an inherited trait.

Ⓑ The population will have fewer black moths than white moths because the black moths blend in with the environment.

Ⓒ The population will have more black moths than white moths because the white moths are more easily seen by predators.

Ⓓ The population will have the same number of black moths and white moths because they are always born in equal numbers.

The following section focuses on investigations students conducted using water.

Read the information below and use it to answer the three selected-response questions and one constructed-response question that follow.

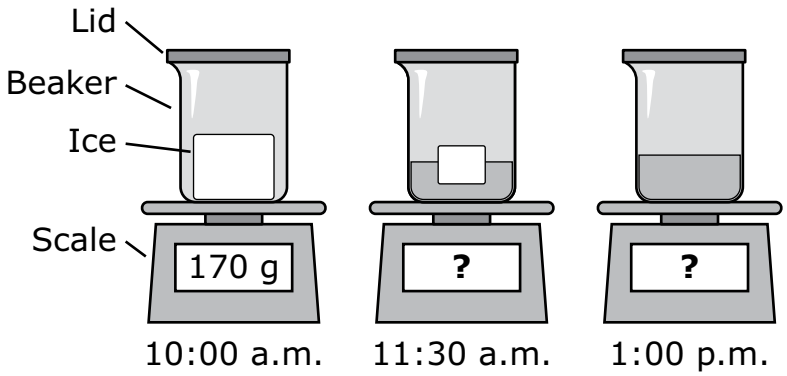
A group of students conducted two investigations using water.

Investigation 1

The students completed the following steps.

1. Put a cube of ice into a beaker and cover the beaker with a lid.
2. Measure the mass of the ice, beaker, and lid.
3. Let the beaker remain at room temperature for three hours so that the ice becomes liquid water.
4. Measure the mass of the liquid water, beaker, and lid.

The diagram shows investigation 1.



Investigation 2

The students completed the following steps.

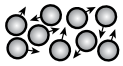
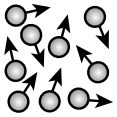
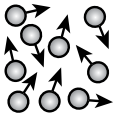
1. Add some salt crystals to a beaker of water.
2. Stir the contents of the beaker until the crystals completely dissolve.
3. Do **not** place a lid on the beaker.
4. Measure and record the mass of the beaker and its contents at the same time every day for three days.

The students observed that on day 3 the water was gone and crystals were at the bottom of the beaker. The data the students collected during investigation 2 are shown in the table.

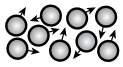
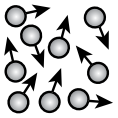
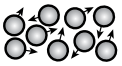
Day	Mass of Beaker and Contents (g)
1	88
2	74
3	60

12 Which of the following best shows the water particles at different times during the investigations?

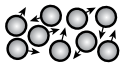
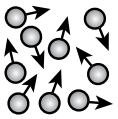
Ⓐ

Investigation 1		Investigation 2	
10:00 a.m.		Day 1	
1:00 p.m.		Day 3	

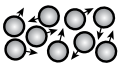
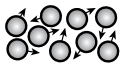
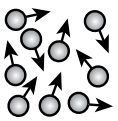
Ⓑ

Investigation 1		Investigation 2	
10:00 a.m.		Day 1	
1:00 p.m.		Day 3	

Ⓒ

Investigation 1		Investigation 2	
10:00 a.m.		Day 1	
1:00 p.m.		Day 3	

Ⓓ

Investigation 1		Investigation 2	
10:00 a.m.		Day 1	
1:00 p.m.		Day 3	

13 During investigation 1, the ice in the beaker changed phase between 10:00 a.m. and 1:00 p.m.

Which of the following best describes the change to the ice in the beaker?

Ⓐ The ice condensed into water because the ice gained heat energy.

Ⓑ The ice evaporated into water because the ice lost heat energy.

Ⓒ The ice melted into water because the ice gained heat energy.

Ⓓ The ice melted into water because the ice lost heat energy.

14 The students conducted a third investigation. They had two unlabeled substances in containers. They knew that one substance was salt and the other was white sand.

The students completed the following steps:

- Observe whether each substance takes the shape of its container.
- Measure the masses and volumes of the unlabeled substances.
- Mix each substance in water and observe whether the substance dissolves.

Which of the following would most help determine which substance was salt and which was white sand?

Ⓐ measuring the mass of each substance

Ⓑ measuring the volume of each substance

Ⓒ observing whether each substance dissolves in water

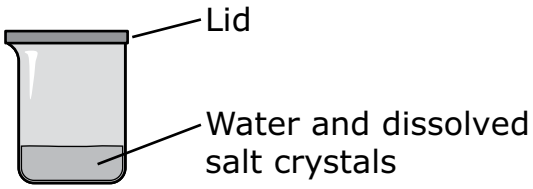
Ⓓ observing whether each substance takes the shape of its container

This question has two parts. Write your response on the next page. Be sure to label each part of your response.

15 The data from investigation 2 show the mass of the beaker and its contents.

A. Explain why the mass of the contents in the beaker decreased during the investigation.

B. The students repeated investigation 2 with the same amounts of salt and water, but this time they put a lid on top of the beaker, as shown.



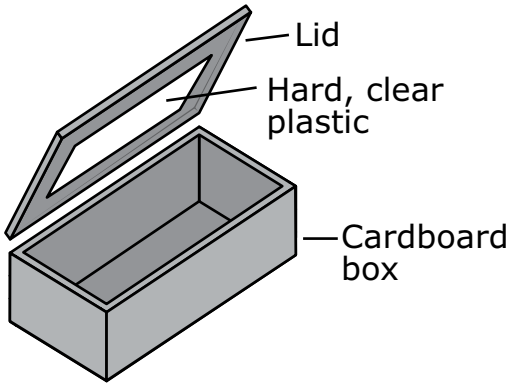
The mass of the beaker, the lid, and the beaker's contents was 90 g on day 1. The students continued to measure the mass of the setup for three days.

What was the most likely total mass of the beaker, the lid, and the beaker's contents on day 3 of the investigation? Explain your reasoning.

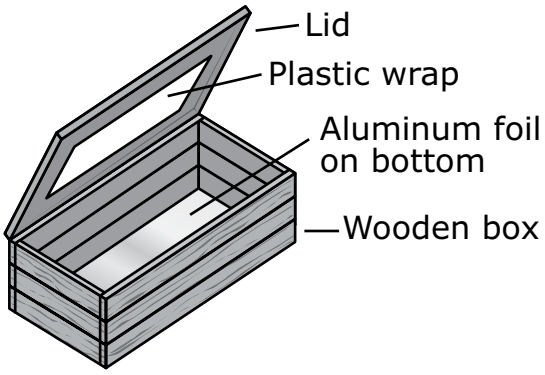
15

16 Solar cookers use sunlight to cook food. A student designs two solar cookers, as shown.

Design 1



Design 2



Design 1 is a cardboard box with a lid that has a window made of hard, clear plastic. The lid can be removed from the box.

Design 2 is a wooden box with a lid that has a window made of clear plastic wrap. The lid can be lifted but not removed from the box. A sheet of aluminum foil that reflects light covers the bottom of the box.

The student tests both designs and finds that food cooks faster in one of the designs.

Which of the following best explains why one design cooks food faster than the other?

Ⓐ Design 1 cooks faster because the box is made of cardboard, not wood.

Ⓑ Design 2 cooks faster because the lid can be lifted and does not need to be removed.

Ⓒ Design 2 cooks faster because its aluminum foil reflects sunlight, and cardboard does not.

Ⓓ Design 1 cooks faster because sunlight passes through hard plastic more easily than clear plastic wrap.

This question has two parts.

17 Part of a weather forecast for four days is shown in the table.

Day	Average Temperature (°F)	Chance of Precipitation	Average Wind Speed (mi./hr)
1	30	60%	15
2	36	30%	18
3	36	60%	5
4	39	20%	8

Part A

Based on the data in the table, on which day is it most likely to snow?

Ⓐ day 1

Ⓑ day 2

Ⓒ day 3

Ⓓ day 4

Part B

Which of the following describes the weather on day 4 compared to the other days?

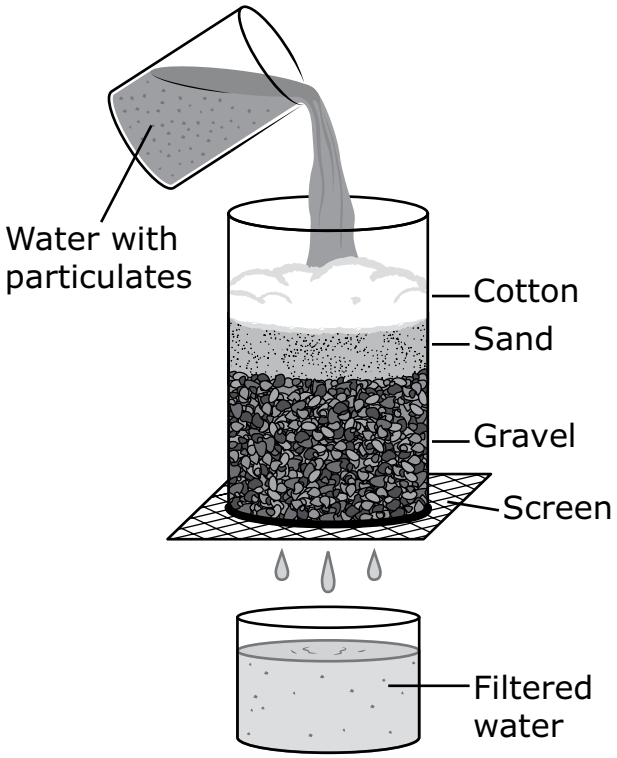
Ⓐ Day 4 has the coldest temperature and the windiest conditions.

Ⓑ Day 4 has the warmest temperature and the windiest conditions.

Ⓒ Day 4 has the coldest temperature and is the least likely to have rain.

Ⓓ Day 4 has the warmest temperature and is the least likely to have rain.

18 Students tested a simple filter designed to remove particulates from water. The filter has a layer of cotton on top of layers of sand and gravel held in by a screen. The diagram shows the filter.



The students found particulates in the water that had moved through the filter. Which of the following changes will most improve the filter?

Ⓐ removing the cotton above the sand

Ⓑ adding a coffee filter just above the screen

Ⓒ making the filter larger so it can hold more water

Ⓓ reducing the amount of water to be cleaned by the filter

19 Australia has regions, such as deserts and rain forests, with very different climates. Which of the following data about each region would be most helpful for learning about the different climates?

Ⓐ daily wind direction and daily wind speed data over one year

Ⓑ number of major floods and fires over one summer and one fall

Ⓒ sunrise and sunset times for winter and summer over several years

Ⓓ average seasonal precipitation and average temperatures over several years

20 Which of the following is an example of an organism responding to the seasonal changes of less sunlight and colder temperatures?

Ⓐ plants starting to flower

Ⓑ birds starting to build a nest

Ⓒ trees starting to lose their leaves

Ⓓ squirrels starting to produce offspring

Grade 5 Science and Technology/Engineering
Spring 2023 Released Operational Items

PBT Item No.	Page No.	Reporting Category	Standard	Science and Engineering Practice Category	Item Type*	Item Description	Correct Answer**
1	3	*Life Science*	5.LS.2.1	C. Evidence, Reasoning, and Modeling	SR	Use a food web to describe how an organism in an ecosystem would be affected if another organism was removed from the ecosystem.	D
2	4	*Earth and Space Science*	5.ESS.2.2	B. Mathematics and Data	SR	Interpret a circle graph to explain why there is a limited amount of fresh water available for human use.	B
3	5	*Earth and Space Science*	4.ESS.3.1	None	SR	Identify renewable and nonrenewable energy resources for a house.	A;A
4	6	*Earth and Space Science*	4.ESS.2.2	C. Evidence, Reasoning, and Modeling	SR	Interpret the features of a map to identify where volcanoes and earthquakes are most likely to occur.	B;A
5	7	*Technology/ Engineering*	3.ETS.1.4	C. Evidence, Reasoning, and Modeling	CR	Compare two diagrams of a design solution, explain why one diagram is better for building a prototype, and describe design changes given the outcomes from testing the prototype.	
6	9	*Physical Science*	4.PS.3.4	A. Investigations and Questioning	SR	Determine how a device can be changed to test how stored energy affects the motion of the device.	D
7	10	*Life Science*	5.LS.1.1	A. Investigations and Questioning	CR	Explain why plant height is measured in a certain investigation and explain why one group of plants grew taller than another group in the investigation.	
8	12	*Technology/ Engineering*	3.ETS.1.1	A. Investigations and Questioning	SR	Determine the problem a given structure was designed to solve.	D
9	14	*Technology/ Engineering*	3.ESS.3.1	None	SR	Describe an important factor to consider in choosing a design solution for a specific design problem.	B
10	15	*Life Science*	3.LS.3.1	B. Mathematics and Data	SR	Analyze data to draw a conclusion about the inheritance of a specific trait.	B
11	16	*Life Science*	3.LS.4.2	None	SR	Describe how some individuals within a population have an advantage in survival and reproduction because of variations of a characteristic.	C
12	19	*Physical Science*	5.PS.1.1	C. Evidence, Reasoning, and Modeling	SR	Analyze information from an investigation to model particle motion before and after two phase changes.	D
13	20	*Physical Science*	5.PS.1.1	None	SR	Identify a phase change and describe the change in heat energy that caused the phase change.	C
14	20	*Physical Science*	5.PS.1.3	A. Investigations and Questioning	SR	Determine the measurement or observation that would be most useful in distinguishing between two substances.	C
15	21	*Physical Science*	5.PS.1.2	C. Evidence, Reasoning, and Modeling	CR	Explain why the mass of a liquid decreases in an open beaker; determine and explain how closing the beaker will most likely affect the mass of the liquid.	

PBT Item No.	Page No.	Reporting Category	Standard	Science and Engineering Practice Category	Item Type*	Item Description	Correct Answer**
16	23	*Technology/ Engineering*	3.ETS.1.2	C. Evidence, Reasoning, and Modeling	SR	Compare design solutions to determine why one design cooks food faster.	C
17	24	*Earth and Space Science*	3.ESS.2.1	B. Mathematics and Data	SR	Use weather data for an area to determine the most likely type of precipitation that will fall and to compare weather conditions at different times.	A;D
18	25	*Earth and Space Science*	5.ESS.3.2	C. Evidence, Reasoning, and Modeling	SR	Describe a change to the design of a filter that would improve how the filter functions.	B
19	26	*Earth and Space Science*	3.ESS.2.2	None	SR	Identify data that would be helpful when describing different climates.	D
20	26	*Life Science*	3.LS.4.4	None	SR	Describe an example of organisms responding to a seasonal change.	C

* Science and Technology/Engineering item types are: selected-response (SR) and constructed-response (CR).

** Answers are provided here for selected-response items only. Sample responses and scoring guidelines for constructed-response items will be posted to the Department's website later this year.

Grade 5 Science and Technology/Engineering
Spring 2023 Unreleased Operational Items

PBT Item No.	Reporting Category	Standard	Science and Engineering Practice Category	Item Type*	Item Description
21	*Physical Science*	5.PS.2.1	None	SR	Identify an action that shows how gravity acts on an object.
22	*Life Science*	4.LS.1.1	None	SR	Explain why similar structures in two types of animals were different.
23	*Life Science*	5.PS.3.1	C. Evidence, Reasoning, and Modeling	SR	Identify the model that shows the flow of energy through an ecosystem.
24	*Life Science*	3.LS.4.4	None	SR	Describe how a change in an ecosystem could affect the survival and reproduction of an organism.
25	*Life Science*	3.LS.3.2	C. Evidence, Reasoning, and Modeling	CR	Identify inherited characteristics of an animal and explain how the characteristics are inherited; identify a characteristic of the animal that is caused by the environment and explain how the characteristic is caused by the environment.
26	*Physical Science*	3.PS.2.1	None	SR	Explain how friction affects the distance that an object moves.
27	*Life Science*	3.LS.4.5	C. Evidence, Reasoning, and Modeling	SR	Compare the life cycles of two organisms to identify similarities in their life stages and explain the importance of the adult life stage.
28	*Physical Science*	4.PS.3.3	None	SR	Identify a type of energy produced during a collision, describe the amount of energy an object has after a collision, and describe how to increase the amount of sound energy produced during a collision.
29	*Technology/ Engineering*	5.ETS.3.2	C. Evidence, Reasoning, and Modeling	SR	Interpret a diagram to describe the purpose of a part of a system.
30	*Technology/ Engineering*	4.ETS.1.5	A. Investigations and Questioning	SR	Determine how a change to a design feature solved a design problem.
31	*Earth and Space Science*	4.ESS.1.1	C. Evidence, Reasoning, and Modeling	SR	Interpret a diagram to identify the cause of a change in a landscape over time.
32	*Physical Science*	5.PS.1.4	C. Evidence, Reasoning, and Modeling	SR	Identify evidence of a chemical reaction in an investigation.
33	*Earth and Space Science*	5.ESS.3.1	C. Evidence, Reasoning, and Modeling	SR	Use a model of a watershed to determine ways to reduce pollution in a river.
34	*Technology/ Engineering*	3.ETS.1.1	A. Investigations and Questioning	SR	Select two criteria for success of a design solution.
35	*Earth and Space Science*	4.ESS.2.1	None	SR	Describe how soil forms through weathering.
36	*Physical Science*	4.PS.3.1	C. Evidence, Reasoning, and Modeling	SR	Use the evidence from an investigation to compare the sound and kinetic energies of two objects involved in separate collisions.
37	*Earth and Space Science*	5.ESS.3.1	None	CR	Describe several different ways a school community could help the environment.
38	*Technology/ Engineering*	3.ESS.3.1	C. Evidence, Reasoning, and Modeling	CR	Identify a weather condition that could cause damage to a roof, describe the damage it could cause, and explain how a certain roof design could prevent this weather damage.
39	*Technology/ Engineering*	4.PS.4.3	C. Evidence, Reasoning, and Modeling	SR	Determine two types of information transfer that are used to communicate a message.

PBT Item No.	Reporting Category	Standard	Science and Engineering Practice Category	Item Type*	Item Description
40	*Earth and Space Science*	5.ESS.1.2	None	SR	Identify when a certain moon phase will occur next and describe how long it takes the Moon to orbit Earth.
41	*Physical Science*	4.PS.3.2	None	SR	Use information about a device to determine energy transformations that occur during its operation.

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