MASSACHUSETTS DEPARTMENT OF
ELEMENTARY AND SECONDARY
EDUCATION

Release of Spring 2022 MCAS Test Items

from the

Grade 5 Science and Technology/Engineering Paper-Based Test

June 2022
Massachusetts Department of
Elementary and Secondary Education

MASSACHUSETTS DEPARTMENT OF
ELEMENTARY AND SECONDARY
EDUCATION

This document was prepared by the
Massachusetts Department of Elementary and Secondary Education
Jeffrey C. Riley
Commissioner

Overview of Grade 5 Science and Technology/Engineering Test

The spring 2022 grade 5 Science and Technology/Engineering (STE) test was a next-generation assessment that was administered in two primary formats: a computer-based version and a paper-based version. The vast majority of students took the computer-based test. The paper-based test was offered as an accommodation for students with disabilities who are unable to use a computer, as well as for English learners who are new to the country and are unfamiliar with technology.

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 April 2016 version of the *Massachusetts Science and Technology/Engineering Curriculum Framework*. The four content strands are listed below.

- Earth and Space Science

- Life Science

- Physical Science

- Technology/Engineering

The 2016 *Massachusetts Science and Technology/Engineering Curriculum Framework* is available on the Department website at www.doe.mass.edu/frameworks/current.html.

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

Some 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, 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 family breeds their two cats. The mother cat has four kittens after she mates with the father cat.

Which of the following best describes the traits that the kittens inherited?

Ⓐ All the kittens inherited traits only from the father cat.

Ⓑ All the kittens inherited traits only from the mother cat.

Ⓒ Each kitten inherited some traits from the mother cat and some traits from the father cat.

Ⓓ Two kittens inherited traits only from the mother cat and two kittens inherited traits only from the father cat.

2 Some communication systems represent information using Morse code. Morse code uses a different pattern of dots and dashes to represent each letter of the alphabet. The table shows Morse code for three letters.

Letter	Morse Code
F	● ● ▬ ●
G	▬ ▬ ●
H	● ● ● ●

Which of the following best describes the process of changing letters into Morse code?

Ⓐ decoding

Ⓑ encoding

Ⓒ receiving

Ⓓ sending

3 Mastodons are extinct animals that were similar to modern-day elephants. The diagram shows the skeleton of a mastodon.
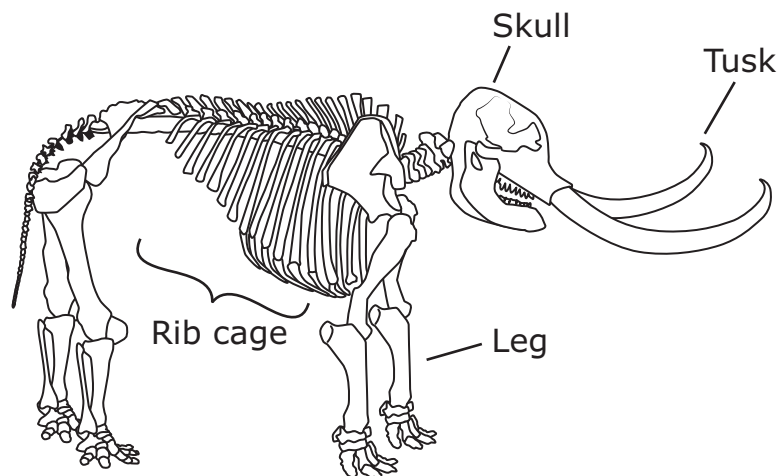
Which of the following best supports a claim that mastodons lived on land?

Ⓐ The mastodon had a thick skull to protect its brain.

Ⓑ The mastodon had a large rib cage to protect its organs.

Ⓒ The mastodon had long tusks to defend against its predators.

Ⓓ The mastodon had strong leg bones to support its body weight.

4 A model of the sunlight that Earth receives is shown. Four locations on Earth are labeled W, X, Y, and Z.

Earth   Sunlight

In which pair of locations would a person most likely be experiencing night?

Ⓐ locations W and X

Ⓑ locations W and Z

Ⓒ locations X and Y

Ⓓ locations Y and Z

This question has two parts.

5 A fifth-grade class is designing a small fan that will be easy to carry. The students need to select the following parts for the fan:

- a motor

- a power supply

- a switch

- fan blades

Part A

The students are trying to choose the best type of power supply for the fan design. Which of the following would be the best source of information?

Ⓐ a video that shows how one type of power supply works

Ⓑ a list of companies that sell different types of power supplies

Ⓒ a website that has information about different types of power supplies

Ⓓ an informational brochure about how to connect one type of power supply to a motor

Part B

What should the students do to test the amount of airflow the fan will produce?

Ⓐ create a video

Ⓑ draw a sketch

Ⓒ construct a prototype

Ⓓ complete a graphic organizer

6 Sea anemones are animals that live in shallow ocean environments. They can move very slowly from one place to another. A scientist investigated sea anemones by observing their behavior in a large saltwater aquarium over 15 days.

The scientist placed 10 sea anemones on the side of the aquarium that received direct, bright light. Then the scientist placed 10 other anemones on the opposite side, which had no direct light and was darker.

The graph below shows the number of sea anemones that were found on the side of the aquarium with bright light over the 15-day investigation.

**Number of Sea Anemones
Found under Bright Light**
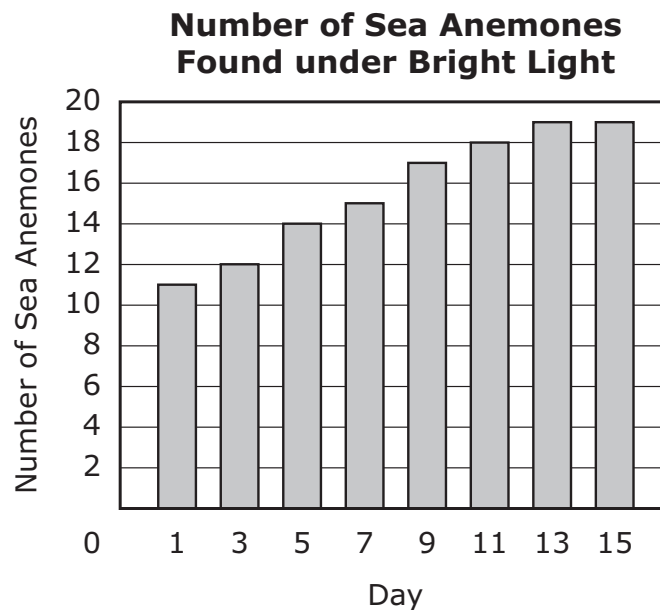
A dock is built along a coast where wild sea anemones live. The dock blocks most of the sunlight. Based on the results of the scientist's investigation, what will most likely happen over two weeks?

Ⓐ Most of the wild sea anemones under the dock will die off, but a few will migrate to a sunny area.

Ⓑ Most of the wild sea anemones under the dock will migrate to a sunny area, but a few will stay under the dock.

Ⓒ About 50% of the wild sea anemones under the dock will hibernate, and about 50% will migrate to a sunny area.

Ⓓ About 75% of the wild sea anemones under the dock will move around, and about 25% will migrate to a sunny area.

7 Over the years, technologies have been developed that allow people to communicate over long distances. Two examples of these technologies are described in the table.

| Technology	Description	Developed
telegraph	uses short and long electrical signals (Morse code) to send and receive messages through wires	1830s
telephone	uses electrical signals to transmit voice and other audio through wires	1870s

Which of the following best explains why the telephone was an innovation and not an invention?

Ⓐ Telephones used electrical signals.

Ⓑ Telephones added to what telegraphs could do.

Ⓒ Telephones made two-way communication possible.

Ⓓ Telephones allowed people to communicate over long distances.

8 On a sunny day, a student sees a bird, as shown in the diagram.
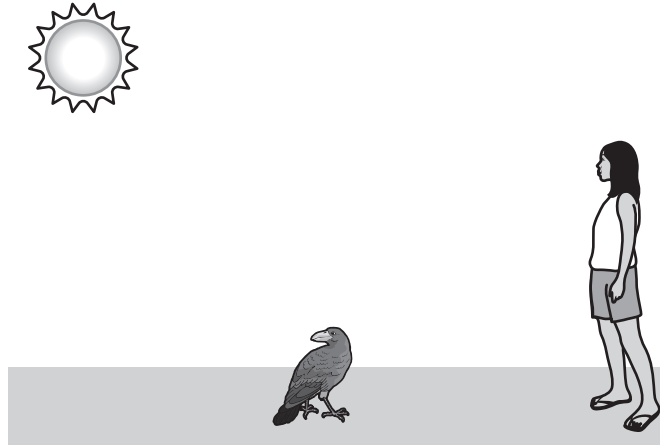
Which of the following models shows how light travels and makes it possible for the student to see the bird?

Ⓐ

Ⓑ

Ⓒ

Ⓓ
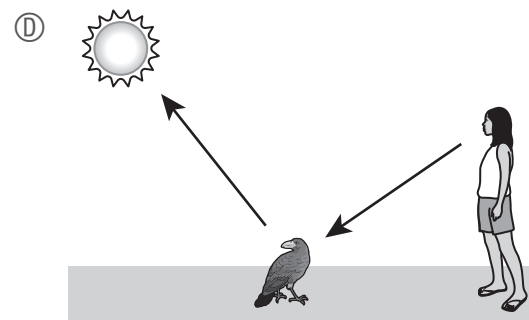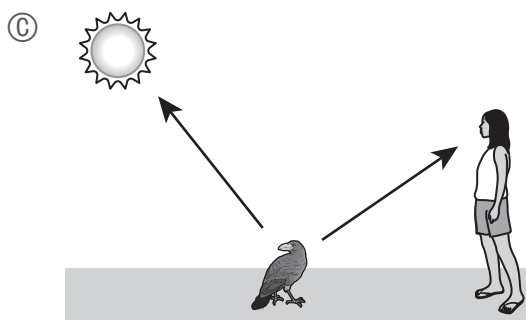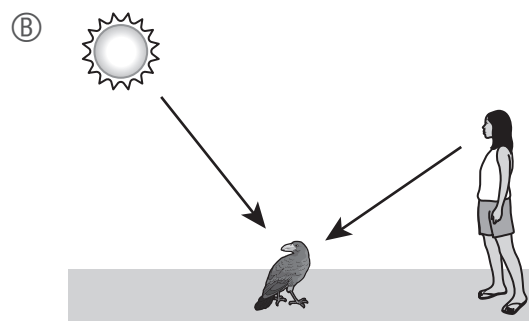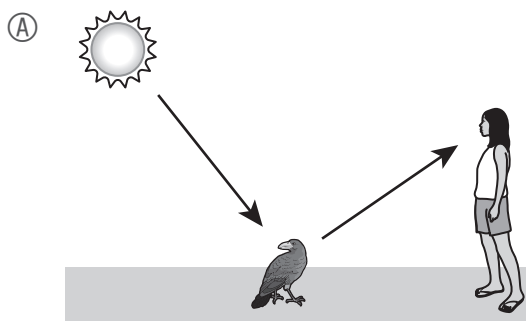
Grade 5
Science and Technology/Engineering
SESSION 2

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 The owners of a restaurant with a wooden floor want chairs that slide but do not scratch the floor. The owners test different materials on the bottom of the chair legs. They rate the materials on how well the chairs slide and whether or not they scratch the floor. The results are shown in the table.

Scoring Key

Worst ⟶ Best

1	2	3	4

Material	Allows Chair to Slide	Does Not Scratch Floor
W	3	4
X	3	1
Y	4	2
Z	1	4

Which material will **best** allow the chairs to slide without scratching the floor?

Ⓐ material W

Ⓑ material X

Ⓒ material Y

Ⓓ material Z

The following section focuses on solutions to address flooding problems on a sports field.

Read the information below and use it to answer the three selected-response questions and one constructed-response question that follow.
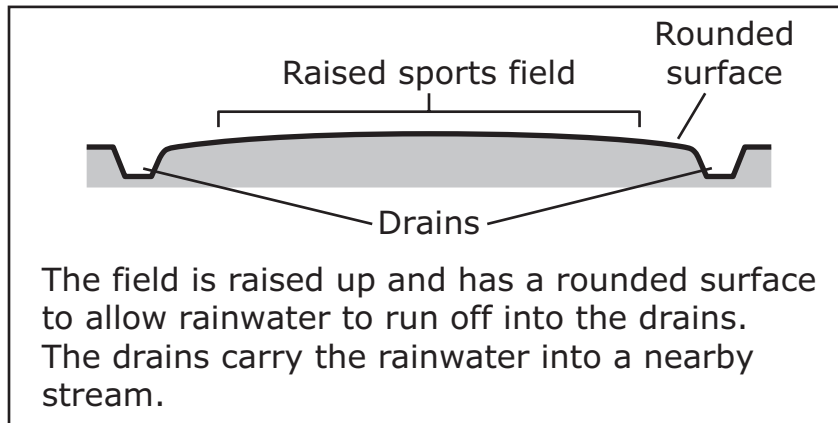
At a school, a sports field became flooded following a large rainstorm. Students were unable to play on the field for several days while the water slowly absorbed into the ground. To better predict when a rainstorm might flood the field, a group of students gathered the seasonal climate data shown in the table.

Seasonal Climate Data

	Winter	Spring	Summer	Fall
Average Precipitation (in.)	10.6	11.3	9.8	10.4
Average Low Temperature (°F)	22.7	38.7	61.7	45.3
Average High Temperature (°F)	38.3	56.7	80.0	63.0
Average Wind Speed (mi. per hr)	17.3	12.7	7.3	10.0

The students designed two possible solutions to the flooding problem. The diagrams show the features of each design solution.

Design Solution 1

Raised sports field

Rounded surface

Drains

The field is raised up and has a rounded surface to allow rainwater to run off into the drains. The drains carry the rainwater into a nearby stream.

Design Solution 2

Plants

Rounded surface

Raised sports field

Rain garden

The field is raised up and has a rounded surface to allow rainwater to flow into rain gardens, where the water is absorbed.
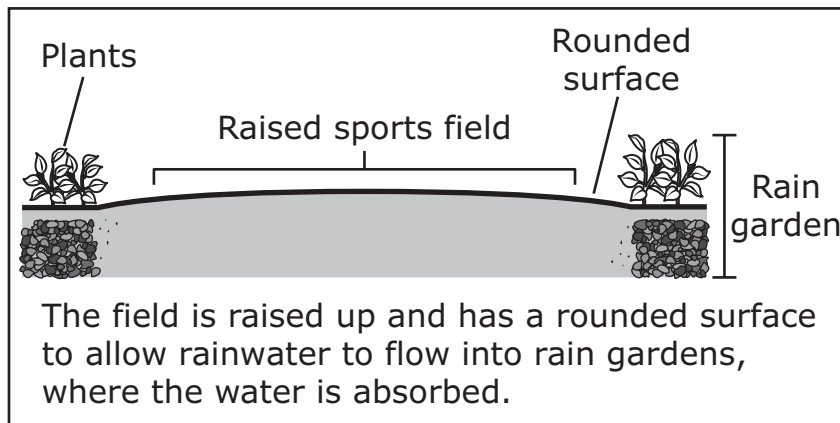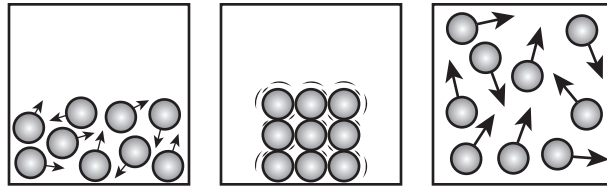
10 Based on the climate data table, which of the following best describes the climate of the area?

Ⓐ tundra, with low temperatures and low precipitation year round

Ⓑ tropical, with high temperatures and high precipitation year round

Ⓒ desert, with extreme high and low temperatures and very low precipitation year round

Ⓓ temperate, with changing seasonal temperatures and medium amounts of precipitation year round

11 Every spring, fertilizer is spread on the sports field. Some of the fertilizer runs off into a nearby stream.

Which of the following best explains why design solution 2 would be more effective than design solution 1 at reducing the amount of fertilizer entering the nearby stream?

Ⓐ In design solution 2, the fertilizer is broken down on the sports field.

Ⓑ In design solution 2, the fertilizer remains on the surface of the sports field.

Ⓒ In design solution 2, the fertilizer is absorbed by the plants in the rain garden.

Ⓓ In design solution 2, the fertilizer combines with the rainwater to become a new substance.

12 Before rain falls, water particles in the air form into rain droplets. The models show water particles in three different phases.


Which of the following best shows how water particles in the air form into rain droplets?

Ⓐ

Ⓑ

Ⓒ

Ⓓ

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

13   The amount of groundwater in the area near the sports field changes throughout the year.

     A. Identify the season when the **least** amount of water becomes groundwater in the area near the sports field. Explain why, in this season, the least amount of water becomes groundwater. Include data from the climate data table to support your answer.

     B. Describe how design solution 1 will affect the amount of groundwater in the area near the sports field (increase, decrease, or stay the same) compared to the design of the existing field. Explain your reasoning.

     C. Describe how design solution 2 will affect the amount of groundwater in the area near the sports field (increase, decrease, or stay the same) compared to design solution 1. Explain your reasoning.

⑬

14   Two teams of students, team X and team Y, are playing tug of war, as shown. Both teams pull on the rope, but the flag in the middle does not move.

Team X   Team Y

Flag
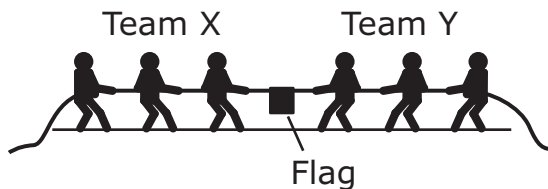
The model below shows the force from team X on the rope. The force from team Y is missing. The length of the arrow represents the strength of the force.

Team X force   Team Y force

?

Flag

Which arrow should be added to the model to show the force from team Y on the rope?

Ⓐ   ⬅

Ⓑ   ⬅

Ⓒ   ➡

Ⓓ   ➡

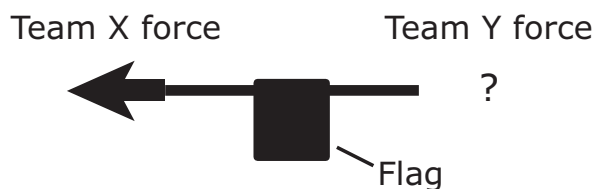**This question has three parts. Write your response on the next page. Be sure to label each part of your response.**

15 A student is investigating how magnets work. The student has two plastic toy boats. A bar magnet is placed in each boat. The poles of the magnets are not identified. The student then places the boats in a long, narrow tank of water. The sides of the tank prevent the boats from turning. The diagram shows the boats in the tank of water and a magnet in each boat.

Boats   Tank of water

? ?   ? ?
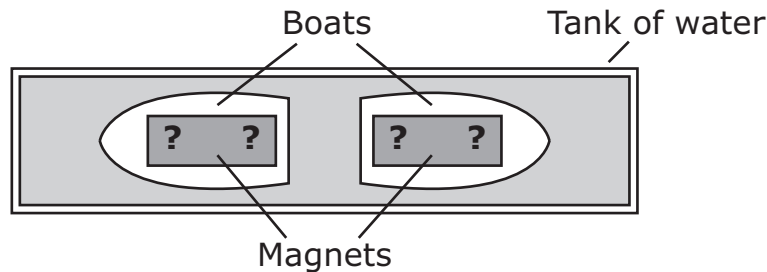
Magnets

A. When the student places the boats near each other in the tank, they move toward each other.

On the diagram on the next page, add an "N" or an "S" to each box to identify the poles of the magnet.

B. The student replaces the magnet in one of the boats with a block of iron, as shown.

Boats   Tank of water

? ?

Block of iron   Magnet
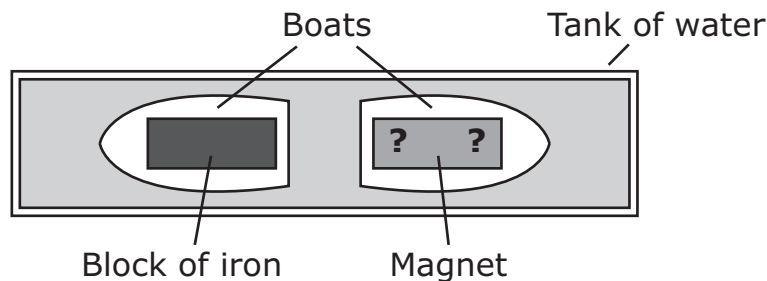
Describe how the boats move after the student replaces the magnet with a block of iron. Explain your reasoning.

C. In the investigation, stored magnetic energy is converted into another form of energy.

Identify the form of energy that the stored magnetic energy is converted into. Explain your reasoning.

15   A.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

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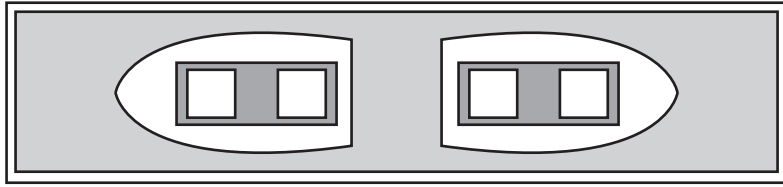
This question has two parts. Write your response on the next page. Be sure to label each part of your response.

16   The picture shows a lynx.
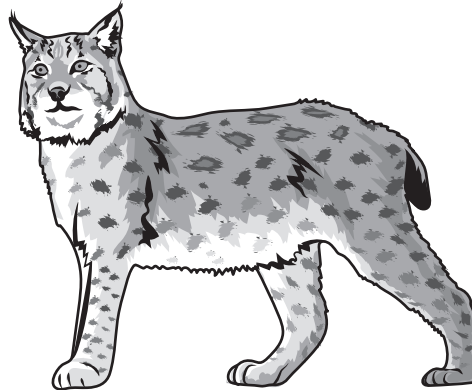
Lynx are wild cats that have brown spotted fur, sharp claws, furry ears, and wide paws. Lynx live in forests that are cold many months of the year. They hunt rabbits and other small animals.

A. From the information given, identify one trait that provides camouflage for the lynx in its environment. Explain how the trait provides camouflage for the lynx.

B. Describe one way the claws of the lynx help it survive in its environment.

16

This question has two parts.

17   Humans use energy and fuels in their daily lives.

Part A

Which of the following best describes the energy and fuels humans use?

Ⓐ   Energy and fuels always produce electricity.

Ⓑ   Energy and fuels always are made from rocks.

Ⓒ   Energy and fuels always come from natural resources.

Part B

Coal, wind, natural gas, and ocean tides are types of energy sources.

Which of the following tables correctly identifies the energy sources as renewable or nonrenewable energy sources?

Ⓐ

Renewable	Nonrenewable
coal	ocean tides
natural gas	wind

Ⓑ

Renewable	Nonrenewable
ocean tides	coal
wind	natural gas

Ⓒ

Renewable	Nonrenewable
coal	ocean tides
wind	natural gas

Ⓓ

Renewable	Nonrenewable
wind	coal
natural gas	ocean tides

18 A student weighs a solid piece of butter in a beaker and finds the total mass is 17 g. The student then heats the butter until it melts and measures the mass again. The diagram shows the melted butter and beaker on a scale.
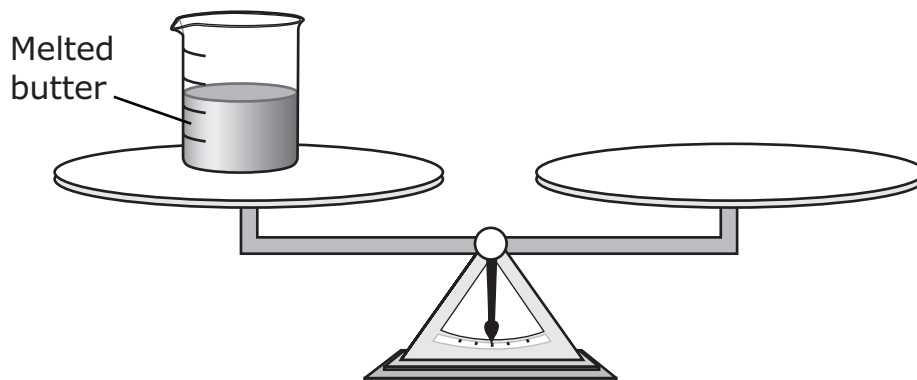
Which combination of weights shows the mass of the butter and beaker after the butter has melted?

Ⓐ

Ⓑ

Ⓒ

Ⓓ
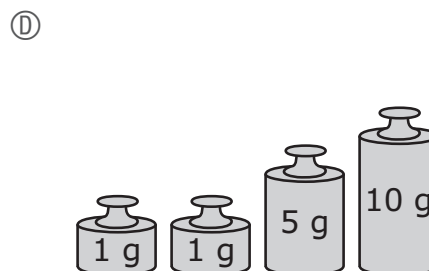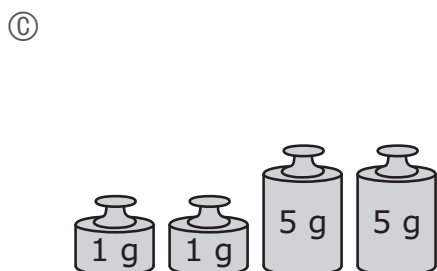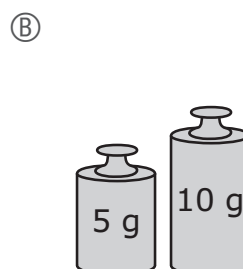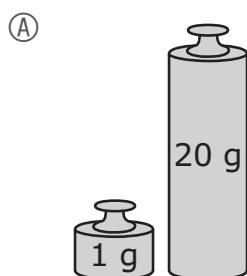
19 The table below shows some information about the life-cycle stages of four animals.

Animal	Birth: Hatches from Eggs	Growth: Young Looks Like a Small Adult	Reproduction: Lays Eggs in Water	Death: Maximum Lifespan
rainbow trout (fish)	✓	✓	✓	6 years
American bullfrog	✓		✓	9 years
bald eagle (bird)	✓	✓		28 years
monarch butterfly	✓			8 months

Based on this information, which of the following best describes the life-cycle stages of the four animals?

Ⓐ The animals have a similar birth stage, but they each have a different lifespan.

Ⓑ The animals have a similar growth stage, but they each develop in a different way.

Ⓒ The animals have similar birth and death stages, and they all reproduce in a similar way.

Ⓓ The animals have similar birth and reproduction stages, and they all enter the adult stage at the same time.

20   A concrete walkway leads to the door of a school building. Wind in the area around the school typically blows from only one direction, as shown.
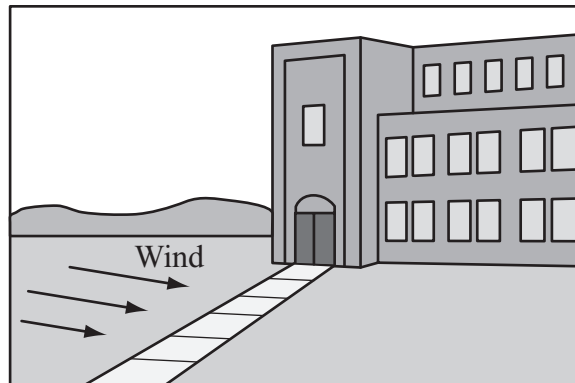
During winter, the wind causes the walkway to become covered with snow. Which of the following solutions is the best way to keep snow off the walkway?

Ⓐ   add small stones to the walkway

Ⓑ   make the walkway two times wider

Ⓒ   build a fence on the side of the walkway that the wind reaches first

Ⓓ   set up a large fan to blow across the walkway in the opposite direction of the wind

Grade 5 Science and Technology/Engineering
Spring 2022 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*	3.LS.3.1	None	SR	Describe how traits are inherited from a mother and a father.	C
2	4	*Technology/ Engineering*	4.PS.4.3	None	SR	Determine that changing characters into a code is an example of encoding.	B
3	5	*Life Science*	3.LS.4.1	C. Evidence, Reasoning, and Modeling	SR	Use fossil evidence to support a claim that an organism once lived on land.	D
4	6	*Earth and Space Science*	5.ESS.1.2	C. Evidence, Reasoning, and Modeling	SR	Determine two locations on a model where a person on Earth would be experiencing night.	A
5	7	*Technology/ Engineering*	3.ETS.1.4	None	SR	Determine the information needed to solve a design problem and identify that a prototype should be used to test the design solution.	C;C
6	8	*Life Science*	3.LS.4.4	B. Mathematics and Data	SR	Interpret data to explain how reducing the sunlight in an area will affect a type of organism living there.	B
7	9	*Technology/ Engineering*	5.ETS.3.1	C. Evidence, Reasoning, and Modeling	SR	Distinguish between an innovation and an invention given descriptions of two technologies.	B
8	10	*Physical Science*	4.PS.4.2	C. Evidence, Reasoning, and Modeling	SR	Determine which model shows how light reflects off an object and enters an eye in order for the object to be seen.	A
9	12	*Technology/ Engineering*	4.ETS.1.3	C. Evidence, Reasoning, and Modeling	SR	Analyze a data table to determine which material should be used in a design solution to meet the criteria.	A
10	15	*Earth and Space Science*	3.ESS.2.2	B. Mathematics and Data	SR	Interpret seasonal climate data to describe the climate of an area.	D
11	15	*Earth and Space Science*	5.ESS.3.1	C. Evidence, Reasoning, and Modeling	SR	Compare two design solutions to determine which is more effective at reducing human impact on the local environment.	C
12	16	*Physical Science*	5.PS.1.1	C. Evidence, Reasoning, and Modeling	SR	Determine which particle model shows the phase change from a gas to a liquid.	B
13	17	*Earth and Space Science*	5.ESS.2.1	C. Evidence, Reasoning, and Modeling	CR	Analyze climate data to compare the amount of water that becomes groundwater during different seasons and explain how two design solutions affect the amount of groundwater in an area.	
14	19	*Physical Science*	3.PS.2.1	C. Evidence, Reasoning, and Modeling	SR	Complete a model to show the forces acting on an object that is not moving.	D
15	20	*Physical Science*	3.PS.2.3	C. Evidence, Reasoning, and Modeling	CR	Determine the orientation of magnets in an investigation, the result of replacing one magnet with a block of iron, and an energy conversion that takes place.	
16	22	*Life Science*	4.LS.1.1	C. Evidence, Reasoning, and Modeling	CR	Identify a trait that helps provide camouflage to an organism and describe how another trait helps the organism survive in its environment.	
17	24	*Earth and Space Science*	4.ESS.3.1	None	SR	Identify that the energy and fuels humans use comes from natural resources and distinguish between renewable and nonrenewable energy sources.	C;B
18	25	*Physical Science*	5.PS.1.2	B. Mathematics and Data	SR	Determine the mass of a substance after a phase change.	D
19	26	*Life Science*	3.LS.1.1	B. Mathematics and Data	SR	Draw a conclusion from information about the life cycles of four animals.	A
20	27	*Technology/ Engineering*	3.ESS.3.1	None	SR	Determine which design solution will work best for a given situation.	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 2022 Unreleased Operational Items

PBT Item No.	Reporting Category	Standard	Science and Engineering Practice Category	Item Type*	Item Description
21	*Life Science*	3.LS.4.2	C. Evidence, Reasoning, and Modeling	SR	Determine which plant has a survival advantage based on its characteristics.
22	*Physical Science*	4.PS.3.1	B. Mathematics and Data	SR	Identify the position at which a person has the greatest kinetic energy based on the person's speed.
23	*Earth and Space Science*	3.ESS.2.2	B. Mathematics and Data	SR	Interpret climate data to classify different climate regions.
24	*Technology/Engineering*	3.ESS.3.1	C. Evidence, Reasoning, and Modeling	SR	Identify which design solutions will reduce the impact of weather on a structure.
25	*Technology/Engineering*	4.ETS.1.3	A. Investigations and Questioning	SR	Describe how to improve a test of a design feature to identify failure points.
26	*Physical Science*	3.PS.2.4	C. Evidence, Reasoning, and Modeling	SR	Analyze a diagram to determine the correct orientation of a magnet for a design solution.
27	*Technology/Engineering*	3.ETS.1.2	C. Evidence, Reasoning, and Modeling	CR	Evaluate different designs using a list of criteria and constraints to determine whether each design meets the design requirements.
28	*Life Science*	5.LS.2.2	A. Investigations and Questioning	CR	Identify what could be measured to determine how well a composter works and describe changes to the composter to make it work better.
29	*Physical Science*	4.PS.4.1	C. Evidence, Reasoning, and Modeling	SR	Describe the transfer of energy and regular pattern of motion that occurs as a wave travels.
30	*Physical Science*	4.PS.3.3	B. Mathematics and Data	CR	Analyze data to determine in which collision an object had the greatest change in energy and describe how energy was converted during the collision.
31	*Earth and Space Science*	5.ESS.3.1	B. Mathematics and Data	SR	Analyze data to determine how a farmer could conserve water.
32	*Life Science*	5.LS.2.1	None	SR	Identify the main role of bacteria in the cycling of matter in an ecosystem.
33	*Life Science*	5.PS.3.1	None	SR	Describe how food contains the energy and nutrients that animals need to survive.
34	*Earth and Space Science*	4.ESS.2.1	None	SR	Interpret a diagram to determine how a rock is being weathered.
35	*Life Science*	5.LS.1.1	A. Investigations and Questioning	SR	Determine the environmental conditions students should observe in an investigation about plant growth.
36	*Physical Science*	4.PS.3.2	None	SR	Interpret a scenario to determine what form of energy is transferred.
37	*Earth and Space Science*	5.ESS.2.2	B. Mathematics and Data	SR	Explain why a bar graph about the different sources of fresh water and salt water on Earth should be revised.
38	*Technology/Engineering*	3.ETS.1.4	None	SR	Identify the best representation to help a person replicate a design solution.
39	*Earth and Space Science*	4.ESS.1.1	None	SR	Determine that weathering and erosion played a role in the formation of a landscape.
40	*Earth and Space Science*	5.ESS.3.2	A. Investigations and Questioning	SR	Determine what to measure to see how well water filters work.
41	*Life Science*	3.LS.4.1	C. Evidence, Reasoning, and Modeling	SR	Explain how a fossil of a marine organism may be found in a desert.

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