Massachusetts MCAS 2022 Grade 8 Science

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MASSACHUSETTS DEPARTMENT OF
ELEMENTARY AND SECONDARY
EDUCATION

Release of Spring 2022
MCAS Test Items

from the

Grade 8 Science and
Technology/Engineering
Paper-Based Test

June 2022
Massachusetts Department of
Elementary and Secondary Education

Grade 8
Science and Technology/Engineering
SESSION 1

This session contains 9 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 teacher asked a class to write the "cosmic address" of Massachusetts. A cosmic address is ordered from smallest to largest.

The first four parts of the cosmic address are shown below.

<div align="center">

Massachusetts

United States

North America

Northern Hemisphere

?

?

?

?

</div>

Which of the following best completes the cosmic address of Massachusetts?

Ⓐ

Earth
Milky Way galaxy
solar system
universe

Ⓑ

Earth
solar system
universe
Milky Way galaxy

Ⓒ

Earth
solar system
Milky Way galaxy
universe

Ⓓ

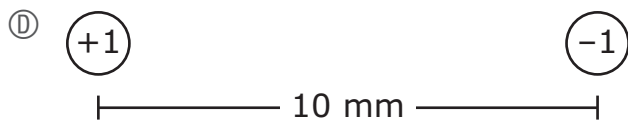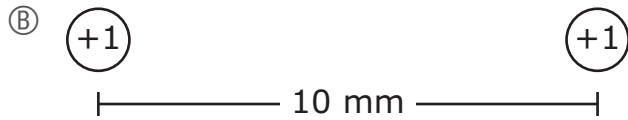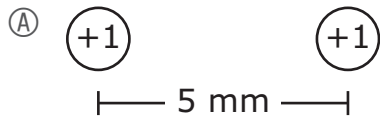| Earth |
|---|
| universe |
| solar system |
| Milky Way galaxy |

2   The map shows some of the tectonic plates that form Earth's surface, and four areas labeled W, X, Y, and Z.
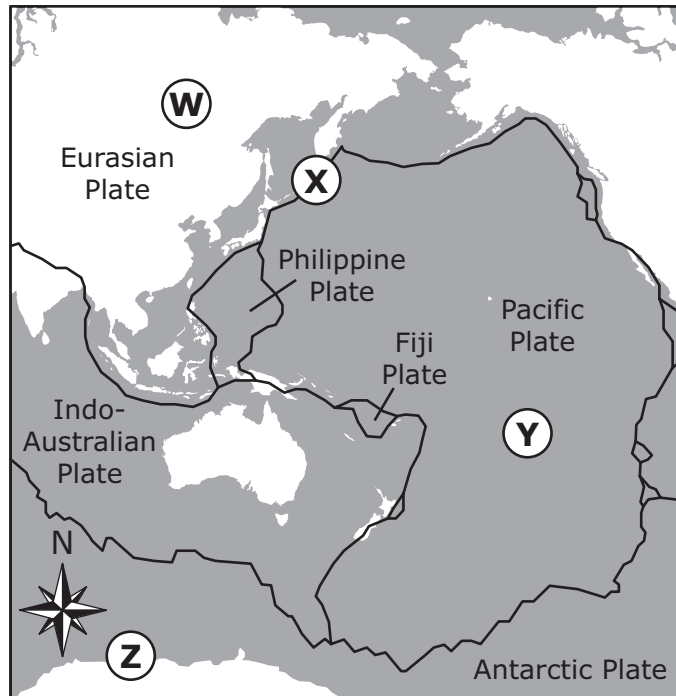
In which area is an earthquake most likely to occur?

Ⓐ   area W

Ⓑ   area X

Ⓒ   area Y

Ⓓ   area Z

3　Which of the following models has the greatest attractive electric force between the charged particles?

Ⓐ　(+1)　　　　　　(+1)

├── 5 mm ──┤

Ⓑ　(+1)　　　　　　　　　　　　(+1)

├────── 10 mm ──────┤

Ⓒ　(+1)　　　　　　(−1)

├── 5 mm ──┤

Ⓓ　(+1)　　　　　　　　　　　　(−1)

├────── 10 mm ──────┤

4   The table shows the masses of four planets and the distance of each planet from the Sun.

	Jupiter	Saturn	Uranus	Neptune
Mass ($\times 10^{24}$ kg)	1898	568	86.8	102
Distance from the Sun ($\times 10^6$ km)	778.6	1433.5	2872.5	4495.1

Based on the data in the table, on which planet does the Sun exert the greatest gravitational force?

Ⓐ Jupiter

Ⓑ Saturn

Ⓒ Uranus

Ⓓ Neptune

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

5　　Two students are riding identical bicycles on a level sidewalk. Student R has a mass of 55 kg and student S has a mass of 40 kg.

A. Both students are traveling at a speed of 3 m/s.

Determine whether student R has a larger, a smaller, or an equal amount of kinetic energy compared to student S. Explain your reasoning.

B. Student R is at rest, begins to ride, and then moves faster and faster.

Identify which graph (1, 2, or 3) best represents the relationship between student R's speed and kinetic energy. Explain your reasoning.
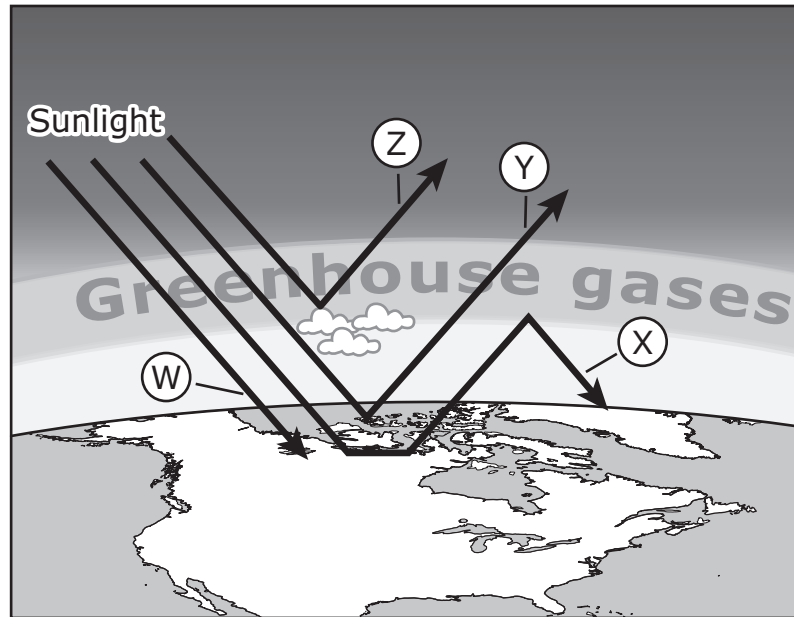
Graph 1	**Graph 2**	**Graph 3**
Kinetic Energy vs. Speed	Kinetic Energy vs. Speed	Kinetic Energy vs. Speed
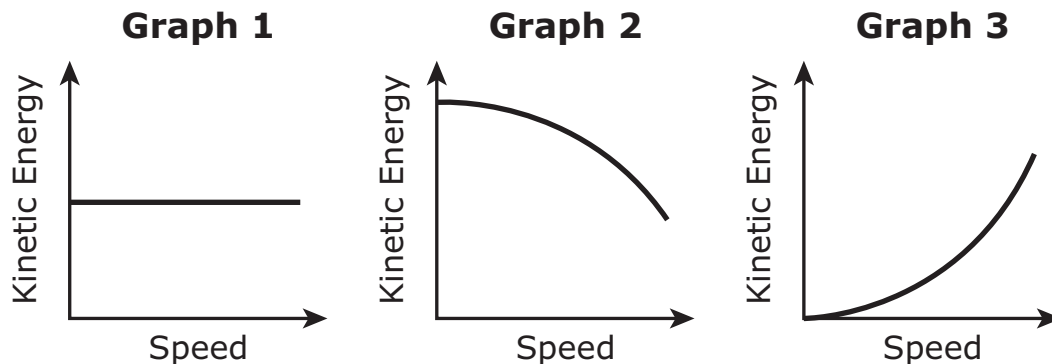
5

This question has two parts.

6 Human activities are playing a role in increasing greenhouse gases. The increase in greenhouse gases is causing a rise in global temperatures.

Part A

The model represents the movement of thermal energy through Earth's systems.

Which arrow best shows the movement of thermal energy that is causing a rise in global temperatures?

Ⓐ   arrow W

Ⓑ   arrow X

Ⓒ   arrow Y

Ⓓ   arrow Z

Part B

Select **three** activities that would help reduce the amount of greenhouse gases in Earth's atmosphere.

Ⓐ using bicycles as a form of transportation

Ⓑ implementing public transportation systems

Ⓒ cutting down forests to build farms and cities

Ⓓ burning coal at power plants to make electricity

Ⓔ using solar panels to collect energy from the Sun

7 A homeowner and a builder discussed three parts of a system that were involved in replacing the shingles on the roof of the homeowner's home:

- hammering a nail

- roof with new shingles

- tools

Which table correctly classifies each part of the system as an input, a process, or an output?

Ⓐ

Input	Process	Output
hammering a nail	tools	roof with new shingles

Ⓑ

Input	Process	Output
hammering a nail	roof with new shingles	tools

Ⓒ

Input	Process	Output
roof with new shingles	hammering a nail	tools

Ⓓ

Input	Process	Output
tools	hammering a nail	roof with new shingles

**8**   The diagram shows a toy sailboat with some parts labeled.
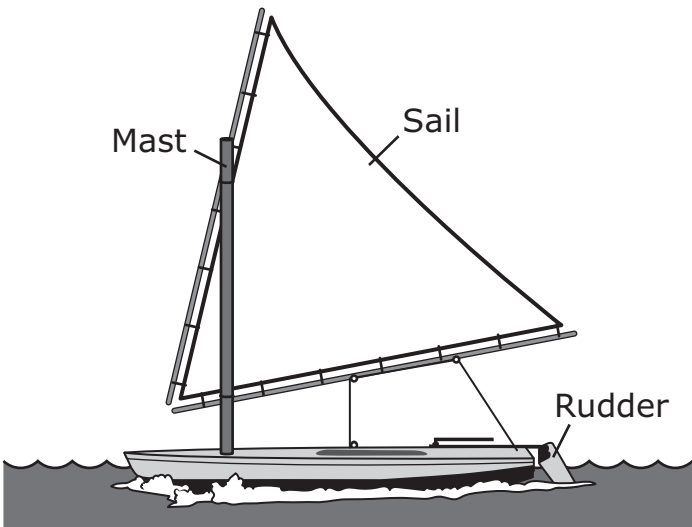
The labeled parts of the sailboat have specific functions.

- The sail provides the force needed to move the boat.

- The mast holds up the sail.

- The rudder steers the boat.

Which table correctly classifies each part of the sailboat as a structural, propulsion, or control subsystem?

Ⓐ

Structural	Propulsion	Control
mast	sail	rudder

Ⓑ

Structural	Propulsion	Control
rudder	mast	sail

Ⓒ

Structural	Propulsion	Control
sail	rudder	mast

Ⓓ

Structural	Propulsion	Control
mast	rudder	sail

9 A student plans to build a bench like the one shown.
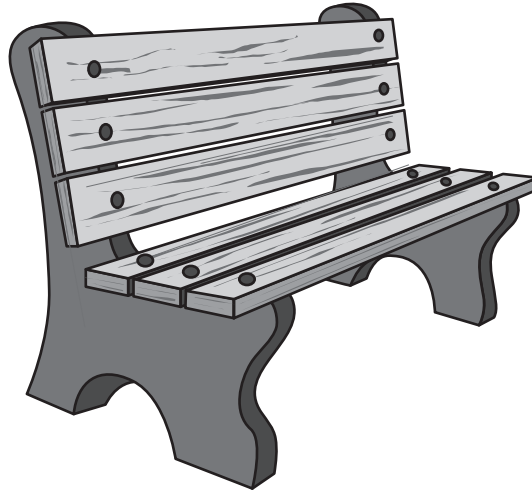
The student has determined that the following steps need to be completed:

- make measurements
- cut wood
- smooth edges
- attach pieces of wood together with fasteners

The student will use an electric sander, a screwdriver, and an electric saw to build the bench.

Select **three** other items the student should use to safely build the bench.

Ⓐ 12-inch ruler

Ⓑ dust mask

Ⓒ goggles

Ⓓ pliers

Ⓔ tape measure

Grade 8
Science and Technology/Engineering
SESSION 2

This session contains 11 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.

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10 The table shows weather data for three days in Boston.

Date	Sky Conditions	High Temperature (°F)	Low Temperature (°F)	Air Pressure (in. of mercury)
June 1	rainy	70	55	29.72
June 2	partly cloudy	73	56	30.02
June 3	sunny	79	58	30.37

Select the **two** most likely explanations for the change in weather from June 1 to June 3.

Ⓐ A cold front moved into the area.

Ⓑ A warm front moved through the area.

Ⓒ A low pressure system moved into the area.

Ⓓ A high pressure system moved into the area.

Ⓔ A cold air mass stalled over a warm air mass in the area.

11   A teacher performs an investigation by heating a 5.4 g piece of aluminum and placing it into a beaker of water. The table shows the temperatures before and after the aluminum was placed in the water.

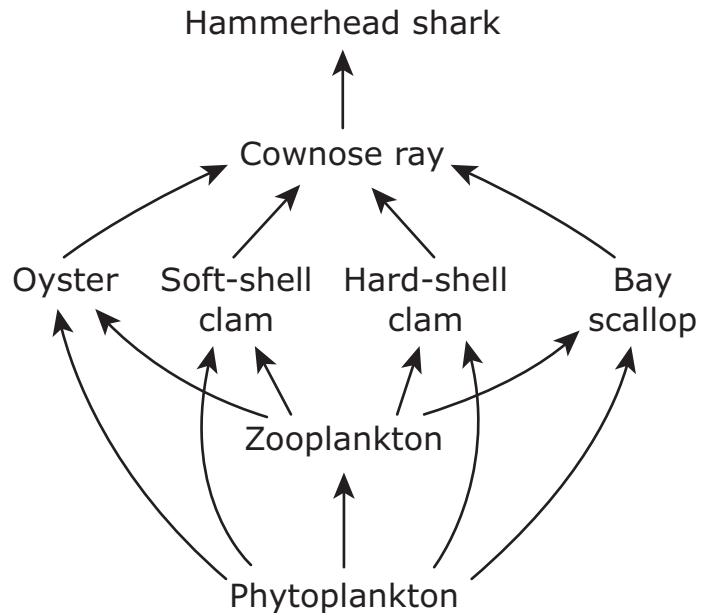| Substance	Initial Temperature (°C)	Final Temperature (°C)
aluminum	100	28
water	26	28

The teacher repeats the investigation using a larger, 20 g piece of aluminum heated to 100°C. Which of the following best explains what will happen to the final temperature of both the water and the 20 g piece of aluminum?

Ⓐ   The temperature will be 28°C because both pieces of aluminum transfer heat energy at the same rate.

Ⓑ   The temperature will be 28°C because both pieces of aluminum are heated to the same initial temperature.

Ⓒ   The temperature will be lower than 28°C because the smaller piece of aluminum transfers heat energy more quickly than the larger piece of aluminum.

Ⓓ   The temperature will be higher than 28°C because the larger piece of aluminum transfers more heat energy to the water than the small piece of aluminum.

The following section focuses on the ecosystem of the hammerhead shark.

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

Sharks are large fish that live in the ocean. Hammerhead sharks are a part of a marine ecosystem, as shown in the food web.

Hammerhead shark

Cownose ray

Oyster   Soft-shell   Hard-shell   Bay
            clam   clam   scallop

Zooplankton

Phytoplankton

⓬ Which of the following **best** describes the role that hammerhead sharks play in the ecosystem?

Ⓐ The sharks act as a food source for clams, oysters, and scallops.

Ⓑ The sharks compete with cownose rays for access to nutrients in the environment.

Ⓒ The sharks break down the remains of zooplankton and phytoplankton, returning nutrients to the environment.

Ⓓ The sharks limit the population size of cownose rays, preventing them from overfeeding on clams, oysters, and scallops.

⓭ The diagram represents one process that transfers energy in the marine ecosystem.

Energy from sunlight	⟶	Energy in food molecules
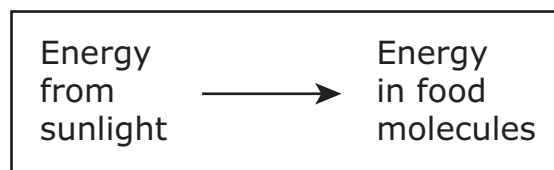
The process occurs in which of the following organisms?

Ⓐ cownose rays

Ⓑ hammerhead sharks

Ⓒ oysters

Ⓓ phytoplankton

14 In recent decades, overfishing has led to large decreases in the sizes of shark populations. Biologists studying the effects of overfishing on marine ecosystems have hypothesized that a decrease in hammerhead sharks has led to a decrease in bay scallops.

Select **two** pieces of data that the biologists would most likely use to test their hypothesis.

Ⓐ the population counts for bay scallops

Ⓑ the number of times hammerhead sharks reproduce each year

Ⓒ the number of offspring produced from one mating between bay scallops

Ⓓ the number of hammerhead sharks in each of the marine ecosystems over time

Ⓔ the temperature of the water in which hammerhead sharks and bay scallops live

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

15 Cownose rays are an important part of the marine ecosystem.

A. Identify the ecological relationship (competitive, parasitic, or predatory) between cownose rays and oysters in the ecosystem. Explain your reasoning.

B. Describe what would most likely happen to the size of the cownose ray population (increase, decrease, or stay the same) if there were a large decrease in the phytoplankton population in the ecosystem. Explain your reasoning.

C. Based on the food web, describe what would most likely happen to the hammerhead shark population if the cownose rays were removed from the ecosystem. Explain your reasoning.

15

16 The diagram shows a model of the water cycle. Four steps of the water cycle are labeled W, X, Y, and Z.
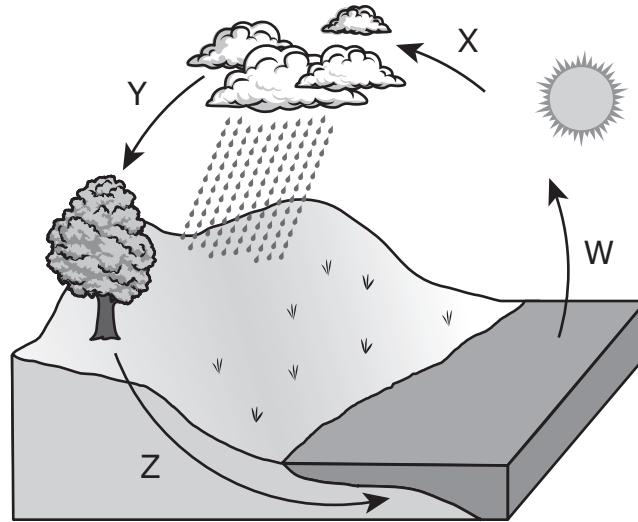
Which change would most likely increase the movement of water during step W?

Ⓐ an increase in absorption

Ⓑ an increase in cloud cover

Ⓒ an increase in precipitation

Ⓓ an increase in solar radiation

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

17 Students investigated what happens when citric acid combines with baking soda in water. They followed these steps:

1. Place a thermometer in a beaker of room-temperature water.

2. Add baking soda to the beaker of water and stir until the baking soda is no longer visible.

3. Add citric acid to the beaker and stir for 5 sec.

The students recorded observations in a lab notebook every 30 sec for 2 min. They made the following observations:

- The temperature decreased.

- Bubbles formed.

- The color did not change.

A. Identify the type of energy that was measured by the thermometer.

B. Identify whether the reaction in the beaker was endothermic or exothermic. Explain your answer.

C. Show how the students should have set up the lab notebook to record their data. In the table shown on the next page, fill in the row and column headings using labels from the list below. Write one label in each space that has dashed lines. Each label may be used once or not at all.

Labels:

- 0 sec
- 30 sec
- 60 sec
- 90 sec
- 120 sec
- Baking soda
- Bubbles
- Citric acid
- Color
- Temperature
- Time
- Water

17

C.

Part C. Lab Notebook Table

This question has two parts.

18   The diagram shows an example of a communication system for a United States Geological Survey (USGS) data collection site that collects information about water in a lake.
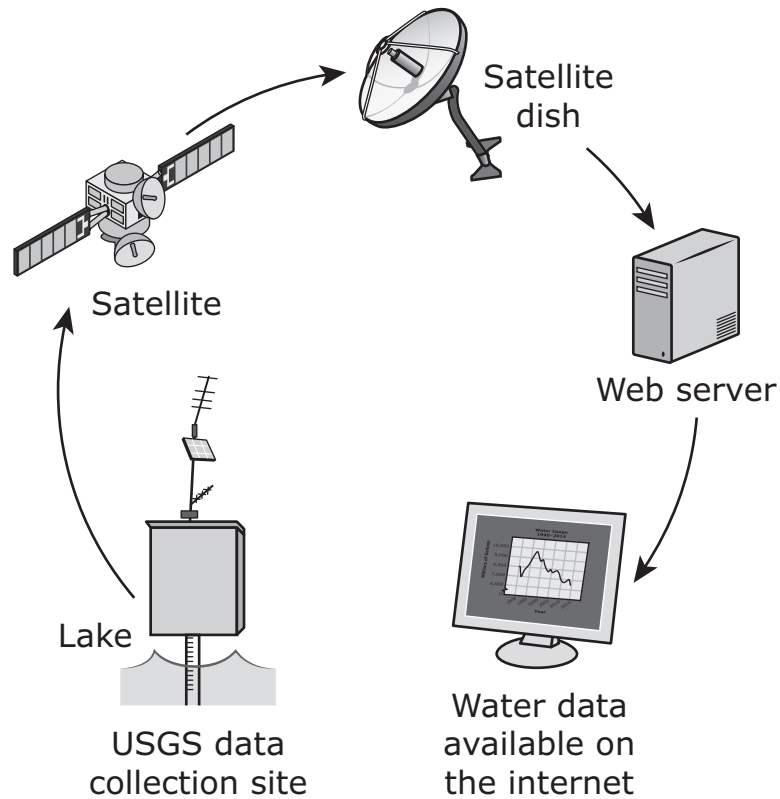
Part A

What is the source of the message in this communication system?

  Ⓐ   the satellite

  Ⓑ   the satellite dish

  Ⓒ   the USGS data collection site

  Ⓓ   the water data available on the internet

Part B

Which of the following is the storage for this communication system?

Ⓐ the lake

Ⓑ the satellite

Ⓒ the satellite dish

Ⓓ the web server

19   A company is developing a new kind of camera. Which of the following **best** describes a prototype for the camera?

Ⓐ   a full-size working version of the camera

Ⓑ   a three-dimensional clay model of the camera

Ⓒ   a list of the materials needed to build the camera

Ⓓ   a drawing showing the different sides of the camera

20   When a person eats a sandwich, the person's digestive system breaks down the sandwich into food molecules.

Select **two** statements that describe how the food molecules are used by the person's body.

Ⓐ   The food molecules deliver oxygen and remove wastes from cells.

Ⓑ   The food molecules are used to produce energy for cell processes.

Ⓒ   The food molecules store genetic information that is used to direct cell division.

Ⓓ   The food molecules are assembled into larger molecules that are used for cell growth.

Grade 8 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	*Earth and Space Science*	6.ESS.1.5	C. Evidence, Reasoning, and Modeling	SR	Use a model to order a planet, a solar system, a galaxy, and the universe from smallest to largest.	C
2	4	*Earth and Space Science*	7.ESS.3.2	C. Evidence, Reasoning, and Modeling	SR	Interpret a map to determine where an earthquake is most likely to occur.	B
3	5	*Physical Science*	7.PS.2.3	C. Evidence, Reasoning, and Modeling	SR	Compare the strengths of the electric forces between charged particles at different distances to determine which two particles have the greatest attractive electric force.	C
4	6	*Earth and Space Science*	8.ESS.1.2	B. Mathematics and Data	SR	Analyze mass and distance data of planets to determine the planet that has the greatest gravitational force acting on it.	A
5	7	*Physical Science*	7.PS.3.1	B. Mathematics and Data	CR	Compare the kinetic energy of two students when given their speed and mass and explain the reasoning; identify the graph that shows the relationship between speed and kinetic energy and explain the reasoning.	
6	9	*Earth and Space Science*	8.ESS.3.5	C. Evidence, Reasoning, and Modeling	SR	Interpret a model to show how thermal energy that causes global warming moves through Earth's systems and identify activities that will reduce greenhouse gas production.	B;A,B,E
7	11	*Technology/ Engineering*	7.ETS.3.5	None	SR	Determine whether parts of a system are inputs, processes, or outputs.	D
8	12	*Technology/ Engineering*	7.ETS.3.3	C. Evidence, Reasoning, and Modeling	SR	Determine whether parts of a vehicle are structural, propulsion, or control subsystems.	A
9	13	*Technology/ Engineering*	6.ETS.2.3	A. Investigations and Questioning	SR	Select the appropriate safety equipment and tools needed to construct a prototype.	B,C,E
10	15	*Earth and Space Science*	8.ESS.2.5	B. Mathematics and Data	SR	Analyze data to determine the causes of a change in weather.	B,D
11	16	*Physical Science*	7.PS.3.4	C. Evidence, Reasoning, and Modeling	SR	Explain how mass affects the amount of heat energy that one object can transfer to another.	D
12	18	*Life Science*	7.LS.2.2	C. Evidence, Reasoning, and Modeling	SR	Analyze a food web to describe how the ecological relationships among organisms influence populations in an ecosystem.	D
13	18	*Life Science*	7.LS.2.3	C. Evidence, Reasoning, and Modeling	SR	Use a food web to determine which organisms in an ecosystem transfer energy from sunlight into food molecules.	D
14	19	*Life Science*	7.LS.2.4	A. Investigations and Questioning	SR	Determine what data should be collected to study how overfishing one population affects another population.	A,D
15	19	*Life Science*	7.LS.2.1	C. Evidence, Reasoning, and Modeling	CR	Analyze a food web to describe and explain the ecological relationship between two organisms and explain how changes to the populations of organisms affect the population sizes of other organisms.	
16	21	*Earth and Space Science*	7.ESS.2.4	C. Evidence, Reasoning, and Modeling	SR	Analyze a water cycle model to determine what would cause an increase in evaporation.	D
17	22	*Physical Science*	6.PS.1.6	A. Investigations and Questioning	CR	Analyze the results of an investigation to determine whether a reaction was endothermic or exothermic, and show how the results should be organized in a lab notebook.	
18	24	*Technology/ Engineering*	7.ETS.3.1	C. Evidence, Reasoning, and Modeling	SR	Interpret a model of a communication system to determine its source and storage.	C;D
19	26	*Technology/ Engineering*	7.ETS.1.7	None	SR	Describe the function of a prototype.	A
20	27	*Life Science*	8.LS.1.7	None	SR	Describe how digested food molecules are used by a person's body.	B,D

* 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.

PBT Item No.	Reporting Category	Standard	Science and Engineering Practice Category	Item Type*	Item Description
21	*Technology/ Engineering*	7.ETS.1.2	B. Mathematics and Data	SR	Interpret a decision matrix to determine the best design solutions.
22	*Physical Science*	6.PS.4.2	C. Evidence, Reasoning, and Modeling	SR	Determine which model shows how light is transmitted through a material.
23	*Life Science*	8.LS.3.4	C. Evidence, Reasoning, and Modeling	SR	Determine which model shows the pairs of alleles that code for a trait in an offspring and its parents.
24	*Technology/ Engineering*	6.ETS.1.1	A. Investigations and Questioning	SR	Determine a constraint of a design solution for a manufacturer.
25	*Technology/ Engineering*	6.ETS.1.5	B. Mathematics and Data	SR	Calculate the length of a scaled drawing and select the correct scaled drawing by measuring its length.
26	*Technology/ Engineering*	6.ETS.2.1	None	SR	Determine which property of a metal blade allows it to cut other materials.
27	*Technology/ Engineering*	8.ETS.2.5	C. Evidence, Reasoning, and Modeling	CR	Identity which manufacturing processes are used to make a product and explain an advantage of using computer-controlled machines for some manufacturing steps.
28	*Earth and Space Science*	6.ESS.1.4	C. Evidence, Reasoning, and Modeling	CR	Identify and explain the relative ages of rock layers, explain how fossils of a species can be found in a different environment from where the species lived, and explain why fossils of a species may be found in only one rock layer.
29	*Earth and Space Science*	8.ESS.1.1	C. Evidence, Reasoning, and Modeling	SR	Identify the model that shows the Sun-Earth system and describe the daylight hours in the Southern Hemisphere for a certain month.
30	*Physical Science*	8.PS.1.1	C. Evidence, Reasoning, and Modeling	SR	Compare the properties of two molecules by interpreting models of the molecules.
31	*Physical Science*	8.PS.2.2	C. Evidence, Reasoning, and Modeling	SR	Use information about the motion and speed of an object to determine if the forces on the object are balanced or unbalanced.
32	*Life Science*	8.LS.1.5	C. Evidence, Reasoning, and Modeling	SR	Analyze data to determine that an environmental factor influenced the growth of organisms.
33	*Earth and Space Science*	8.ESS.2.1	C. Evidence, Reasoning, and Modeling	SR	Use a model to draw a conclusion about oceanic crust near a mid-ocean ridge.
34	*Physical Science*	6.PS.4.1	C. Evidence, Reasoning, and Modeling	SR	Compare wave models and determine which two have the same amplitude.
35	*Life Science*	8.LS.3.2	C. Evidence, Reasoning, and Modeling	SR	Explain why sexual reproduction helped a species survive an environmental change.
36	*Life Science*	8.LS.4.4	C. Evidence, Reasoning, and Modeling	CR	Identify whether an inherited trait will increase in a population over time and explain the reasoning.
37	*Physical Science*	7.PS.3.3	None	SR	Explain how an insulated cooler can keep its contents cold.
38	*Life Science*	6.LS.4.1	C. Evidence, Reasoning, and Modeling	SR	Analyze fossil record data to determine how the fossil record changed and explain why the change occurred.
39	*Physical Science*	6.PS.1.7	B. Mathematics and Data	SR	Use a data table with mass, volume, and physical state to determine which material has the greatest density.
40	*Earth and Space Science*	6.ESS.1.1	C. Evidence, Reasoning, and Modeling	SR	Describe how Earth would appear from the Moon when Earth is experiencing a lunar eclipse.
41	*Life Science*	8.LS.3.3	C. Evidence, Reasoning, and Modeling	SR	Explain why different types of cells in an organ can have different functions.

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