XVI. Science and Technology/Engineering, Grade 5

Grade 5 Science and Technology/Engineering Test

The spring 2007 grade 5 MCAS Science and Technology/Engineering test was based on learning standards in the Massachusetts *Science and Technology/Engineering Curriculum Framework* (2006). The *Framework* identifies four major content strands, listed below. Page numbers for the grades 3–5 learning standards appear in parentheses.

- Earth and Space Science (*Framework*, pages 26–29)
- Life Science (Biology) (*Framework*, pages 46–49)
- Physical Sciences (Chemistry and Physics) (*Framework*, pages 64–66)
- Technology/Engineering (*Framework*, page 86)

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

In *Test Item Analysis Reports* and on the Subject Area Subscore pages of the MCAS *School Reports* and *District Reports*, Science and Technology/Engineering test results are reported under four MCAS reporting categories, which are identical to the four *Curriculum Framework* content strands listed above.

Test Sessions

The MCAS grade 5 Science and Technology/Engineering test included two separate test sessions. Each session included multiple-choice and open-response questions.

Reference Materials and Tools

The use of bilingual word-to-word dictionaries was allowed for current and former limited English proficient students only, during both Science and Technology/Engineering test sessions. No other reference tools or materials were allowed.

Cross-Reference Information

The table at the conclusion of this chapter indicates each item's reporting category and the *Framework* learning standard it assesses. The correct answers for multiple-choice questions are also displayed in the table.

Science and Technology/Engineering

Session 1

DIRECTIONS

This session contains seventeen multiple-choice questions and two open-response questions. Mark your answers to these questions in the spaces provided in your Student Answer Booklet.

1 Some types of trees are able to survive the heat of a forest fire. Which of the following characteristics would **best** help a tree survive a fire?

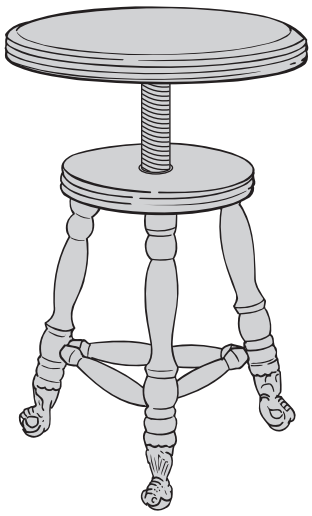
A. large leaves

B. shallow roots

C. thick bark

D. thin trunks

2 The picture below shows an antique piano stool.



This piano stool uses what type of simple machine to adjust the height?

A. wedge

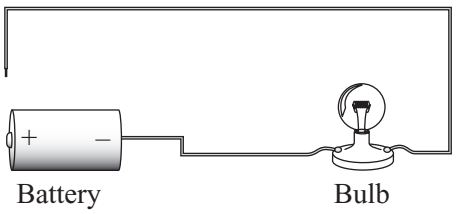
B. screw

C. pulley

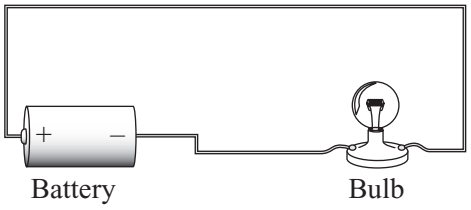
D. lever

3 Which diagram below shows a circuit that will cause the bulb to light?

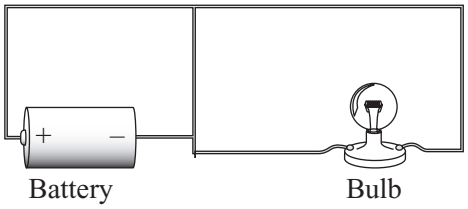
A.



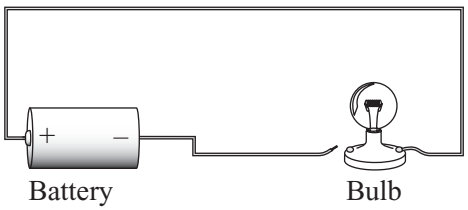
B.



C.



D.



4 The picture below shows a frozen juice bar.

The frozen juice bar was placed in a bowl and left to melt. Which of the following properties of the juice bar changed the **most** once it melted?

A. color

B. mass

C. shape

D. volume

5 The Mohs scale for minerals is shown below.

softest → **hardest**									
1	2	3	4	5	6	7	8	9	10
talc	gypsum	calcite	fluorite	apatite	feldspar	quartz	topaz	corundum	diamond

An unknown mineral can be scratched by topaz, but not by feldspar. According to the Mohs scale, which of the following **best** describes the hardness of the unknown mineral?

A. less than 5

B. more than 8

C. less than 8, but more than 6

D. more than 4, but less than 6

6 Tom needs to buy some screws to use with a certain type of screwdriver. When he reads the boxes at the store, which of the following sets of information would **most** help Tom choose the correct type of screw?

A.

	Composition
Screw Type 1	steel
Screw Type 2	stainless steel

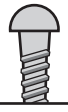
B.

Screw Type 1	
Screw Type 2	

C.

	Number of Screws per Pound
Screw Type 1	165
Screw Type 2	150

D.

Screw Type 1	
Screw Type 2	

7 Each year, humpback whales migrate from the coast of Antarctica to the north coast of Australia. The map below shows the whales' migration route.

Which of the following are the whales **most likely** responding to when they begin to migrate?

A. the force of gravity

B. a shift in ocean waves

C. a change in water temperature

D. the approach of stormy weather

8 Delilah put a container of water in the freezer and left it there overnight. The next morning she saw that the water in the container had changed to ice.

Which of the following statements **best** explains why the water changed to ice?

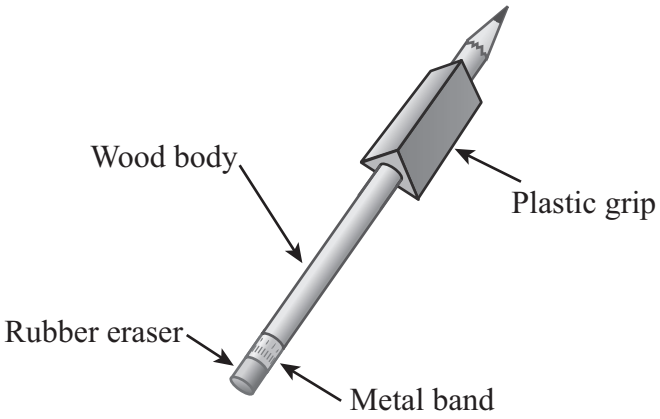
A. The water gained energy.

B. The water absorbed light.

C. Mass was released from the water.

D. Heat was taken away from the water.

9 The picture below shows four parts of a wooden pencil.



Which part of the pencil is the **best** conductor of electricity?

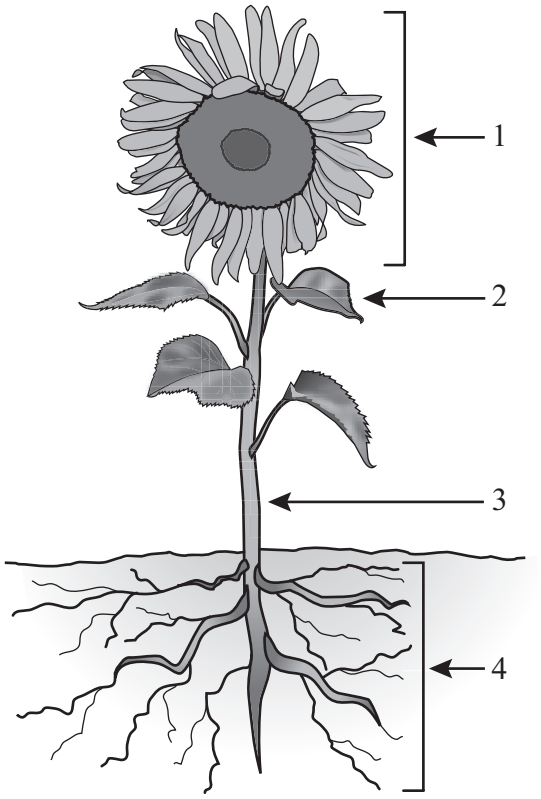
A. metal band

B. plastic grip

C. rubber eraser

D. wood body

10 Four parts of a sunflower plant are identified by numbers in the picture below.

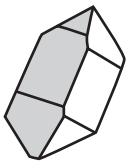


Which numbered part of the sunflower plant is **mainly** responsible for reproduction?

A. part 1
B. part 2
C. part 3
D. part 4

11 Dora wrote down some observations of four rock samples she was studying. Based on her observations, which of the following rock samples is **most likely** a sedimentary rock?

A.



has large crystal shape that is almost clear, has smooth sides

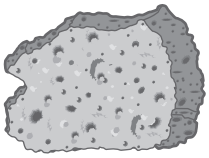
B.

has many very small grains of sand in different layers

C.

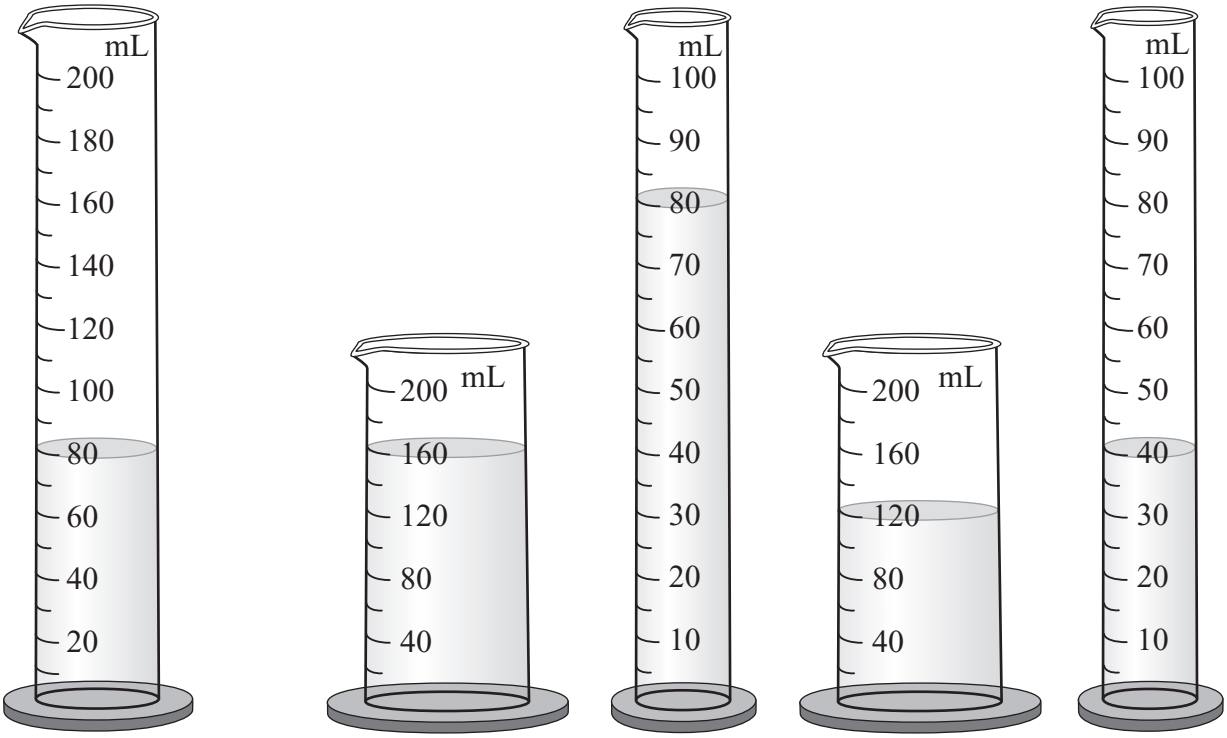
has solid black color, looks like smooth glass with sharp edges

D.



has rough surface full of holes and is light in weight

12 Carol poured some water into a 200-milliliter (mL) graduated cylinder. Pictured below are Carol's graduated cylinder and four numbered graduated cylinders.



Carol's graduated cylinder **1** **2** **3** **4**

Which numbered graduated cylinder contains the same volume of water as Carol's graduated cylinder?

A. graduated cylinder 1

B. graduated cylinder 2

C. graduated cylinder 3

D. graduated cylinder 4

13 While on a walk, Samuel saw a tree he had not seen before. He used a key to help him identify the type of tree. A branch from the tree and the key he used are shown below.

Key to Identify Evergreen Trees

- evergreen tree with needle-shaped leaves
  - single leaves
    - flat leaves → **fir**
    - angled leaves → **spruce**
  - grouped leaves (4 or 5 leaves in a group) → **pine**
  - clustered leaves (more than 5 leaves per cluster) → **tamarack**

Based on the key, which type of tree did Samuel **most likely** see?

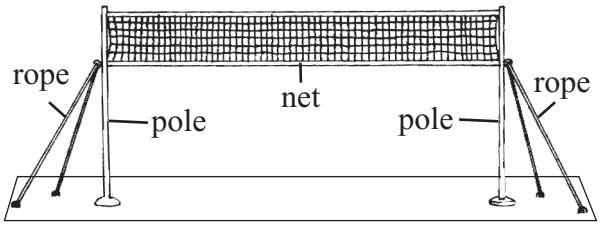
A. fir

B. spruce

C. pine

D. tamarack

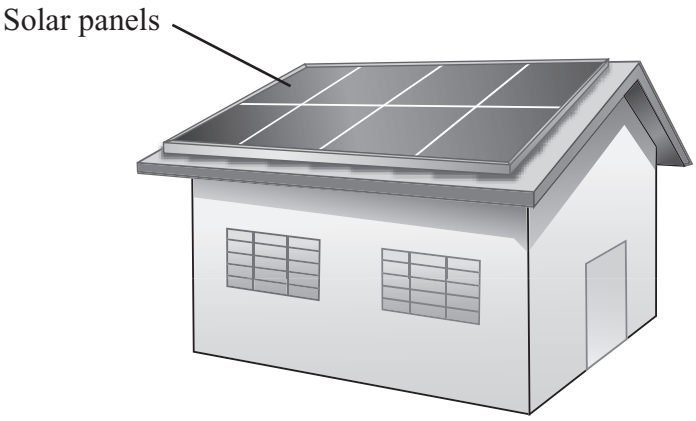
14 The picture below shows a volleyball net with the ropes pulled tight.



Which of the following properties of the ropes is **most** important for holding the net in place?

A. flexibility
B. hardness
C. strength
D. weight

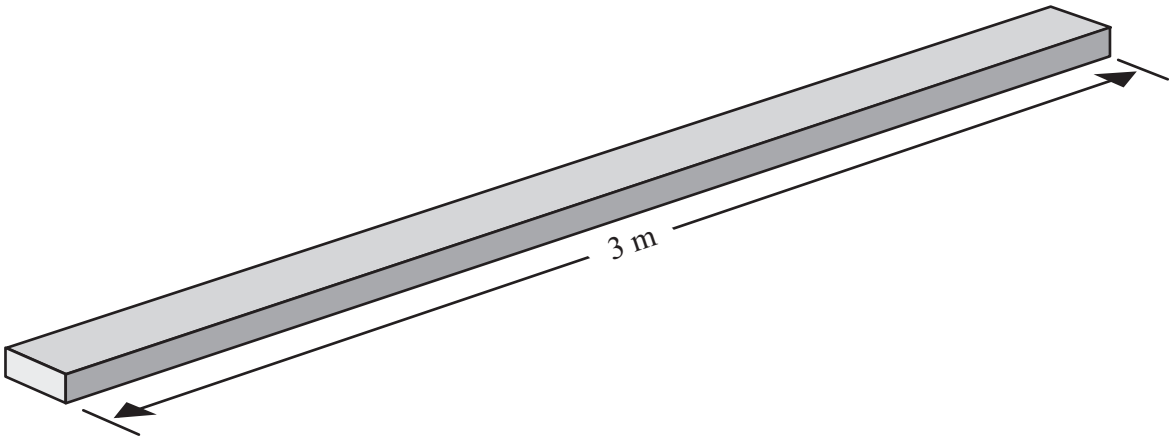
15 A solar panel is used to collect energy from the Sun and change it into other forms of energy. The picture below shows some solar panels on the roof of a building.



Which form of energy is collected by the solar panels?

A. wind
B. sound
C. magnetic
D. light

16 Andrea has a wooden board that is 3 m long, as shown below.



Which of the following pairs of tools would be **best** for Andrea to use to cut the board into three pieces of equal length?

A. a saw and an ax

B. an ax and a hammer

C. a tape measure and a saw

D. a hammer and a tape measure

17 Which of the following has the **greatest** effect on the ability of soil to hold water?

A. the age of the soil particles
B. the size of the soil particles
C. the color of the soil particles
D. the luster of the soil particles

Questions 18 and 19 are open-response questions.

- **BE SURE TO ANSWER AND LABEL ALL PARTS OF EACH QUESTION.**
- **Show all your work (diagrams, tables, or computations) in your Student Answer Booklet.**
- **If you do the work in your head, explain in writing how you did the work.**

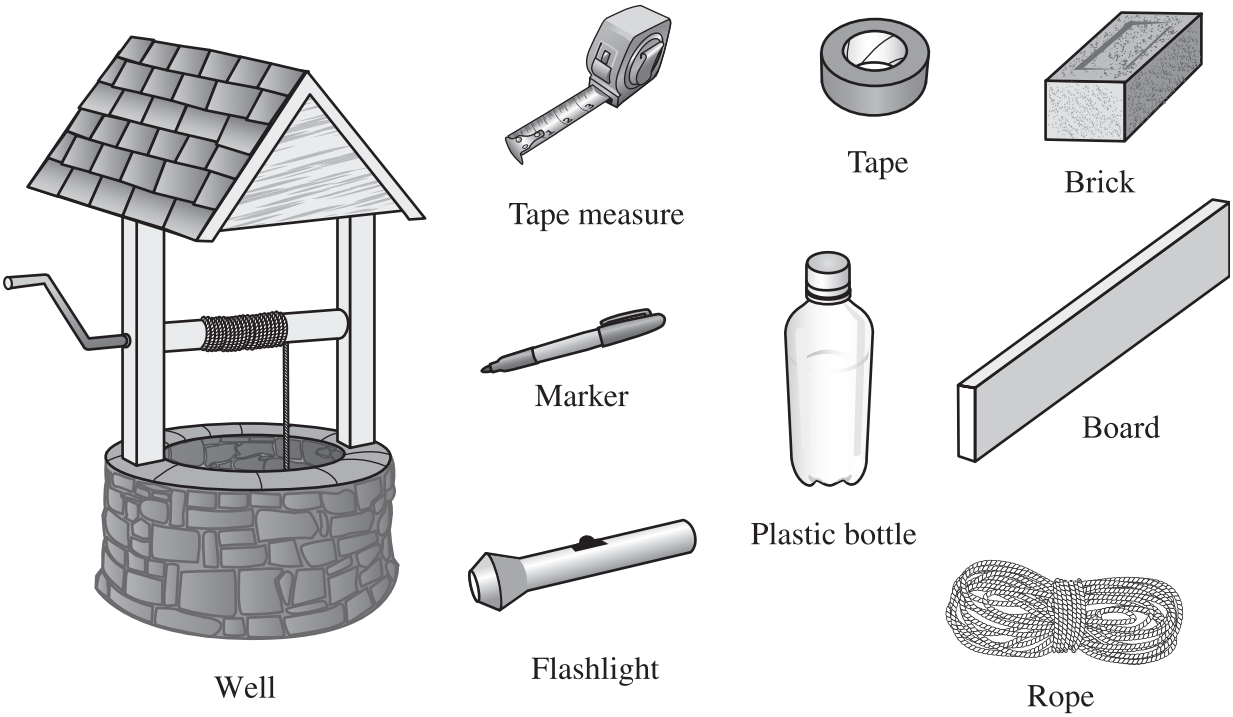
Write your answer to question 18 in the space provided in your Student Answer Booklet.

18 The surface of Earth is always changing. Some natural processes change Earth's surface slowly over time and others change Earth's surface very quickly. The picture below shows an area of Earth's surface that was shaped by natural processes.

Name and describe **three** natural processes that might have helped to shape this area.

Write your answer to question 19 in the space provided in your Student Answer Booklet.

19 Rosa wants to measure the depth of the well in her backyard. To help her find the depth of the well, Rosa gathered her tape measure and several objects from around her house. Her tape measure is 12 ft. long, but the well is deeper than 12 ft. The well and the objects that Rosa gathered are shown below.



a. Identify which of these objects Rosa can use with her tape measure to find the depth of the well.

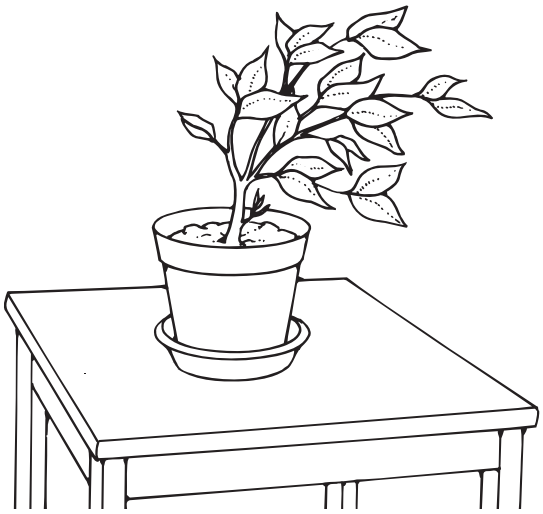
b. Explain how Rosa can use her tape measure and **each** object you identified in part (a) to find the depth of the well.

Science and Technology/Engineering
SESSION 2

DIRECTIONS

This session contains seventeen multiple-choice questions and three open-response questions. Mark your answers to these questions in the spaces provided in your Student Answer Booklet.

20 The picture below shows a plant that is bending as it grows.



What **most likely** caused the plant to bend this way?

A. fertilizer

B. gravity

C. heat

D. light

21 Which form of precipitation is **most likely** to cause damage when hitting the roof of a car?

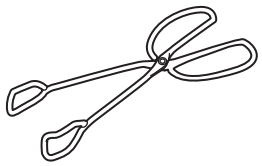
A. hail

B. rain

C. sleet

D. snow

22 The picture below shows tongs.



The tongs work as which of the following simple machines?

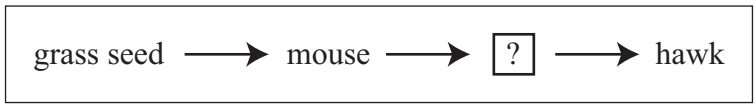
A. inclined plane

B. lever

C. pulley

D. wedge

23 An incomplete food chain is shown below.



Which of the following organisms would **best** complete the food chain?

A. rabbit
B. robin
C. snake
D. tree

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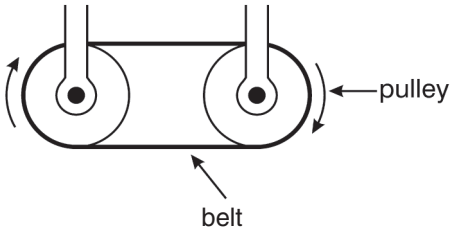
24 Steel cans are separated from aluminum cans in a recycling center. Which of the following is the **best** way the recycling center can separate the steel cans from the aluminum cans?

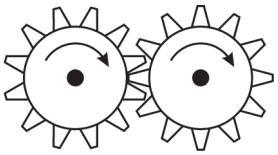
A. sort the cans by size
B. put the cans in water
C. cool the cans to a low temperature
D. put the cans under an electromagnet

25 Alexa wants to build a machine for her technology class. To think of ideas, she drew four sketches of moving parts for her machine. Which design will work?

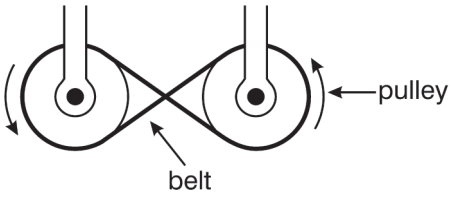
A.



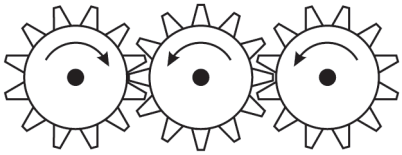
B.



C.

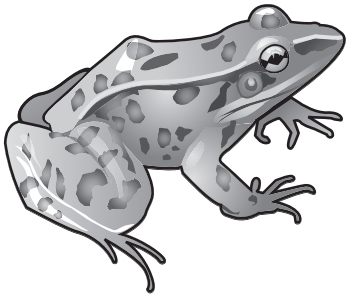


D.



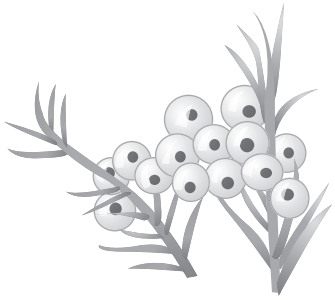
26 Which of the following pictures shows a stage in a frog's life cycle when it breathes entirely through gills?

A.

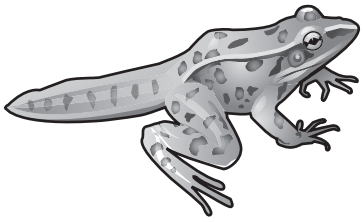


B.

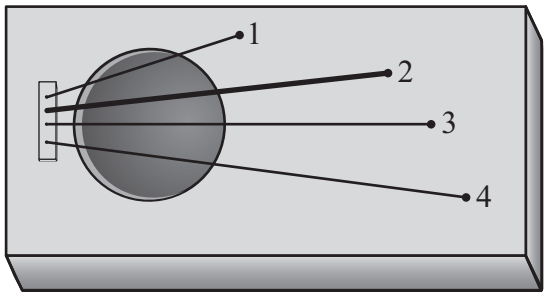
C.



D.



27 The picture below shows a musical instrument that Jamie made during science class. Each string on the instrument will produce a different sound when plucked.



Which of the following identifies the string that will **most likely** produce the sound with the highest pitch?

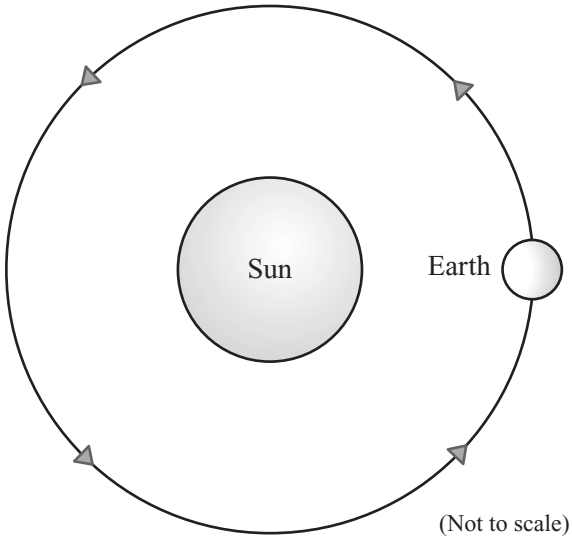
A. string 1, because it is the shortest

B. string 2, because it is the thickest

C. string 3, because it is centered over the hole

D. string 4, because it is the longest

28 The diagram below represents Earth's orbit around the Sun.



(Not to scale)

About how long does it take Earth to make one complete orbit around the Sun?

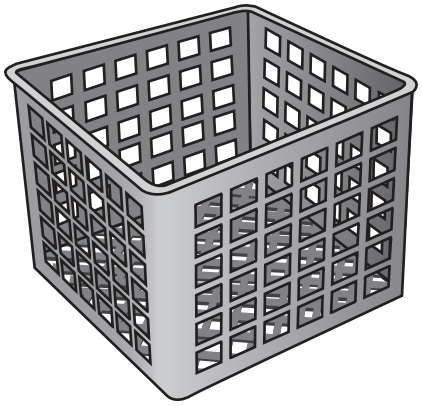
A. 24 hours

B. 7 days

C. 1 month

D. 1 year

29 A crate for carrying milk containers is shown below.



An engineer is designing milk containers to put in the crate. In her design, she wants to fit as many milk containers as possible in each crate.

Which of the following features of the milk containers is **most** important to consider in her design?

A. color
B. hardness
C. shape
D. weight

30 A student places a sheet of black construction paper on her desk. What happens to **most** of the light that strikes the black construction paper?

A. The light is bent by the paper.
B. The light reflects off the paper.
C. The light is absorbed by the paper.
D. The light passes through the paper.

31 Rachel purchased a kit for making a skateboard ramp. Which of the following is **most important** to have for putting the ramp together?

A. a picture showing the colors of different ramp parts
B. a diagram showing some ways to use the ramp
C. a list of prices for other available kits
D. a set of instructions for the kit materials

32 The map below shows the continental United States and four arrows representing wind directions.

Which arrow **best** represents the direction of the jet stream that influences weather across the continental United States?

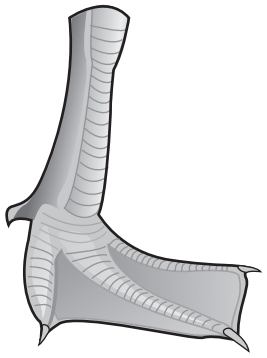
A. arrow 1

B. arrow 2

C. arrow 3

D. arrow 4

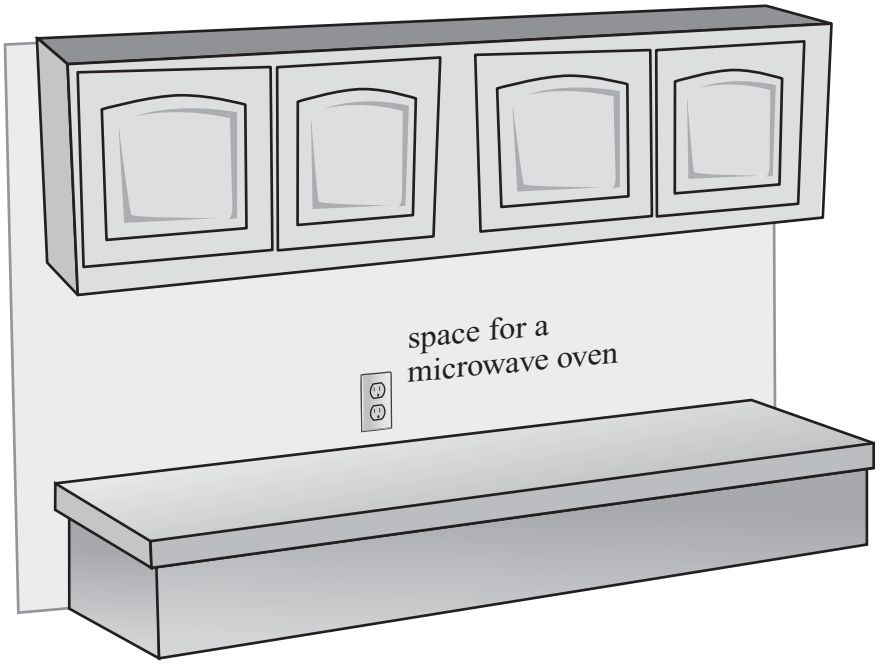
33 The picture below shows the foot of a certain species of bird.



In which of the following environments is this species **best** adapted for survival?

A. desert
B. freshwater lake
C. meadow
D. tropical rain forest

34 Lyle is planning to buy a microwave oven. He will put it in his kitchen in the space labeled in the diagram below.



In order to be sure he can put the microwave oven in the space in the kitchen, which of the following questions should Lyle ask before buying the microwave oven?

A. Is the microwave oven powered by electricity?

B. Does the microwave oven have an automatic timer?

C. What are the measurements of the microwave oven?

D. How many power levels does the microwave oven have?

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35 Which of the following forms of energy can travel by vibrating particles of air?

A. electrical

B. light

C. magnetic

D. sound

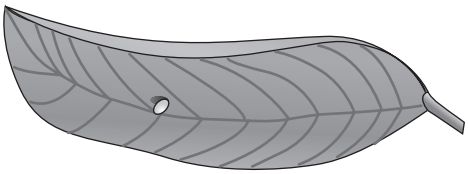
36 The diagram below names three of the four stages in the life cycle of a butterfly.

egg → ? → pupa → adult

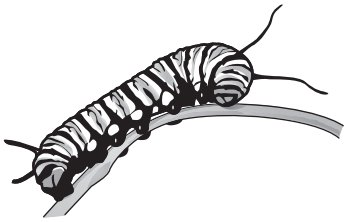
Which of the following pictures shows the stage that is missing in the diagram?

A.

C.



B.



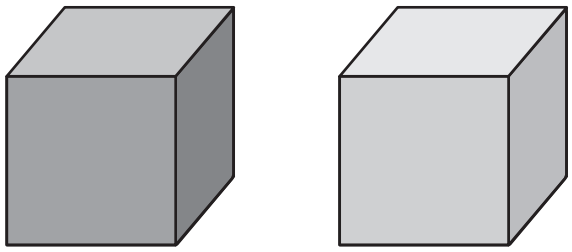
D.

Questions 37 through 39 are open-response questions.

- **BE SURE TO ANSWER AND LABEL ALL PARTS OF EACH QUESTION.**
- **Show all your work (diagrams, tables, or computations) in your Student Answer Booklet.**
- **If you do the work in your head, explain in writing how you did the work.**

Write your answer to question 37 in the space provided in your Student Answer Booklet.

37 The pictures below show two cubes that are the same size. One cube is made of iron metal and the other cube is made of pine wood.



Iron cube **Pine cube**

The two cubes can be compared by their physical properties. One physical property is color. The iron cube has a gray color and the pine cube has a tan color.

a. Name **two** other physical properties that can be used to compare the cubes.

b. For **each** physical property that you named in part (a), describe how you could measure or test that physical property to compare the cubes.

Write your answer to question 38 in the space provided in your Student Answer Booklet.

38 A geology club is planning to go on a trip to the coast to observe rock formations. Based on the club's calendar, they can schedule the trip in either May or September. The table below shows the average weather conditions at the coast for May and September.

Average Weather Conditions at the Coast

Condition	May	September
high temperature (°F)	55	63
number of days with precipitation	12	9
number of days with sunshine	16	22
wind speed (mi. per hr)	14	10

a. Which month has the highest average wind speed? Include data from the table to support your answer.

b. Based on the information in the table, which month would **most likely** have the best weather conditions for a trip to the coast to observe rock formations? Include data from the table to support your answer.

c. When the geology club finally went on their trip to the coast, it was 60°F with cloudy skies, and the wind speed was 5 mi. per hr. Explain why it is not unusual that the weather conditions on the day of the club's trip were different from those shown in the table for either month.

Write your answer to question 39 in the space provided in your Student Answer Booklet.

39 During the fall, changes in the environment in Massachusetts cause many animals to prepare for the coming winter season.

a. Describe **two** changes in the environment in Massachusetts during the fall that cause animals to prepare for the winter.

b. Identify **one** way that animals in Massachusetts prepare to survive the winter. Explain how this helps the animals to survive the winter.

Grade 5 Science and Technology/Engineering
Spring 2007 Released Items:
Reporting Categories, Standards, and Correct Answers

Item No.	Page No.	Reporting Category	Standard	Correct Answer (MC)*
1	409	*Life Science (Biology)*	2	C
2	409	*Technology/Engineering*	1.3	B
3	410	*Physical Sciences (Chemistry and Physics)*	6	B
4	410	*Physical Sciences (Chemistry and Physics)*	2	C
5	411	*Earth and Space Science*	2	C
6	412	*Technology/Engineering*	2.2	B
7	412	*Life Science (Biology)*	7	C
8	413	*Physical Sciences (Chemistry and Physics)*	3	D
9	413	*Physical Sciences (Chemistry and Physics)*	7	A
10	414	*Life Science (Biology)*	2	A
11	414	*Earth and Space Science*	3	B
12	415	*Physical Sciences (Chemistry and Physics)*	2	B
13	416	*Life Science (Biology)*	1	D
14	417	*Technology/Engineering*	1.1	C
15	417	*Physical Sciences (Chemistry and Physics)*	4	D
16	418	*Technology/Engineering*	1.2	C
17	419	*Earth and Space Science*	5	B
18	420	*Earth and Space Science*	12	
19	421	*Technology/Engineering*	1.2	
20	422	*Life Science (Biology)*	9	D
21	422	*Earth and Space Science*	7	A
22	422	*Technology/Engineering*	1.3	B
23	423	*Life Science (Biology)*	11	C
24	423	*Physical Sciences (Chemistry and Physics)*	8	D
25	424	*Technology/Engineering*	2.3	A
26	424	*Life Science (Biology)*	4	B
27	425	*Physical Sciences (Chemistry and Physics)*	11	A
28	425	*Earth and Space Science*	14	D
29	426	*Technology/Engineering*	2.3	C
30	426	*Physical Sciences (Chemistry and Physics)*	12	C
31	426	*Technology/Engineering*	2.2	D
32	427	*Earth and Space Science*	8	A
33	428	*Life Science (Biology)*	6	B
34	429	*Technology/Engineering*	2.3	C
35	429	*Physical Sciences (Chemistry and Physics)*	11	D
36	430	*Life Science (Biology)*	4	B
37	431	*Physical Sciences (Chemistry and Physics)*	1	
38	432	*Earth and Space Science*	6	
39	433	*Life Science (Biology)*	8	

* Answers are provided here for multiple-choice items only. Sample responses and scoring guidelines for open-response items, which are indicated by shaded cells, will be posted to the Department's Web site later this year.