Release of
Spring 2010
MCAS Test Items

June 2010
Massachusetts Department of
Elementary and Secondary Education
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Commissioner’s Foreword

Dear Colleagues:

The Department of Elementary and Secondary Education is committed to work in partnership with schools to support a system that will prepare all students to succeed as productive and contributing members of our democratic society and the global economy. To assist in achieving this goal, the Department regularly releases MCAS test items to provide information about the kinds of knowledge and skills that students are expected to demonstrate.

As it has in the past, this publication contains all MCAS test items on which student scores are based for grade 10 English Language Arts and Mathematics tests and for high school Biology and Introductory Physics tests. This year, high school Chemistry and Technology/Engineering items are also included. This document also contains approximately 50% of common test items from spring 2010 MCAS tests in grades 3–8. By recycling some items each year and thus reducing the number of field-test items on each form, we have shortened the length of each test and the amount of time devoted to MCAS testing. Despite this decrease, the items released in this document still represent all topics and reporting categories.

For over a decade, the Department has banked thousands of MCAS items that are currently posted on the Department website. These items, which are available at http://www.doe.mass.edu/mcas/testitems.html, will continue to be a rich resource for schools.

This publication is available only on the Department website. The released test items for individual subjects at each grade level can be printed from this site. I encourage educators to use the relevant sections of this document together with their Test Item Analysis Report Summaries and Test Item Analysis Rosters as guides for planning changes in curriculum and instruction that may be needed to support schools and districts in their efforts to improve student performance.

Thank you for your support as we work together to strengthen education for our students in Massachusetts.

Sincerely,

Mitchell D. Chester, Ed.D.
Commissioner of Elementary and Secondary Education
I. Document Purpose and Structure
Document Purpose and Structure

Purpose

The purpose of this document is to share with educators and the public all of the spring 2010 test items on which grade 10 and high school student results are based, as well as selected test items for grades 3–8. Local educators will be able to use this information to identify strengths and weaknesses in their curriculum and instruction, and to guide the changes necessary to more effectively meet their students’ needs.

This document is also intended to be used by school and district personnel as a companion document to the test item analysis reports. Each school can access electronically a 2010 School Test Item Analysis Report Summary and a Test Item Analysis Roster for each content area at each grade level tested (e.g., grade 10 Mathematics). These reports provide data generated from student responses. Each report lists, for the school accessing the report, the names of all enrolled students in the grade covered by the report as well as information about how each student answered each common item contained in this Released Item Document. Each report also labels each item as multiple-choice, open-response, short-response, short-answer, or writing prompt and identifies the item’s MCAS reporting category. Item numbers in this document correlate directly to the “Item Numbers” in the test item analysis report and roster. Like last year, reports for grades 3–8 will indicate whether students responded correctly or incorrectly to 2010 MCAS common items that are not included in this document; reports will not indicate the correct responses to unreleased items. Reporting categories and framework standards assessed by unreleased 2010 MCAS common items are included in a table at the conclusion of each chapter for grades 3–8 in this document.

Structure

Each subsequent chapter of this document contains information and materials for one MCAS test (one grade level and one content area). For example, chapter II contains information for the grade 3 ELA Reading Comprehension test; chapter XV contains information for the grade 10 Mathematics test. Note that chapters III, VI, and VIII contain information for both the ELA Composition (Part A) and the ELA Reading Comprehension (Part B) tests for the relevant grade.

Beginning with chapter II, each chapter has three main sections. The first section introduces the chapter by listing the Massachusetts curriculum framework content strands assessed by MCAS in that chapter’s content area, as well as the MCAS reporting categories under which test results are reported to schools and districts. The first section also provides the Web address for the relevant framework and the page numbers on which the learning standards assessed by the test items in the chapter can be found. In addition, there is a brief overview of the test (number of test sessions, types of items, reference materials allowed, and cross-referencing information).

For grades 3–8, the second section of each chapter contains approximately half of each content area’s common test items used to generate spring 2010 MCAS student results. The second section of each chapter for grade 10 and high school MCAS tests contains all of the common items on which spring 2010 MCAS student results are based. With the exception of the ELA Composition writing prompt, the test questions in this document are shown in the same order and basic format in which they were presented in the test
booklets. The Mathematics Tool Kit pieces used by students to answer released items in grades 3 and 4, as well as the Mathematics Reference Sheets used by students in grades 5, 6, 7, 8, and 10 MCAS Mathematics test sessions are inserted immediately following the last question in the second section of each Mathematics chapter. Students in all the tested grades were also provided with plastic rulers. Images of these rulers are not presented in this document. The reference tools used by students during the high school Science and Technology/Engineering tests (Chemistry Formula and Constants Sheet/Periodic Table of the Elements for the Chemistry test; formula sheets for the Introductory Physics and Technology/Engineering tests) are inserted immediately following the last question in the second section of the associated chapter.

Due to copyright restrictions, certain English Language Arts reading passages are not available on the Department’s website. Copyright information for all released common reading passages is provided in the document. Note that the Department of Elementary and Secondary Education has obtained permission to post all English Language Arts reading passages that appear on its website. While the Department grants permission to use the posted test items for educational purposes, it cannot grant or transfer permission to use the passages that accompany the items. Such permission must be obtained directly from the holder of the copyright. For further information, contact Student Assessment Services at 781-338-3625.

The final section of each chapter includes a table that cross-references each released common item with its MCAS reporting category and with the framework standard it assesses. Correct answers to released multiple-choice questions and, for the Mathematics tests, released short-answer questions are also listed in the table. This year, for grades 3–8, this section also includes a table that cross-references each unreleased common item with its MCAS reporting category and with the framework standard it assesses.

Responses to open-response items and compositions written in response to writing prompts are scored individually. An overview of procedures for scoring these responses and compositions is presented in the MCAS Frequently Asked Questions, which are available on the Department’s website at www.doe.mass.edu/mcas/overview.html. Scoring procedures will also be explained further in the MCAS document, Guide to Interpreting the Spring 2010 MCAS Reports for Schools and Districts, due for release in September 2010. Similar guides are currently available on the Department’s website for previous years’ MCAS School Reports and District Reports. Sample student responses and compositions from previous MCAS administrations may also be viewed on the Department’s website.

Materials presented in this document are not formatted exactly as they appeared in student test booklets. For example, in order to present items most efficiently in this document, the following modifications have been made:

- Some fonts and/or font sizes may have been changed and/or reduced.

- Some graphics may have been reduced in size from their appearance in student test booklets; however, they maintain the same proportions in each case.

- For grades 7 and 10, the English Language Arts Composition writing prompt is presented on the same page as the make-up writing prompt, and the four lined pages provided for students’ initial drafts are omitted.
All references to page numbers in answer booklets have been deleted from the directions that accompany test items.

In February 2009, the Board of Elementary and Secondary Education approved a two-year suspension of MCAS History and Social Science testing and waived the Competency Determination requirement for the graduating classes of 2012 and 2013. As a result of this decision, no MCAS History and Social Science tests were administered in spring 2010.
II. English Language Arts, Reading Comprehension, Grade 3
Grade 3 English Language Arts
Reading Comprehension Test

The spring 2010 grade 3 MCAS English Language Arts Reading Comprehension test was based on learning standards in the two content strands of the Massachusetts English Language Arts Curriculum Framework (2001) listed below. Specific learning standards for grade 3 are found in the Supplement to the Massachusetts English Language Arts Curriculum Framework (2004). Page numbers for the learning standards appear in parentheses.

- Language (Framework, pages 19–26; Supplement, pages 6–7)
- Reading and Literature (Framework, pages 35–64; Supplement, pages 7–9)

The English Language Arts Curriculum Framework and Supplement are available on the Department website 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, ELA Reading Comprehension test results are reported under two MCAS reporting categories: Language and Reading and Literature, which are identical to the two framework content strands listed above.

Test Sessions and Content Overview

The MCAS grade 3 ELA Reading Comprehension test included two separate test sessions. Each session included reading passages, followed by multiple-choice, short-response, and/or open-response questions. Selected common reading passages and approximately half of the common test items are shown on the following pages as they appeared in grade 3 test & answer booklets.

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 ELA Reading Comprehension test sessions. No other reference materials were allowed during any ELA Reading Comprehension test session.

Cross-Reference Information

The tables at the conclusion of this chapter indicate each released and unreleased common item’s reporting category and the framework general standard it assesses. The correct answers for released multiple-choice questions are also displayed in the released item table.
DIRECTIONS
This session contains two reading selections with sixteen multiple-choice questions, one short-response question, and one open-response question. For multiple-choice questions, mark your answers by filling in the circle next to the best answer. For short-response and open-response questions, write your answer in the space below the question.

As a child, George Washington Carver was a slave who belonged to Moses and Susan Carver. He grew up during a time when African American children did not have the same opportunities as everyone else, but he still found a way to go to school and become a successful scientist. Read the article to find out more about George Washington Carver’s life and answer the questions that follow.

**George Washington Carver**
the peanut scientist
Born 1864 (?) – January 5, 1943
by Patricia and Fredrick McKissack

**Why? and How?**

1. When George was about twelve years old, he left the Carvers. He wanted to go to school. He walked to Neosho, Missouri. A family found George sleeping in their barn. They let the boy live with them. George worked and went to Lincoln School.

2. A few years passed. George learned all he could at Lincoln. He heard about a school in Fort Scott, Kansas. So he moved there. Another family let George live with them. Soon, young Carver was old enough to live on his own. For a while he moved from place to place.

3. Then he came to a small Kansas town. Another man named George Carver lived there. So George added a “W” to his name. “It is for Washington,” he told his friends. George Washington Carver—he liked the sound of his new name.

4. George wanted to go to college. Not many black men went to college in the 1890s. But George Carver was sure that he would go. He worked hard and saved his money.
At last Carver went to college in Iowa. There he studied what he liked best—plants and farming. Then he went to Iowa State College in Ames to study. He graduated in 1896. Still, there was much more he wanted to learn. George Washington Carver would spend the rest of his life asking questions and looking for the answers. He was a scientist. And scientists are always asking Why? and How?

**Tuskegee Farm**

George Carver was asked to stay at Iowa State and teach. But Booker T. Washington asked Professor Carver to come teach at Tuskegee Institute in Alabama.

The all-black school was started by Booker T. Washington in 1881. In 1896, Mr. Washington wrote a letter to Professor Carver: “Will you come to Tuskegee to teach?” Carver thought about it. Then he answered: “I am coming.”

It was fall 1896 when Professor Carver went to Tuskegee. He had thirteen students. His job was to teach science. But he had no lab. This didn’t stop him. The class made a lab from things they found.

The school also had a farm. The soil was poor. The cotton plants were small and weak. Farmers in the South had been growing cotton on the land for many years. Professor Carver said, “The soil needs a rest.” He and the class did a project. “We will not plant cotton,” he said. “We will plant sweet potatoes.” And they did.

Professor Carver said that learning skills like farming was “the key to unlock the golden door of freedom” for African Americans.
The next year they grew cowpeas, another kind of vegetable. “The land has to rest,” he said. So the third year they grew cotton again. That cotton crop grew bigger and stronger than before. Carver was one of the first scientists to teach crop rotation—growing different plants to make the soil better.

The boll weevil is a bug that eats cotton plants. In the early 1900s, boll weevils came into the United States from Mexico. Farmers were worried. What could they do? Carver told them to plant goobers! Boll weevils don’t like goobers.

Plant Goobers!

Goobers is an old African name for peanut. Slaves brought goobers from Africa. They grew them in small gardens. Goobers were mostly used to feed animals.

Farmers came to Tuskegee from all over the South. Professor Carver told them about his work. What can be done with peanuts? They are only good for hogs, people said. Carver found many ways to use peanuts. His students liked peanut butter best.

Who will buy the peanuts? Professor Carver didn’t know. But, as always, he kept looking for answers.

Then an idea came. The quiet professor asked a group of important businessmen to have dinner with him. He served them bread, soup, meat, cookies, and ice cream.

They all agreed that the food was good—very good. Then Professor Carver told them: Everything they had eaten had been made with peanuts! What a surprise!
Professor Carver was full of more surprises. He showed the businessmen what they could make from the peanuts. He showed them why they should buy the farmers’ peanut crops. What he said made sense. Now the farmers could sell their crops.

It is no surprise that George Washington Carver was called the farmer’s best friend.

Mark your choices for multiple-choice questions 1 through 10 by filling in the circle next to the best answer.

1. Based on the article, what was the main reason Carver moved from place to place while he was young?
   - A. He wanted to meet new people.
   - B. He wanted to visit bigger towns.
   - C. He wanted to find better schools.
   - D. He wanted to see different farms.

2. According to the article, what was the main reason Carver chose to give himself a middle name?
   - A. to make himself seem like an average student
   - B. to make himself seem like an important scientist
   - C. to show respect for a president with the same name
   - D. to be different from a person in town with the same name
3. According to the article, why did Carver move to Alabama?
   - A. to take a job as a professor
   - B. to find better crops to plant
   - C. to take more farming classes
   - D. to find new uses for the peanut

4. Based on paragraph 10, Carver decided to try crop rotation because
   - A. he worried that cotton would not be easy to sell.
   - B. he noticed that the cotton plants were not healthy.
   - C. he saw that the cotton seeds cost too much money.
   - D. he thought that cotton would take too long to grow.

5. Based on paragraph 10, how did Carver help the soil rest and get better?
   - A. by adding insects to the soil
   - B. by giving more water to the soil
   - C. by planting vegetables in the soil
   - D. by planting more cotton in the soil

6. Based on the article, people were not eating peanuts because they thought peanuts were
   - A. hard to find.
   - B. just for animals.
   - C. difficult to plant.
   - D. just like cowpeas.
7. Based on the article, why was Carver called the “farmer’s best friend”?

A. He visited with many farmers.
B. He went to school to be a farmer.
C. He invited farmers to his college.
D. He showed farmers better ways to grow crops.

8. Which of the following questions is answered in the section titled “Plant Goobers!”?

A. Why should farmers plant peanuts?
B. How should farmers plant peanuts?
C. When should farmers plant peanuts?
D. Where should farmers plant peanuts?

9. Read the sentence from paragraph 3 in the box below.

Then he came to a small Kansas town.

Which of the following words from the sentence is an adjective?

A. he
B. came
C. small
d. town

10. Read the words from the article in the box below.

• Fort Scott
• George Carver
• Iowa State College
• Tuskegee Institute

What do the words in the box have in common?

A. They are verbs.
B. They are adjectives.
C. They are proper nouns.
D. They are compound words.
Question 11 is an open-response question.

- Read the question carefully.
- Explain your answer.
- Add supporting details.
- Double-check your work.

Write your answer to question 11 in the lined space below.

Based on the article, explain why George Washington Carver is famous. Support your answer with important information from the article.

__________________________________________________________________________________________________________________________________________________________________________________
Read this folktale and answer the questions that follow.

The Billy Goat
and the
Vegetable Garden
retold by Lucía M. González

Once there was a very old woman and a very old man who lived on a farm. They shared a vegetable garden in which they grew tomatoes, lettuce, peppers, potatoes, beans, and plantains. They spent hours working in their garden and planning all the delicious dishes they were going to make with their vegetables.

One morning, a billy goat came into their garden and began eating up all the vegetables.

“Look!” cried the little old woman. “That billy goat is going to eat up everything in our garden. What shall we do?”

“Don’t worry,” said the little old man. “I can make him go away if I speak to him very, very nicely.”

So he went down to the field where the billy goat was eating and he patted it on its back. “Buenos días, Señor Billy Goat,” he said. “Good morning. Please do not eat up our garden. You are so young and strong, and we are so old and weak. Surely you can find food somewhere else. Please go away.”

But before the old man finished talking, the rude Señor Billy Goat’s legs swung up in the air and his head bent low. Then he turned and charged at the old man with his horns!

“¡Ay, Mujer!* ¡Mujer!” the old man cried out to his wife, running up the hill as fast as he could. “Open the door, please! The billy goat is after me!”

* Mujer — wife
The little old man ran inside the house, shut the door, and began to cry.

Then suddenly, something tickled the little old man’s ear. He shook his head to get rid of it and, as he did, down dropped a little red ant.

“I have come to help you,” said the little ant. “I can make Señor Billy Goat go away from your garden.”

“You?” cried the little old woman. “You are so small, what can you do? How can you help us?”

“Just watch me,” said the ant. “You are being too nice to that bully. I can speak to him in the only language he understands.”

And with that, the little ant crawled out of the house, through the field, and over to the billy goat. The goat didn’t even see the little ant as he crawled up his hind leg, across his back, straight up to his ear — and stung him!

“¡Ay!” cried the billy goat.

The little ant now crawled to the other ear and stung him.

“¡Ay!” cried the billy goat again.

Then the little ant crawled up his back and down again — stinging him all over as he crawled along!

“¡Ay, ay, ay, ay, ay!” the billy goat cried.

“I have stepped in an anthill! If I don’t get out of this garden at once, these ants will eat me alive!”

Quickly, he jumped up into the air and ran out of the garden as fast as he could.

The little old man and the little old woman gave many thanks to that brave and clever little red ant for saving their vegetable garden, and they always made sure he had plenty to eat. They spent many hours that fall harvesting their beautiful ripe vegetables and talking about the delicious dishes they were going to prepare.

And what about that billy goat? Well, for all anyone knows, he hasn’t gone near that vegetable garden to this very day!
Reading Comprehension

Mark your choices for multiple-choice questions 12 through 17 by filling in the circle next to the best answer.

12 Based on paragraphs 7 and 8, what is the most likely reason the old man is crying?

- A  He is tired of his garden.
- B  He is angry with his wife.
- C  He is upset about the goat.
- D  He is worried about the ant.

13 In the folktale, why does the billy goat think he has stepped in an anthill?

- A  He sees bugs crawling on him.
- B  He has been stung many times.
- C  He gets his foot stuck in a hole.
- D  He has been warned about insects.

14 In the folktale, who is telling the story?

- A  an ant
- B  a narrator
- C  the old man
- D  the old woman

15 What is the main problem in the folktale?

- A  An ant is tricking a billy goat.
- B  A billy goat is chasing an old man.
- C  An old woman is worried about a goat.
- D  A goat is eating the vegetables in a garden.
Based on the folktale, which statement would the old man and woman most likely agree with?

- Many animals are helpful in a garden.
- Food tastes best when shared with others.
- Small friends can help solve big problems.
- Kindness can be used to solve any problem.

Read the sentence from paragraph 6 in the box below.

Then he turned and charged at the old man with his horns!

Which meaning of charged is used in the sentence?

- blamed
- attacked
- asked a price
- loaded with electricity

Question 18 is a short-response question. Write your answer to question 18 in the lined space below.

Based on the folktale, how does the ant show that he is clever?
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*Answers are provided here for multiple-choice items only. Sample responses and scoring guidelines for open-response and short-response items, which are indicated by the shaded cells, will be posted to the Department’s website later this year.
### Grade 3 English Language Arts

#### Reading Comprehension

Spring 2010 Unreleased Common Items:
Reporting Categories and Standards

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III. English Language Arts, Grade 4

A. Composition
B. Reading Comprehension
Grade 4 English Language Arts Test

Test Structure

The grade 4 MCAS English Language Arts test was presented in the following two parts:

- the ELA Composition test, which used a writing prompt to assess learning standards from the Massachusetts English Language Arts Curriculum Framework’s Composition strand
- the ELA Reading Comprehension test, which used multiple-choice and open-response questions to assess learning standards from the English Language Arts Curriculum Framework’s Language and Reading and Literature strands

A. Composition

The spring 2010 grade 4 MCAS English Language Arts Composition test and Composition Make-Up test were based on learning standards in the Composition strand of the Massachusetts English Language Arts Curriculum Framework (2001). The learning standards for the Composition strand appear on pages 72–83 of the Framework, which is available on the Department website 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, ELA Composition test results are reported under the reporting categories Composition: Topic Development and Composition: Standard English Conventions.

Test Sessions and Content Overview

The MCAS ELA Composition test included two separate test sessions, administered on the same day with a short break between sessions. During the first session, each student wrote an initial draft of a composition in response to the appropriate writing prompt on the next two pages. During the second session, each student revised his or her draft and submitted a final composition, which was scored in the areas of Topic Development and Standard English Conventions. The Scoring Guides for the MCAS English Language Arts Composition are available at www.doe.mass.edu/mcas/student/elacomp_scoreguide.html.

Reference Materials and Tools

At least one English-language dictionary per classroom was provided for student use during ELA Composition test sessions. The use of bilingual dictionaries was allowed for current and former limited English proficient students only. No other reference materials or tools were allowed during either ELA Composition test session.

Cross-Reference Information

Framework general standards 19–22 are assessed by the ELA Composition.
WRITING PROMPT

Think about a time when school was closed and you had the day off.

Write a story about what you did on your day off from school. Give enough details in your story to show readers how you spent your day.

You may use the space below to plan what you are going to write (notes, outlines, other pre-writing activities).
Writing Prompt

Write a story about a time when something funny or unusual happened. Give enough details in your story to show readers why the event was funny or unusual.

You may use the space below to plan what you are going to write (notes, outlines, other pre-writing activities).
B. Reading Comprehension

The spring 2010 grade 4 MCAS English Language Arts Reading Comprehension test was based on learning standards in the two content strands of the Massachusetts English Language Arts Curriculum Framework (2001) listed below. Page numbers for the learning standards appear in parentheses.

- Language (Framework, pages 19–26)
- Reading and Literature (Framework, pages 35–64)

The English Language Arts Curriculum Framework is available on the Department website 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, ELA Reading Comprehension test results are reported under two MCAS reporting categories: Language and Reading and Literature, which are identical to the two framework content strands listed above.

Test Sessions and Content Overview

The MCAS grade 4 ELA Reading Comprehension test included two separate test sessions. Each session included reading passages, followed by multiple-choice and open-response questions. Selected common reading passages and approximately half of the common test items are shown on the following pages as they appeared in test booklets.

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 ELA Reading Comprehension test sessions. No other reference materials were allowed during any ELA Reading Comprehension test session.

Cross-Reference Information

The tables at the conclusion of this chapter indicate each released and unreleased common item’s reporting category and the framework general standard it assesses. The correct answers for released multiple-choice questions are also displayed in the released item table.
Have you ever wondered what roller coasters were like in the past or how they were invented? Read the article to find out and answer the questions that follow.

Word Bank

Golden Age of Roller Coasters—a period during the 1920s when roller coasters were very popular

gravity ride—any ride that uses gravity for power

theme park—an amusement park built around an idea, such as a historical event or entertainment personality

whiplash—a severe sprain of the neck caused by sudden movement or twisting of the head

Coaster History
by Gil Chandler

1 The Russians built the very first gravity rides in the 1600s. In winter, they built high wooden ramps and covered them with water, which soon became ice. The ramps were about two feet (.6 meter) wide—just wide enough for a small sled. Passengers would climb a 70-foot (21-meter) ladder, then sit down on the sled. A helper pushed the sled onto the ramp. Down it went, speeding to the bottom of the hill and then coasting to a stop along a 600-foot (183-meter) straightaway.

2 People in big cities and small villages enjoyed the ice slides. They were built outside in public parks and even inside in fancy palaces. Some of the ramps had lanterns for night sliding.

3 In the early 1800s, a French builder brought the “Russian mountains” to Paris, the capital of France. But Russia was much colder than France, where ice turned soft in the warmer, rainy winters. So the French ran their sleds over wooden rollers. This is the origin of the term “roller coaster.”

Coasters Cross the Atlantic

4 In the 1870s, an old mining railway became the first gravity ride in the United States. This was the Mauch Chunk Switchback Railway in Pennsylvania. A steam engine
hauled the cars up a mountain. The cars then coasted down at six miles (10 kilometers) per hour. Passengers on the Mauch Chunk Railway paid five cents a ride.

In 1884, LaMarcus A. Thompson designed a new coaster for Coney Island, an amusement park in Brooklyn, New York. Thompson’s Switchback Gravity Pleasure Railway was a big hit. Thompson built 44 more of these rides in North America and Europe.

Other coaster inventors like Phillip Hinckle and Lina Beecher began working at Coney Island. Hinckle was the first to use a chain lift to get his cars up the hill. Beecher built the Flip-Flap, the first coaster to run upside-down through a loop. The cars had to go so fast to make it through the loop, however, that several riders suffered whiplash. The Flip-Flap soon shut down.

By the 20th century, roller coasters had much more than single cars and simple ramps. The builders put tracks through turns, hills, and figure-eights. The inventor John Miller added a third set of wheels, known as undertrack wheels. The undertrack wheels held the cars firmly on the track at high speeds and through sharp turns.

The Golden Age

Roller coasters were all the rage in the 1920s. Designers were making them taller, longer, and faster. Some lift hills climbed as high as 100 feet (30 meters).
The Coney Island Cyclone, built in 1927, rose 85 feet (26 meters) and ran at 55 miles (89 kilometers) per hour over eight steep hills.

The Depression of the 1930s and World War II (1939–1945) put an end to this Golden Age of Roller Coasters. Fewer people were going to amusement parks. There was a shortage of the money and materials needed to build new rides. Instead of raising new coasters, workers were tearing down hundreds of them.

Disneyland

In 1955, Walt Disney reversed this trend. He built a new amusement park in Anaheim, California. This was the first theme park, Disneyland.

In 1959, the Matterhorn opened at Disneyland. This was a steel roller coaster that turned and twisted down the sides of a miniature steel-and-concrete mountain. At the end of the ride, the cars—four-passenger bobsleds—splashed through a pool of water. It became one of the most popular rides in Disneyland.

Other theme parks appeared around the country. Each had a new roller coaster. At Six Flags Over Mid-America, in Eureka, Missouri, the Screamin’ Eagle rose 110 feet (34 meters). In 1975, it was the highest wooden coaster in the world.
What is the most likely reason the article begins with a description of the Russian ice slides?
A. They differed from other roller coasters of the times.
B. They were the most dangerous type of roller coaster.
C. They led to the creation of roller coasters.
D. They were the first roller coasters to operate in the dark.

Based on the article, why were the first gravity rides ridden only in the winter?
A. The rides were too expensive to run year-round.
B. The rides were too dangerous to run year-round.
C. The rides needed the snow to slow down the sleds.
D. The rides needed the cold weather to harden the ice.

Based on paragraph 4, how did the French make it possible to build gravity rides in Paris?
A. They created thicker ramps.
B. They built new ramps indoors.
C. They built larger sleds to fit more people.
D. They invented a new way for sleds to travel.

Based on the article, what was one sign that roller coasters were successful?
A. They were having fewer problems.
B. They were becoming less expensive.
C. They were taking more time to design.
D. They were being built around the world.
According to paragraph 7, why did the Flip-Flap have to stop running?
A. It broke down too often.
B. Passengers were hurt while riding it.
C. It was not as popular as other gravity rides.
D. Passengers thought it was not exciting enough.

According to paragraph 11, what role did Walt Disney play in the history of roller coasters?
A. He invented the chain lift for the Flip-Flap.
B. He reintroduced an interest in roller coasters.
C. He designed the tallest roller coaster in the country.
D. He helped design the Switchback Gravity Pleasure Railway.

Based on the article, what was one way the Matterhorn was different from earlier roller coasters and gravity rides?
A. It was made of steel.
B. It took more power to operate.
C. It used small cars to carry people.
D. It used more than one car at a time.

Which of the following statements best states the main idea of the article?
A. The Golden Age was a popular time for roller coasters.
B. Gravity rides have been built in many different countries.
C. The Six Flags theme park had the tallest gravity ride in the world.
D. Roller coasters have become the rides they are today as a result of many improvements.
Question 11 is an open-response question.

- Read the question carefully.
- Explain your answer.
- Add supporting details.
- Double-check your work.

Write your answer to question 11 in the space provided in your Student Answer Booklet.

Based on the article, describe how roller coasters have changed over time. Support your answer with important details from the article.
Have you ever visited the ocean? “Hear Me” looks at the ocean from an unusual point of view. Read the poem and answer the questions that follow.

**Hear Me**

I am the ocean.
Give me room!
I need to stretch myself out
from shore to shore.

Hear my sound.
Shhh...Shhh...And boom!
And roar!

I am the ocean.
I am changeable.

I can creep up the sand so slowly,
you won’t even notice me.
Yet I can crash over rocks and castles.

I can carry your buckets out to sea.
I am the ocean.
Look out for me.

I am deeper than deep.
I am greater than great.

Even my floor has mountains.
I am the ocean.
What more shall I say?

I am richer than rich
Plants and creatures (all sizes and shapes),
coral and seaweed,
barnacles, sharks, and whales,
shells, storms, and ships are mine.
What more shall I say?
I am the ocean.
I never rest.
I have energy and life.
I am constantly moving,
in and out, up and down,
around and around.
I am alive.
Hear my sound.

Calm,
gentle,
agitated,
strong—
All these I have been before.
You will never know me through and through,
though you explore, explore.

My secrets are deep.
I am the ocean.
I never sleep.
Shhh. . .Shhh. . .
I have secrets to keep.

—Dee Lillegard

12. In lines 7 and 47, the words “Shh... Shh...” describe the sound of
   A. fish.
   B. wind.
   C. water.
   D. boats.

13. Based on the poem, why is the ocean “richer than rich”?
   A. It is very deep.
   B. It is full of life.
   C. It is very strong.
   D. It is full of secrets.

14. Which statement would the speaker in the poem most likely agree with?
   A. The ocean is always still.
   B. The ocean is never threatening.
   C. The ocean should be respected.
   D. The ocean should not be studied.
15. What do lines 42 and 43 most suggest about the ocean?
   A. It is dangerous.
   B. It is mysterious.
   C. It is welcoming.
   D. It is uninteresting.

16. Read lines 32–34 from the poem in the box below.

   I am constantly moving, in and out, up and down, around and around.

   Which of the following words means the same as **constantly**?
   A. always
   B. quietly
   C. smoothly
   D. sometimes
# Grade 4 English Language Arts

## Reading Comprehension

### Spring 2010 Released Items:

**Reporting Categories, Standards, and Correct Answers***

<table>
<thead>
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<th>Item No.</th>
<th>Page No.</th>
<th>Reporting Category</th>
<th>Standard</th>
<th>Correct Answer (M C)*</th>
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* 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 website later this year.
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IV. English Language Arts, Reading Comprehension, Grade 5
Grade 5 English Language Arts
Reading Comprehension Test

The spring 2010 grade 5 MCAS English Language Arts Reading Comprehension test was based on learning standards in the two content strands of the Massachusetts English Language Arts Curriculum Framework (2001) listed below. Specific learning standards for grade 5 are found in the Supplement to the Massachusetts English Language Arts Curriculum Framework (2004). Page numbers for the learning standards appear in parentheses.

- Language (Framework, pages 19–26; Supplement, page 10)
- Reading and Literature (Framework, pages 35–64; Supplement, pages 11–13)

The English Language Arts Curriculum Framework and Supplement are available on the Department website 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, ELA Reading Comprehension test results are reported under two MCAS reporting categories: Language and Reading and Literature, which are identical to the two framework content strands listed above.

Test Sessions and Content Overview

The MCAS grade 5 ELA Reading Comprehension test included two separate test sessions. Each session included reading passages, followed by multiple-choice and open-response questions. Selected common reading passages and approximately half of the common test items are shown on the following pages as they appeared in test booklets.

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 ELA Reading Comprehension test sessions. No other reference materials were allowed during any ELA Reading Comprehension test session.

Cross-Reference Information

The tables at the conclusion of this chapter indicate each released and unreleased common item’s reporting category and the framework general standard it assesses. The correct answers for released multiple-choice questions are also displayed in the released item table.
In my classroom
We study by sunlight.
But when the wind whistles,
And the clouds hurry in front of the sun,
The trees bow.
Leaves flutter,
And the pages of our books
Begin flipping by themselves,
And the clouds are full of rain.

Then the wooden windows
Of my classroom
Are pulled shut.
In the ebony dark room
Grinning students whisper
How wonderful it is
Not to have to do their
Arithmetic, reading, and writing.
The whispering fades.
On wooden desks students rest their heads.

On wooden tables teachers rest their heads.
For in the ebony room
The rain sings
A lullaby to students and teachers.

The pit-a-pat of the rain
On the wooden windowpanes
And the whistling wind
Get louder.
Pupils wake up and sing:
“Stop, rain, stop.

We cannot play on green grass.
We cannot go home to our parents.
Stop, rain, stop.
Come back another day.”

But the rain, with a mind of its own,
Beats against our wooden windows.
And pit-a-pat we hear it say:
“I have a rain forest to fill
And grass to keep green!
I will rain till I’m through.

Children can wait.
My music will not.”
So in the dark room we nod and doze
To the rain’s lullaby.

— Isaac Olaleye

* ebony — a dark wood or a shade of black

“In the Ebony Room” by Isaac Olaleye, from The Distant Talking Drum. Copyright © 1995 by Isaac Olaleye. Reprinted by permission of Wordsong, an imprint of Boyds Mills Press.
Reading Comprehension

Session 1

1. Which line in the poem first signals a change?
   A. “We study by sunlight.”
   B. “But when the wind whistles,”
   C. “Leaves flutter,”
   D. “Begin flipping by themselves,”

2. In the second stanza, how does the rain affect the students?
   A. They are fascinated by the noise of the storm.
   B. They are bored because recess has been cancelled.
   C. They are happy to have a break from their lessons.
   D. They are upset because they must stay in their seats.

3. What is the most likely reason the poet uses repetition in lines 19 and 20?
   A. to show that schoolwork is boring
   B. to suggest the great power of the wind
   C. to suggest the crowded conditions in the classroom
   D. to show that the storm affects everyone in the classroom
4 Stanzas 3 and 4 describe a conflict between
A. the students and the teachers.
B. the parents and the teachers.
C. the students and the rain.
D. the rain and the parents.

5 Line 34 states that the rain has “a mind of its own.” Which of the following lines supports this image?
A. “And the whistling wind”
B. “Stop, rain, stop.”
C. “I will rain till I’m through.”
D. “So in the dark room we nod and doze”
Question 6 is an open-response question.

- Read the question carefully.
- Explain your answer.
- Add supporting details.
- Double-check your work.

Write your answer to question 6 in the space provided in your Student Answer Booklet.

6 Explain how the students in the poem see the rain as both good and bad. Support your answer with important details from the poem.
English Language Arts
READING COMPREHENSION: SESSION 2

DIRECTIONS
This session contains one reading selection with nine multiple-choice questions and one open-response question. Mark your answers to these questions in the spaces provided in your Student Answer Booklet.

What would you need to know if you wanted to travel to Antarctica? Read the selection to find out and then answer the questions that follow.

Planning Your Trip to Antarctica
by Lucy Jane Bledsoe

1. Why would anyone go to Antarctica? It's the coldest, windiest, driest, and most remote continent on Earth. Winds coming from the South Pole can howl across the ice at 200 miles an hour. The temperature can drop to 100 degrees below zero Fahrenheit (–73°C). An ice sheet, three miles thick in places, covers 98 percent of the continent, giving it the nickname the Ice. There are only two ways to get there: by plane, which, if it flies into a blizzard, might not be able to land; or by ship across the roughest seas on Earth.

2. If you're the kind of person who says, “Yeah! Sign me up!” when you read those kinds of facts, then Antarctica is the continent for you.

When to Go

3. The seasons in the southern hemisphere are the opposite of those in the northern hemisphere. Summertime in Antarctica is November, December, and January. Wintertime is June, July, and August. In an Antarctic summer, the sun never sets. In an Antarctic winter, the sun never rises.

4. For much of the year, Antarctica is surrounded by ice. In the dead of winter, the sea ice forms a huge skirt around the continent, 30 to 900 miles wide and 10 feet thick. This means that Antarctica doubles in size each winter. Only a handful of scientists and their staffs stay there during these dark, frigid winter months.

5. The best time to visit is the summer. In November, the pack ice begins to break up and the penguins start courting and mating. In December and January, their chicks hatch. In February, the whales are at their most active, and the penguin chicks leave the nests.

How to Get There

6. Antarctica is very hard to get to because it sits all alone at the bottom of the world. It's more than 2,800 miles from Africa, 2,000 from Australia, 650 from South America, and 8,850 from New York.
Almost all tourists go to Antarctica by ship. There is one flight company that takes private parties to the Ice, but these flights cost many thousands—sometimes even hundreds of thousands—of dollars. They’re used only by very wealthy tourists or by explorers who have spent years raising money to support their expeditions.

Tourist ships leave from the port town Ushuaia, on the southern tip of Argentina. Two National Science Foundation ships, the Laurence M. Gould and the Nathaniel B. Palmer, leave from another port town, Punta Arenas, in Chile. These ships usually go to the Antarctic Peninsula, a long arm that reaches out from the continent. To get from the tip of South America to the tip of the Antarctic Peninsula, a ship must cross the Drake Passage—legendary for its stormy weather and giant waves. Many people spend the

An Air Force LC-130, equipped with skis for landing, transports scientists and workers to Antarctica and back.
entire voyage being seasick. Once in a while, the crossing is calm, and then the ship’s crew call that stretch of water Drake Lake.

American scientists and their helpers who are traveling to the interior of Antarctica fly from Christchurch, New Zealand, on U.S. Air Force planes, operated by the 109th Airlift Wing of the New York Air National Guard. These LC-130s are outfitted with skis instead of wheels for landing on the ice runways.

The flight from Christchurch to McMurdo Station, the biggest American base in Antarctica, takes eight hours. Boomerang flights—ones that turn around midway—are common. The planes can’t carry enough fuel to fly to Antarctica and back again to New Zealand. They must refuel in Antarctica. But when there’s a blizzard on the Ice, the pilots can’t land to refuel. So at the midway point, the pilot always radios ahead. If there’s a chance of a storm, the plane turns around and flies back to New Zealand. One third of all flights headed for Antarctica are forced to turn around midway. This midway point is called the point of no return.

**Antarctic People: Brad Range**

Each year the National Science Foundation selects a Boy Scout or a Girl Scout to travel to Antarctica as a special visitor. The scout, who must be at least 18 years old, stays for a couple of months and works on a variety of science projects. Over the 2003–2004 season, Boy Scout Brad Range worked on the Ice, studying everything from penguins to ozone levels in the atmosphere. For New Year’s Eve, Range was at the South Pole, where he got recruited to be lead singer in the local rock group El Hot Soup. Accompanied by the head chef on bass and a shop mechanic on electric guitar, Range helped the Polies—as people at South Pole Station call themselves—celebrate the New Year.

“Planning Your Trip to Antarctica” by Lucy Jane Bledsoe, from How to Survive in Antarctica. Copyright © 2006 by Lucy Jane Bledsoe. Reprinted by permission of Holiday House, Inc.
What does paragraph 1 suggest about the continent of Antarctica?
A. Scientists rarely are able to research Antarctica.
B. There are many different landforms in Antarctica.
C. People know very little about the history of Antarctica.
D. Antarctica experiences some of the most severe weather in the world.

According to paragraph 4, how does Antarctica double in size each winter?
A. Giant snowstorms create huge mountains.
B. More scientists visit to study the climate.
C. Many tourists arrive to observe wildlife.
D. Sea water freezes along the shoreline.

According to the selection, in which month should a person who is interested in watching whales go to Antarctica?
A. January
B. February
C. November
D. December

According to the selection, what is the main reason most tourists travel to Antarctica by ship instead of by plane?
A. Flying costs too much.
B. Flying is too dangerous.
C. Boats can reach more places.
D. Boats allow more sightseeing.
11 According to the selection, when is the Drake Passage sometimes called Drake Lake?
A. when it is frozen solid
B. when it is easier to cross
C. when scientists are part of the crew
D. when the voyage seems shorter than it is

12 According to the selection, what special equipment is used on planes going to Antarctica?
A. skis
B. wheels
C. heaters
D. propellers

13 According to the selection, which of the following best describes Brad Range?
A. He is a professional musician who entertained at the South Pole.
B. He is a famous scientist who studies wildlife at the South Pole.
C. He is a skilled pilot who flies tourists to the South Pole.
D. He is a young man who visited the South Pole.

14 Read the statement from paragraph 1 in the box below.

The temperature can drop to 100 degrees below zero . . .

Why is the word below written in italics?
A. to show a direction
B. to highlight an opinion
C. to highlight a key word
D. to indicate an unfamiliar word

15 In paragraph 4, which word is used in an unusual way?
A. year
B. skirt
C. wide
D. months
Question 16 is an open-response question.

- Read the question carefully.
- Explain your answer.
- Add supporting details.
- Double-check your work.

Write your answer to question 16 in the space provided in your Student Answer Booklet.

16 Based on the selection, explain why a trip to Antarctica could be considered a great adventure. Support your answer with important information from the selection.
# Grade 5 English Language Arts
## Reading Comprehension
### Spring 2010 Released Items:
**Reporting Categories, Standards, and Correct Answers**

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V. English Language Arts, Reading Comprehension, Grade 6
Grade 6 English Language Arts
Reading Comprehension Test

The spring 2010 grade 6 MCAS English Language Arts Reading Comprehension test was based on learning standards in the two content strands of the Massachusetts English Language Arts Curriculum Framework (2001) listed below. Page numbers for the learning standards appear in parentheses.

- Language (Framework, pages 19–26)
- Reading and Literature (Framework, pages 35–64)

The English Language Arts Curriculum Framework is available on the Department website 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, ELA Reading Comprehension test results are reported under two MCAS reporting categories: Language and Reading and Literature, which are identical to the two framework content strands listed above.

Test Sessions and Content Overview

The MCAS grade 6 ELA Reading Comprehension test included two separate test sessions. Each session included reading passages, followed by multiple-choice and open-response questions. Selected common reading passages and approximately half of the common test items are shown on the following pages as they appeared in test booklets.

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 ELA Reading Comprehension test sessions. No other reference materials were allowed during any ELA Reading Comprehension test session.

Cross-Reference Information

The tables at the conclusion of this chapter indicate each released and unreleased common item’s reporting category and the framework general standard it assesses. The correct answers for released multiple-choice questions are also displayed in the released item table.
In this folktale from Tuscany, a region of Italy, a shepherd tries to stay a step ahead of March weather. Read the folktale and then answer the questions that follow.

March
and the Shepherd

Retold by Domenico Vittorini

One morning at the very beginning of spring, a shepherd led his sheep to graze, and on the way he met March.

“Good morning,” said March. “Where are you going to take your sheep to graze today?”

“Well, March, today I am going to the mountains.”

“Fine, Shepherd. That’s a good idea. Good luck.” But to himself March said, “Here’s where I have some fun, for today I’m going to fix you.”

And that day in the mountains the rain came down in buckets. It was a veritable deluge. The shepherd, however, had watched March’s face very carefully and noticed a mischievous look on it. So instead of going to the mountains, he had remained in the plains. In the evening, upon returning home, he met March again.

“Well, Shepherd, how did it go today?”

“It couldn’t have been better. I changed my mind and went to the plains. A very beautiful day. Such a lovely warm sun.”

“Really? I’m glad to hear it,” said March, but he bit his lip in vexation. “Where are you going tomorrow?”

“Tomorrow I’m going to the plains, too. With this fine weather, I would be crazy if I went to the mountains.”

“Oh, really? Fine! Farewell.”

And they parted.

But the shepherd didn’t go to the plains again. He went to the mountains. And on the plains March brought rain and wind and hail—a punishment indeed from heaven. In the evening he met the shepherd homeward bound.

“Good evening, Shepherd. How did it go today?”

“Very well indeed. Do you know? I changed my mind again and went to the mountains after all. It was heavenly there. What a day! What a sky! What a sun!”

“I’m really happy to hear it, Shepherd. And where are you going tomorrow?”
“Well, tomorrow I’m going to the plains. I see dark clouds over the mountains. I wouldn’t want to find myself too far from home.”

To make a long story short, whenever the shepherd met March, he always told him the opposite of what he planned to do the next day, so March was never able to catch him. The end of the month came, and on the last day, the thirtieth, March said to the shepherd, “Well, Shepherd, how is everything?”

“Things couldn’t be any better. This is the end of the month and I’m out of danger. There’s nothing to fear now. I can begin to sleep peacefully.”

“That’s true,” said March. “And where are you going tomorrow?”

The shepherd, certain that he had nothing to fear, told March the truth. “Tomorrow,” he said, “I shall go to the plains. The distance is shorter and the work less hard.”

“Fine. Farewell.”

March hastened to the home of his cousin April and told her the whole story. “I want you to lend me at least one day,” he said. “I am determined to catch this shepherd.” Gentle April was unwilling but March coaxed so hard that finally she consented.

The following morning the shepherd set off for the plains. No sooner had his flock scattered than there arose a storm that chilled his very heart. The sharp wind howled and growled, snow fell in thick, icy flakes, hail pelted down. It was all the shepherd could do to get his sheep back into the fold.

That evening as the shepherd huddled in a corner of his hearth, silent and melancholy, March paid him a visit.

“Good evening, Shepherd,” he said.

“Good evening, March.”

“How did it go today?”

“I’d rather not talk about it,” said the shepherd. “I can’t understand what happened. Not even in the middle of January have I ever seen a storm like the one on the plains today. It seemed as if all the devils had broken loose from hell. Today I had enough rough weather to last me the whole year. And oh, my poor sheep!”

Then at last was March satisfied.

And from that time on March has had thirty-one days because, as it is said in Tuscany, the rascal never returned to April the day he borrowed from her.
1. Which of the following phrases from paragraph 5 is an example of figurative language?
   A. “came down in buckets”
   B. “going to the mountains”
   C. “remained in the plains”
   D. “upon returning home”

2. Based on paragraph 8, what is true about March?
   A. He wants to visit the mountains.
   B. He does not mean what he says.
   C. He wants the shepherd to be happy.
   D. He does not think the shepherd should leave.

3. Based on paragraphs 17 and 18, what does the shepherd believe?
   A. that March is sorry for his earlier actions
   B. that he can continue to fool March forever
   C. that March has run out of time to bother him
   D. that he can convince March to leave him alone

4. Based on the folktale, which of the shepherd’s statements most likely makes March the happiest?
   A. “I changed my mind again . . .’” (paragraph 14)
   B. “‘Things couldn’t be any better.’” (paragraph 18)
   C. “‘This is the end of the month . . .’” (paragraph 18)
   D. “‘I’d rather not talk about it,’” (paragraph 28)

5. Read the sentence from paragraph 23 in the box below.
   It was all the shepherd could do to get his sheep back into the fold.
   The word fold is used as which part of speech in the sentence?
   A. preposition
   B. adjective
   C. noun
   D. verb
Question 6 is an open-response question.

- Read the question carefully.
- Explain your answer.
- Add supporting details.
- Double-check your work.

Write your answer to question 6 in the space provided in your Student Answer Booklet.

Based on the folktale, explain how March and the shepherd can both be considered tricksters. Support your answer with important details from the folktale.
Dorothea Lange once said, “A camera is an instrument that teaches people how to see without a camera.” She was committed to helping people in trouble. By photographing them, she hoped to awaken and inspire the more fortunate to help, too. That is why her pictures are called documentary, a word that comes from the Latin root docere, meaning “to teach.”

Dorothea became passionate about helping people during the Great Depression, when one out of four Americans lost a job. She had a portrait business in San Francisco then, but outside her window she saw unemployed men lined up for free food. She thought these men were tremendously brave as they endured circumstances they could not control. She had to capture their feelings.

From 1932 to 1934, Dorothea photographed many of the millions affected by America’s poor economic conditions. During that time, people with jobs suffered because wages were low and hours long. Some protested, and in support, Dorothea photographed their demonstrations. When Franklin D. Roosevelt was elected president in 1933, he began programs to help protect Americans and to create jobs for the unemployed.

A year later, Dorothea exhibited her photographs publicly for the first time. Her show surprised people. They were not used to seeing photographs of social problems that provoked such strong emotions. Dorothea chose just the right person or people and setting to reflect the pain of many Americans.

One person who loved her work was an economics professor named Paul Taylor. Paul was doing research for President Roosevelt’s Works Progress Administration (or WPA). He was trying to help poor Americans in rural areas by talking to them about their lives and then sending reports to the government. When he saw Dorothea’s photographs, he knew his reports
would be more effective if her work accompanied them. Dorothea liked his idea. She was hired by the government as a “typist,” the only job slot available, and went with Paul on his field trips.

In 1934 and 1935, thousands of farmers from Kansas, Oklahoma, Texas, New Mexico, and Arkansas left their farms because a terrible drought had killed their crops. The soil was so dry and the wind so fierce that the area became known as the Dust Bowl. These farmers migrated to California, hoping to find better conditions, but there were far too many workers for the number of available jobs. As the Depression continued, the farms that were successful used machines—tractors and harvesters—instead of workers.

Dorothea and Paul worked tirelessly, speaking to the migrants and taking pictures. The conditions were shocking. As Untitled (Migrant Housing, California, c. 1936) shows, the migrants’ homes were made of whatever they could find: canvas, cardboard, twigs, and even grasses woven between poles. In one report, Dorothea and Paul wrote, “Words cannot describe some of the conditions we saw.”

When the government officials received the reports along with Dorothea’s photographs, they understood the suffering. President Roosevelt responded quickly. He set up camps with tents and trailers and provided food and clean sanitary facilities. Dorothea’s photographs were among the first in America to lead to government action.

Migrant Mother, 1936, perhaps Dorothea’s most famous photograph, was taken during this time. Dorothea had been photographing for weeks and was anxiously driving home alone in a rainstorm. She passed a sign that said Pea Pickers Camp but was too weary to stop. Twenty miles down the road, she felt she must return. She turned around and drove right in “like a homing pigeon,” she recalled. There she found a rain-soaked woman trying to shelter her children. Along with twenty-five hundred men, women, and children in the camp, this family was trying to survive by eating common birds killed by the children and peas that had frozen on the vine. The family could not leave because the mother had had to sell their car tires to buy food.
Dorothea spent ten minutes taking photographs. She took six pictures, talking very little. She learned only that the migrant mother was thirty-two years old and that the father of her seven children was a native of California. Because Dorothea was unsteady on her feet but used a large, heavy camera, each photograph had to be planned quickly. Her first two photographs were taken from a distance and included a teenage daughter. With each following photograph, Dorothea moved in closer. While all the photos clearly portray the pain of this family’s life, the last photograph, known as Migrant Mother, is the most powerful. Here the mother is the focus. She looks to the side with her hand held to her mouth as if she is in a state of despair. The children at her sides have turned their heads and are leaning on their mother as if for comfort. Perhaps Dorothea suggested this to avoid including the children’s expressions, which she may have feared might compete with their mother’s worried look. The baby sleeping on her mother’s lap is dirty, further emphasizing their horrible conditions. This composition became a symbol for all suffering families of the Depression.

Dorothea drove straight home and rushed to develop and print the film. She quickly sent copies not only to the government but also to a San Francisco newspaper, which distributed them along with a story about the pea pickers to other newspapers. The alarmed United States government hurriedly sent the migrants twenty thousand pounds of food. Migrant Mother kept many people from starving.

7. What is the **most likely** reason the author begins the selection with a quotation from Dorothea Lange?
   - A. to provide information about photography
   - B. to introduce Dorothea Lange’s views about photography
   - C. to explain what other photographers were doing at the time
   - D. to compare Dorothea Lange’s early photographs to her later photographs

8. Read the sentence from paragraph 4 in the box below.

   Dorothea chose just the right person or people and setting to reflect the pain of many Americans.

   What does the sentence suggest about Dorothea Lange?
   - A. She wanted her photographs to communicate a message.
   - B. She wanted the public to become familiar with photography.
   - C. She felt it was important to create beauty with her photography.
   - D. She believed children were the best subjects for her photographs.

9. Based on paragraph 5, what was the **most likely** reason Paul Taylor wanted to include Dorothea Lange’s photographs in his reports?
   - A. The photographs showed what his words described.
   - B. The photographs helped to get his reports published.
   - C. The photographs allowed him to travel to new places.
   - D. The photographs allowed him to write shorter reports.

10. Based on paragraph 7, why were the migrants’ homes made of canvas, twigs, and other unusual materials?
    - A. The migrants did not need sturdy homes.
    - B. The migrants could not afford better homes.
    - C. The migrants needed lightweight homes because they moved often.
    - D. The migrants hoped their interesting homes would attract attention.
11. According to paragraph 8, what effect did Dorothea Lange's photographs have on President Roosevelt?
   A. He began to send aid to migrant workers.
   B. He encouraged farmers to move to the cities.
   C. He asked farmers to reduce the size of their farms.
   D. He wrote letters asking for more support for migrant workers.

12. What does paragraph 9 suggest about Dorothea Lange's photograph *Migrant Mother*?
   A. Dorothea originally planned to photograph another subject.
   B. Dorothea hoped the photograph would win an award.
   C. Dorothea almost did not take the photograph.
   D. Dorothea felt it was not her best photograph.

13. Based on the selection, what is the most likely reason Dorothea Lange did not include the children's faces in *Migrant Mother*?
   A. Dorothea Lange wanted to show how shy the children were.
   B. Dorothea Lange wanted to photograph the children individually.
   C. Dorothea Lange wanted to express the mother's love for her family.
   D. Dorothea Lange wanted to highlight the mother's feelings about her life.

14. Read the sentences from paragraph 1 in the box below.

   She was committed to helping people in trouble. . . . That is why her pictures are called documentary, a word that comes from the Latin root docere, meaning “to teach.”

Based on the sentences, why are Dorothea Lange's photographs called “documentary”?
   A. because they were printed on paper
   B. because they were exhibited in public
   C. because they showed the conditions of real life
   D. because they looked like other portraits of the time
Question 17 is an open-response question.

- Read the question carefully.
- Explain your answer.
- Add supporting details.
- Double-check your work.

Write your answer to question 17 in the space provided in your Student Answer Booklet.

Based on the selection, explain why Dorothea Lange became a famous photographer. Support your answer with important details from the selection.
# Grade 6 English Language Arts

**Reading Comprehension**

**Spring 2010 Released Items:**

**Reporting Categories, Standards, and Correct Answers***

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VI. English Language Arts, Grade 7

A. Composition
B. Reading Comprehension
Grade 7 English Language Arts Test

Test Structure

The grade 7 MCAS English Language Arts test was presented in the following two parts:

- the ELA Composition test, which used a writing prompt to assess learning standards from the Massachusetts English Language Arts Curriculum Framework’s Composition strand
- the ELA Reading Comprehension test, which used multiple-choice and open-response questions to assess learning standards from the English Language Arts Curriculum Framework’s Language and Reading and Literature strands

A. Composition

The spring 2010 grade 7 MCAS English Language Arts Composition test and Composition Make-Up test were based on learning standards in the Composition strand of the Massachusetts English Language Arts Curriculum Framework (2001). The learning standards for the Composition strand appear on pages 72–83 of the Framework, which is available on the Department website 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, ELA Composition test results are reported under the reporting categories Composition: Topic Development and Composition: Standard English Conventions.

Test Sessions and Content Overview

The MCAS ELA Composition test included two separate test sessions, administered on the same day with a short break between sessions. During the first session, each student wrote an initial draft of a composition in response to the appropriate writing prompt on the next page. During the second session, each student revised his or her draft and submitted a final composition, which was scored in the areas of Topic Development and Standard English Conventions. The Scoring Guides for the MCAS English Language Arts Composition are available at www.doe.mass.edu/mcas/student/elacomp_scoreguide.html.

Reference Materials and Tools

At least one English-language dictionary per classroom was provided for student use during ELA Composition test sessions. The use of bilingual dictionaries was allowed for current and former limited English proficient students only. No other reference materials or tools were allowed during either ELA Composition test session.

Cross-Reference Information

Framework general standards 19–22 are assessed by the ELA Composition.
Grade 7 Writing Prompt

WRITING PROMPT

Imagine you had the opportunity to live anywhere in the world for a year. Where would you live? Why would you choose this place to live? What would you hope to learn there?

Think of where in the world you would choose to live for a year. In a well-developed composition, explain the reasons you would choose this place to live and what you would hope to learn there.

Grade 7 Make-Up Writing Prompt

WRITING PROMPT

Schools can have many types of problems, such as only offering a limited number of after-school activities or having class sizes that are too large.

Think about a problem at your school and how you might solve it. In a well-developed composition, describe the problem and how you would solve it, and explain why your solution is a good one.
B. Reading Comprehension

The spring 2010 grade 7 MCAS English Language Arts Reading Comprehension test was based on learning standards in the two content strands of the Massachusetts English Language Arts Curriculum Framework (2001) listed below. Specific learning standards for grade 7 are found in the Supplement to the Massachusetts English Language Arts Curriculum Framework (2004). Page numbers for the learning standards appear in parentheses.

- Language (Framework, pages 19–26; Supplement, page 14)
- Reading and Literature (Framework, pages 35–64; Supplement, pages 15–17)

The English Language Arts Curriculum Framework and Supplement are available on the Department website 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, ELA Reading Comprehension test results are reported under two MCAS reporting categories: Language and Reading and Literature, which are identical to the two framework content strands listed above.

Test Sessions and Content Overview

The MCAS grade 7 ELA Reading Comprehension test included two separate test sessions. Each session included reading passages, followed by multiple-choice and open-response questions. Selected common reading passages and approximately half of the common test items are shown on the following pages as they appeared in test booklets.

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 ELA Reading Comprehension test sessions. No other reference materials were allowed during any ELA Reading Comprehension test session.

Cross-Reference Information

The tables at the conclusion of this chapter indicate each released and unreleased common item’s reporting category and the framework general standard it assesses. The correct answers for released multiple-choice questions are also displayed in the released item table.
The play *Lost in Yonkers* is set in New York City during the 1940s. In the play, brothers Arty and Jay live with their grandmother and Aunt Bella in an apartment above the family’s candy store. In this excerpt, the boys are falling asleep after Jay visits the store for a midnight snack of ice cream when their Uncle Louie shows up unexpectedly. Read the excerpt and answer the questions that follow.

from *Lost in Yonkers*  
by Neil Simon

(They put out the flashlight and turn to go to sleep . . . A moment passes . . . Then the front door opens. We see a man in a hat enter, closing the door, then slowly, quietly cross toward the window. He carries a small black bag)

JAY Who’s that?

5 (Turning the flashlight on the man)

LOUIE Get that light outa my face and go back to sleep, kid.

JAY There’s nothing here to steal, mister. I swear.

LOUIE Is that you, Jay?

JAY Yeah. Who are you?

LOUIE It’s Uncle Louie.

JAY Uncle Louie? No kidding? . . . Arty! It’s Uncle Louie.

ARTY Uncle Louie? . . . Really? Hi, Uncle Louie.

LOUIE Is that Arty?

ARTY Yeah. It’s Arty . . . Hi, Uncle Louie.

15 LOUIE Wait a second. (LOUIE turns on the lamp. LOUIE KURNITZ is about thirty-six years old. He wears a double-breasted suit with a hanky in the breast pocket, black pointy shoes, a dark blue shirt, and a loud tie. He also wears a fedora hat and carries a small black satchel, not unlike a doctor’s bag) Whaddya know?
Look at you! Couple a big guys now, ain’t you? . . . You don’t come around for a while and you grow up on me. . . . Come here. Come on. I want a hug. You heard me. Move it. (The boys look at each other, not thinking Louie was the hugging type. They quickly climb out of bed and go to him. He puts his arms around both their shoulders and pulls them in to him. He looks at Jay) Picture of your mother. Pretty woman, your mother . . . (To Arty) And you. You look like a little bull terrier. Is that what you are, a bull terrier? (He musses Arty’s hair)

Arty Yeah, I guess so.

Louie (Fakes a punch at Jay’s midsection) Hey, watch it! What are you now, a middleweight or what? Who’s been beefin’ you up?

Jay Aunt Bella. She’s a good cook.

Louie (Taking off his hat) And a couple a midnight trips down to the ice cream freezer, heh? Diggin’ into the boysenberry with your flashlight? . . . That’s breakin’ and enterin’, kid. Two to five years.

Jay You saw me?

Louie (Crosses to Grandma’s door and listens) I been down there since Ma closed the store.

Jay Sitting in the dark?

Louie Yeah. Waitin’ for her to go to sleep. I wasn’t in no mood for long conversations.

Jay (Looks at Arty, then at Louie) I just took a fingerful, that’s all. I love boysenberry.

Louie Big mistake, kid. Mom reads fingerprints. She’ll nail you in the morning.

Jay Are you serious?

Louie Get outa here. What are you? A couple a pushovers? Like your old man . . . What’d he bring up for you, Arty? A thumbful of pistachio?


Louie You think your pop and I didn’t do that when we were kids? That was the beauty part. Never took nothin’ durin’ the day. A ton a ice cream, a store full a candy, anything we wanted. Never took nothin’ . . . But as soon as Ma let her
braid down and turned out the lights, we were down there lappin’ up the cream and meowin’ like cats . . . A in’t that the way? It’s only fun when there’s a chance a gettin’ caught. Nothin’ sweeter than danger, boys, am I right?

JAY I guess so.

LOUIE Damn right.

ARTY I didn’t know Pop was like that.

LOUIE Yeah, well, he was no good at it anyway. Ma knew what was goin’ on. She could tell if there was salt missin’ from a pretzel . . . But she wouldn’t say nothin’. She’d come up from the store with the milk, siddown for breakfast, knowin’ that two scoops of everything was missin’, and she’d just stare at you . . . right into your eyeballs, pupil to pupil . . . never blinkin’ . . . Her eyes looked like two district attorneys . . . and Eddie couldn’t take the pressure. He’d always crack. Tears would start rollin’ down his cheeks like a wet confession . . . and Whack, he’d get that big German hand right across the head . . . But not me. I’d stare her right back until her eyelids started to weigh ten pounds each . . . And she’d turn away from me, down for the count . . . And you know what? She loved it . . . because I knew how to take care of myself . . . Yeah, me and Ma loved to put on the gloves and go the distance.


1 Based on lines 15–25, what is the boys’ first reaction to Louie?
A. They wonder why Louie is dressed formally at night.
B. They feel that Louie would rather talk to someone else.
C. They believe Louie is mistaking them for other relatives.
D. They think Louie acts different from how they remember him.

2 In lines 23–24, what does Louie mean when he says, “Picture of your mother”?
A. Jay resembles his mother.
B. Louie is becoming confused.
C. Jay is remembering his mother.
D. Louie is looking at an old photograph.
Based on the excerpt, why does Louie enter the apartment after it is dark?
A. He has been delayed in arriving.
B. He has been stealing from the store.
C. He does not want to disturb the boys.
D. He does not want to see his mother right away.

What does Jay’s reaction in lines 39 and 40 most reveal?
A. He feels he must defend himself.
B. He is asking Louie to forgive him.
C. He hopes to put the blame on Arty.
D. He is planning to get more ice cream.

What do Louie’s comments in lines 55-66 suggest about his mother?
A. She admires his defiance.
B. She appreciates his honesty.
C. She fears he will turn to a life of crime.
D. She worries about his influence on his brother.

Based on the excerpt, describe Louie’s character. Support your answer with important and specific details from the excerpt.

Question 6 is an open-response question.
- Read the question carefully.
- Explain your answer.
- Add supporting details.
- Double-check your work.

Write your answer to question 6 in the space provided in your Student Answer Booklet.
Say scorpion to most people, and they will picture a small desert-dwelling animal, its curved tail tipped with a deadly stinger.

This description fits some scorpions, but it is about as accurate as saying that all humans are lawyers who live in cities. Less than 2 percent—about twenty-five of fifteen hundred known scorpion species—have venom that can kill people. And scorpions live not only in deserts but also in jungles, grasslands, caves, along seashores, and high on mountains.

Overall, scorpions are far more varied and much less dangerous than people imagine. Still, throughout history the few poisonous species have killed many people. As a result, in many cultures the scorpion is a symbol of evil and death. In the 1991 book he edited, The Biology of Scorpions, Gary Polis wrote, “The scorpion has appeared repeatedly in religious cults of ancient and modern history as an agent of the night, the devil, or the gods of the underworld.”

Even though he knows how to handle scorpions safely, Gary Polis chooses not to study any deadly species. There are no accurate figures of deaths caused by scorpions worldwide, but estimates range from three thousand to five thousand victims a year. Medicines called antivenins can now save lives, but scorpions are still a major health hazard in parts of India, Africa, South America, and Mexico.

Just one deadly species lives in the United States. Its range extends from Mexico into Arizona and southern Utah. All other scorpions that live in the United States (and one species found also in southern Alberta and British Columbia, Canada) have poison stings that are no worse than those of honeybees or wasps. “I have been stung seven times by scorpions,” Gary Polis says, “and the pain was never bad enough to make me stop what I was doing.”
6 A scorpion’s stinger is located at the tip of its tail. The tail whips forward in a split second to jab a victim and inject venom. Chemists have discovered that scorpion venoms are a mixture of up to thirty neurotoxins (poisons that affect the nervous system). Each toxin is effective against different organisms, for example, insects, mice, and spiders.

7 Scorpions sting to defend themselves or to get food. However, many species rely more on their front claws, or pedipalps, than on venom for defense and food capture. “The bigger a scorpion’s claws,” says Gary Polis, “the less dangerous its venom. Avoid scorpions that have thin little, forcepslike pedipalps. These claws can’t be very good for grabbing and crushing prey, so their presence is a warning that their owners have powerful poisons. In fact all of the most deadly scorpions, in the family Buthidae, have slender pedipalps.”

8 Growing numbers of biologists have become fascinated with scorpions. “When you talk about scorpions, you tend to use a lot of words like ‘the only known example,’ ‘the first,’ ‘the largest,’” says Gary Polis. “It’s just one gee-whiz fact after another.”

9 Scorpions are arachnids, related to spiders, mites, and ticks. All arachnids have eight legs while insects have six. Other arachnids include wind scorpions, false scorpions, and whip scorpions, also called vinegarroons. Despite their names, none of these creatures is a true scorpion.

10 Fossils of “water scorpions” have been found that are about 450 million years old. Some measured ten feet long. Some early land-dwelling scorpions were three feet long. All of these giant scorpions died out, but scorpions have been a remarkably successful and diverse group on land for the past 325 million years. They thrived before, during, and after the dinosaurs.

11 Today’s scorpions resemble the body plan of their ancient ancestors. They all look generally alike. The smallest scorpion, a half inch long, lives on Caribbean islands. The largest, eight inches long, lives in tropical Africa. Overall, scorpions are big creatures—the larger scorpion species are bigger than nearly all arachnids, insects, and other animals without backbones (invertebrates). In fact they are bigger than many lizards, rodents, frogs, and other vertebrates (animals with backbones).

12 Scorpions live on all major land masses except Antarctica. They thrive in many habitats. Some species are found right along ocean shores, where the tides carry in an abundance of food. Other species spend most of their lives in trees; an Australian scorpion that lives in pines has been found more than one hundred twenty feet above the ground.

13 Several kinds of scorpions live in caves. One of these was discovered more than a half mile below the surface. And still other species are mountain dwellers. They are found on ten thousand-foot-tall mountains in the southwestern United States. Some species live under snow-covered stones at even higher elevations in the Himalayas and Andes.
“Scorpions,” says Gary Polis, “are not distributed randomly within a habitat. Rather, particular species are normally found in specific microhabitats. For example, in North America there are scorpions that live only in sand and others that live only on rock.

The bodies, tails, and pedipalps of rock-dwelling scorpions are long and flat, adapted for slipping into cracks and crevices. Sand dwellers, on the other hand, are adapted for travel in loose sand. They have very long hairs that stick out from their legs. These and long claws allow the scorpions to walk on loose sand without sinking.”

While some scorpions live only in certain habitats, many others are more “plastic,” able to inhabit a variety of environments. One example is the scorpion species that lives on Socorro Island off the coast of Baja California in Mexico. It is found in jungle, heavy brush, rocky terrain, and sand, and also on the ground, in vegetation, and near the surf.

Scorpions are rather primitive, ancient animals, but are highly successful. Biologists are curious about the reasons for their success. One is their sense organs. Of all animals, scorpion eyes are the most sensitive to low levels of light. They can navigate using shadows cast by starlight. “Star shadows,” says Gary Polis, “are probably as bright to scorpions as sun shadows are to people.”

Sensitive hairs on the pedipalps of some scorpions detect air movements, including those caused by an insect flying nearby. These scorpions reach and grab prey out of the air. Some scorpions also have slitlike organs on their legs that detect vibrations in the ground caused by insects or other animals walking or burrowing several feet away.

7. Which of the following best explains the relationship between the information in paragraph 1 and the information in paragraph 2?
   A. Paragraph 1 presents a theory; paragraph 2 supports it with data.
   B. Paragraph 1 describes common views; paragraph 2 counters them with facts.
   C. Paragraph 1 provides a historic belief; paragraph 2 gives current information.
   D. Paragraph 1 gives a general summary; paragraph 2 focuses on a personal experience.

8. According to paragraph 6, what is one reason scorpion venom is effective?
   A. The venom is difficult to detect.
   B. The venom kills prey immediately.
   C. The venom completely paralyzes victims.
   D. The venom contains many types of toxins.

9. According to the excerpt, which physical feature provides the best clue to how dangerous a scorpion is?
   A. the curve of the tail
   B. the length of the body
   C. the position of the stinger
   D. the size of the front claws

10. According to the excerpt, which of the following is a defining characteristic of arachnids?
    A. type of venom
    B. number of legs
    C. function of pedipalps
    D. presence of a backbone

11. Based on the excerpt, what is one way some ancient scorpions were different from modern scorpions?
    A. Some ancient scorpions had fewer legs than modern scorpions.
    B. Some ancient scorpions had smaller pedipalps than modern scorpions.
    C. Some ancient scorpions were much larger than modern scorpions.
    D. Some ancient scorpions were much more vicious than modern scorpions.
In the excerpt, what is the main focus of paragraphs 12–14?

A. physical differences among scorpions
B. environmental threats to scorpion survival
C. varied environments in which scorpions live
D. reasons why scorpions have evolved into subspecies

Which quotation from the excerpt best states the main idea?

A. “Say scorpion to most people, and they will picture a small desert-dwelling animal, its curved tail tipped with a deadly stinger.”
B. “Overall, scorpions are far more varied and much less dangerous than people imagine.”
C. “As a result, in many cultures the scorpion is a symbol of evil and death.”
D. “Growing numbers of biologists have become fascinated with scorpions.”

What is the most likely reason for including quotations from Gary Polis in the excerpt?

A. to add humor to the excerpt
B. to provide an expert opinion
C. to engage the reader in the subject
D. to compare his views to those of other scientists

Based on the prefix anti- and the root “venom,” an antivenin is used to

A. kill scorpions.
B. repel scorpions.
C. treat scorpion stings.
D. study scorpion stings.
Based on the excerpt, explain why scorpions have been able to survive for millions of years. Support your answer with important and specific information from the excerpt.
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* 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 website later this year.
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VII. English Language Arts, Reading Comprehension, Grade 8
Grade 8 English Language Arts
Reading Comprehension Test

The spring 2010 grade 8 MCAS English Language Arts Reading Comprehension test was based on learning standards in the two content strands of the Massachusetts English Language Arts Curriculum Framework (2001) listed below. Page numbers for the learning standards appear in parentheses.

- Language (Framework, pages 19–26)
- Reading and Literature (Framework, pages 35–64)

The English Language Arts Curriculum Framework is available on the Department website 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, ELA Reading Comprehension test results are reported under two MCAS reporting categories: Language and Reading and Literature, which are identical to the two framework content strands listed above.

Test Sessions and Content Overview

The MCAS grade 8 ELA Reading Comprehension test included two separate test sessions. Each session included reading passages, followed by multiple-choice and open-response questions. Selected common reading passages and approximately half of the common test items are shown on the following pages as they appeared in test booklets.

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 ELA Reading Comprehension test sessions. No other reference materials were allowed during any ELA Reading Comprehension test session.

Cross-Reference Information

The tables at the conclusion of this chapter indicate each released and unreleased common item’s reporting category and the framework general standard it assesses. The correct answers for released multiple-choice questions are also displayed in the released item table.
DIRECTIONS
This session contains one reading selection with five multiple-choice questions and one open-response question. Mark your answers to these questions in the spaces provided in your Student Answer Booklet.

In this memoir, Narciso Rodriguez, an internationally recognized clothing designer, offers the following definition of “family.” Read the memoir and answer the questions that follow.

Narciso Rodriguez
from Home: The Blueprints of Our Lives

My parents, originally from Cuba, arrived in the United States in 1956. After living for a year in a furnished one-room apartment, twenty-one-year-old Rawedia Maria and twenty-seven-year-old Narciso Rodriguez, Sr., could afford to move into a modest, three-room apartment I would soon call home.

In 1961, I was born into this simple house, situated in a two-family, blond-brick building in the Ironbound section of Newark, New Jersey. Within its walls, my young parents created our traditional Cuban home, the very heart of which was the kitchen. My parents both shared cooking duties and unwittingly passed on to me their rich culinary skills and a love of cooking that is still with me today (and for which I am eternally grateful). Passionate Cuban music (which I adore to this day) filled the air, mixing with the aromas of the kitchen. Here, the innocence of childhood, the congregation of family and friends, and endless celebrations that encompassed both, formed the backdrop to life in our warm home.

Growing up in this environment instilled in me a great sense that “family” had nothing to do with being a blood relative. Quite the contrary, our neighborhood was made up of mostly Spanish, Cuban, and Italian immigrants at a time when overt racism was the norm and segregation prevailed in the United States. In our neighborhood, despite customs elsewhere, all of these cultures came together in great solidarity and friendship. It was a close-knit community of honest, hardworking immigrants who extended a hand to people who, while not necessarily their own kind, were clearly in need.

Our landlord and his daughter, Alegria (my babysitter and first friend), lived above us, and Alegria graced our kitchen table for meals more often than not. Also at the table were Sergio and Edelmira, my surrogate grandparents who lived in the basement apartment. (I would not know my “real” grandparents, Narciso the Elder and Consuelo, until 1970 when they were allowed to leave Cuba.) My aunts Bertha and Juanita and my cousins Arnold, Maria, and Rosemary also all lived nearby and regularly joined us at our table. Countless extended family members came and went — and there was often someone staying with us temporarily until they were able to get back on their feet. My parents always kept their arms and their door open to the many people we considered family, knowing that they would do the same for us.
My mother and father had come to this country with such courage, without any knowledge of the language or the culture. They came selflessly, as many immigrants do, to give their children a better life, even though it meant leaving behind their families, friends, and careers in the country they loved. They struggled both personally and financially, braving the harsh northern winters while yearning for their native tropics and facing cultural hardships. The barriers to work were strong and high, and my parents both had to accept that they might not be able to find the kind of jobs they deserved. In Cuba, Narciso, Sr., had worked in a laboratory and Rawedia Maria had studied chemical engineering. In the United States, they had to start their lives over entirely, taking whatever work they could find. The faith that this struggle would lead them and their children to better times drove them to endure these hard times.

I will always be grateful to my parents for their love and sacrifice. I’ve often told them that what they did was a much more courageous thing than I could have ever done. I’ve often told them of my admiration for their strength and perseverance, and I’ve thanked them repeatedly. But, in reality, there is no way to express my gratitude for the spirit of generosity impressed upon me at such an early age and the demonstration of how important family and friends are. These are two lessons that my parents did not just tell me. They showed me with their lives, and these teachings have been the basis of my life.

It was in this simple house that my parents welcomed other refugees to celebrate their arrival to this country and where I celebrated my first birthdays. It was in the warmth of the kitchen in this humble house where a Cuban feast (albeit a frugal Cuban feast) always filled the air with not just scent and music but life and love. It was here where I learned the real definition of “family.” And for this, I will never forget that house or its gracious neighborhood or the many things I learned there about how to love. I will never forget how my parents turned this simple house into a home.

— Narciso Rodriguez, Fashion designer
Hometown: Newark, New Jersey

1. In the memoir, what is the **main** purpose of paragraph 2?
   A. to describe the location of Narciso's house
   B. to explain why Narciso's parents immigrated
   C. to portray the overall feeling in Narciso's home
   D. to show the economic background of Narciso's parents

2. According to the memoir, for what is Narciso **most** grateful?
   A. his educational opportunities
   B. his Cuban culture and heritage
   C. the chance to grow up in America
   D. the caring and selflessness of his parents

3. What idea does the final sentence of the memoir emphasize?
   A. Home is where one lived as a child.
   B. Memories of home are often better than reality.
   C. Leaving home creates an appreciation of what one had.
   D. Home is about relationships rather than physical space.

4. In paragraph 2, what is the purpose of the words in parentheses?
   A. to indicate a shift in tone
   B. to give definitions of terms
   C. to show contrasting information
   D. to provide additional explanation

5. Which of the following words could **best** replace the word solidarity in paragraph 3?
   A. unity
   B. happiness
   C. satisfaction
   D. organization
Question 6 is an open-response question.

- Read the question carefully.
- Explain your answer.
- Add supporting details.
- Double-check your work.

Write your answer to question 6 in the space provided in your Student Answer Booklet.

6 Describe the mood created by the author in the memoir. Support your answer with relevant and specific information from the memoir.
Ramp It Up
by Pearl Tesler

Up in the Air

Nine stories tall and longer than a football field, the MegaRamp earns its name.

1. Skaters can choose to drop in from a 65- or an 80-foot platform.
2. Gravity accelerates skaters to speeds of up to 44 miles per hour.
3. The lower drop-in leads to a 60-foot gap, and the higher one leads to a 70-foot gap. Flying across either gap, a skater has plenty of time for midair spins and flips.
4. Many runs end in the landing zone, where the impact of the landing causes some skaters to lose control of their boards.
5. At the end of the landing zone, a 27-foot quarterpipe launches skaters up to 50 feet in the air. Again, there’s plenty of time for tricks, but just landing is pretty tricky in itself.

'Gravity Rules!'
1  ... Does skateboarding really defy physics?
2  "Nope, sorry," says Paul Doherty, a physicist at the Exploratorium in San Francisco. "There's no escaping the laws of physics."
3  Skateboard ramps are in fact the perfect place to see physical laws in action, says Doherty. The number-one law at work on the MegaRamp is the law of gravity. "Gravity rules!" says Doherty. "When these guys step off the ledge, every atom in the planet is pulling them down—and there are lots of atoms in the planet.
“As skaters plunge down the ramp, they convert energy from one form into another,” says Doherty. “At the top of the ramp, the skaters have what we call gravitational potential energy—energy due to height above the ground. As they go down, it gets converted into kinetic energy, the energy of motion.”

Kinetic energy means speed—in this case, a lot of it. At the bottom of the first steep descent, skaters move at 44 miles per hour—as fast as if they had simply jumped from the platform. The MegaRamp’s immense height confers such sizzling speed. On a standard 12-foot skateboard ramp, top speeds are confined to well under 20 miles per hour.

Are skaters then just pawns in gravity’s game? Can they control their descent speed at all? “Slightly,” says Doherty. Besides gravity, the other significant force acting on a descending skater is air resistance, a force exerted by air molecules that tends to slow any moving object. Air resistance increases with speed and with the frontal area a skater presents to the wind. “If you stand up tall and wear floppy clothes, you’ll go slower,” says Doherty. “But if you tuck down and make a smaller cross-sectional area, you’ll go faster.”

**Need for Speed**

Maximum speed is a necessity on the MegaRamp. The smoothly arcing curve at the bottom of the big descent leads to the immense, 70-foot gap. Any loss of energy—any mistake that robs a skater of speed—can result in a potentially fatal failure to clear the gap. “If a skater bobbles on the way down, fails to keep a straight line, or touches his toe down, it could be very, very bad,” says Doherty. “Because once you’re in the air, it’s too late.”

As testimony to the big risks of big air, paramedics are standing by at the base of the giant ramp. Meanwhile, in preparation for the rough ride, competitors suit up with helmets, elbow pads, knee pads, wrist guards, and shoulder pads. Although the MegaRamp has claimed no lives, within an hour I see at least a dozen spills nasty enough to draw a collective “Oooooohhh!” from the fans. But every time a competitor falls, he leaps up and hustles back to the elevator, eager for more.

**Bigger Air?**

After nailing several more soaring backflips, [Danny] Way seals a gold-medal victory in the big-air competition, his third in the three years that the competition has existed. But Way isn’t one to rest on his laurels. The wheels of his battered skateboard have barely quit spinning before he announces his desire to build a new—and possibly bigger—ramp. “There’s so much more possible,” he told ESPN.

Way’s announcement leaves skaters and fans alike wondering: Exactly how big can a skate ramp get? Could future skate ramps climb high into the stratosphere? Is the sky the limit?
Three factors put major limits on the height of a skate ramp, says Doherty. The first factor is g-forces, the body-squashing sensations familiar to astronauts and pilots. Whenever your body accelerates—that is, changes speed or direction—you experience a force. When that acceleration is extreme, the body can experience a force equal to or even greater than the downward force exerted by gravity. Such an extreme force due to acceleration is called a g-force, where g is short for gravity. During a space launch, astronauts are pinned to their seats by a force equivalent to three times the force of gravity—3 g’s.

The skaters rocketing down the MegaRamp feel g-forces too. They feel the worst of them at the base of the steep initial descent, where the ramp curves from vertical to horizontal, a change in direction that puts about 2.5 g’s of force on a skater. “For a 200-pound skater, this feels like suddenly weighing 500 pounds,” explains Doherty. “It feels like you’re being squashed into the ground.”

The g-forces a skateboarder feels in a curve are directly related to speed. “If you double speed, the g-forces actually quadruple,” says Doherty. A taller MegaRamp would increase skaters’ speeds and thereby increase the g-forces they experience in the curve at the bottom. For example, doubling the height of the MegaRamp would expose skaters to about 5 g’s. “For a 200-pound athlete, that’s like bench-pressing 1,000 pounds with the legs just to stand up. Few athletes can actually do that.” So to keep g-forces bearable, a taller MegaRamp would have to have more gradual curves.

**Terminal Speed**

The second factor limiting the height of a skate ramp is its terminal velocity (natural speed limit), a phenomenon familiar to skydivers. It is imposed by air resistance. When skydivers jump out of a plane, they gain speed at a constant rate because of gravity. But air resistance slows them, and air resistance increases with speed. As the skydivers fall and their speed increases, the downward force of gravity is eventually balanced by the upward force of air resistance. Skydivers then reach their maximum speed, or terminal velocity. Depending on how divers hold their body, their terminal velocity can range from 120 to 200 miles per hour.

“When you jump out of an airplane,” says Doherty, “you reach terminal velocity after about 1,000 feet. So any skateboard ramp more than 1,000 feet high is pointless. After about 1,000 feet, you won’t gain any more speed, no matter how tall the ramp is. So if you run a ramp down the side of the Empire State Building—that’s 1,200 feet—that’s as big as you need to go. You’ll reach terminal velocity—around 120 miles per hour—just before you reach the bottom.”

**Fear Factor**

The final factor to consider isn’t physical but psychological—the fear factor. If Way builds an even taller skate ramp, will anyone be brave enough to ride it? Would you? Amazingly, Way himself has admitted to a fear of heights: “There’s no question I get butterflies when I’m on the edges of the top of the tower,” he told the Los Angeles Times.
For now, the only permanently installed MegaRamp in the world is located at the home of Bob Burnquist, bronze medalist in the big-air competition, who is famous for having jumped his skateboard off the edge of the Grand Canyon (wearing a parachute, of course). Despite an obvious knack for aerial stunts, even Burnquist finds the MegaRamp daunting. “It’s scary,” he told The New York Times. “You calculate as much as you can, and you try to assess everything that you possibly can, but sometimes it’s just ‘close your eyes and go.’”

11. According to paragraph 6, how can skaters slow their descent speed?
   A. by adding extra weight
   B. by folding in their arms
   C. by wearing a looser shirt
   D. by squatting on the board

12. Based on the article, how are skateboarders able to cross the 70-foot gap in the MegaRamp?
   A. by standing up straight
   B. by building up sufficient speed
   C. by escaping the force of gravity
   D. by eliminating the drag of friction

13. According to the section “Bigger Air?” what affects skateboarders most when they reach the base of the ramp?
   A. g-forces
   B. dizziness
   C. air resistance
   D. potential energy

14. In paragraphs 14 and 15, why does the author compare skateboarding to skydiving?
   A. to suggest that both are dangerous sports
   B. to contrast the risks involved in both sports
   C. to interest enthusiasts in trying something new
   D. to illustrate the physical restrictions of traveling fast

15. According to paragraph 15, what is significant about 1,000 feet as the height of a skateboard ramp?
   A. It limits the effects of g-forces.
   B. It is the maximum height regulations permit.
   C. It is the height of the tallest skateboarding ramp.
   D. It allows skateboarders to reach maximum speed.

16. What does the word daunting mean as it is used in paragraph 17?
   A. unsafe
   B. thrilling
   C. untested
   D. frightening
Based on the article, identify the three factors that limit the height of a skate ramp and explain how each of them limits the ramp’s height. Support your answer with relevant and specific details from the article.
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* 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 website later this year.
Grade 8 English Language Arts
Reading Comprehension
Spring 2010 Unreleased Common Items:
Reporting Categories and Standards

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VIII. English Language Arts, Grade 10

A. Composition
B. Reading Comprehension
Grade 10 English Language Arts Test

Test Structure

The grade 10 MCAS English Language Arts test was presented in the following two parts:

- the ELA Composition test, which used a writing prompt to assess learning standards from the Massachusetts English Language Arts Curriculum Framework’s Composition strand
- the ELA Reading Comprehension test, which used multiple-choice and open-response questions to assess learning standards from the English Language Arts Curriculum Framework’s Language and Reading and Literature strands

A. Composition

The spring 2010 grade 10 MCAS English Language Arts Composition test and Composition Make-Up test were based on learning standards in the Composition strand of the Massachusetts English Language Arts Curriculum Framework (2001). The learning standards appear on pages 72–83 of the Framework, which is available on the Department website 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, ELA Composition test results are reported under the reporting categories Composition: Topic Development and Composition: Standard English Conventions.

Test Sessions and Content Overview

The MCAS ELA Composition test included two separate test sessions, administered on the same day with a short break between sessions. During the first session, each student wrote an initial draft of a composition in response to the appropriate writing prompt on the next page. During the second session, each student revised his or her draft and submitted a final composition, which was scored in the areas of Topic Development and Standard English Conventions. The Scoring Guides for the MCAS English Language Arts Composition are available at www.doe.mass.edu/mcas/student/elacomp_scoreguide.html.

Reference Materials and Tools

At least one English-language dictionary per classroom was provided for student use during ELA Composition test sessions. The use of bilingual dictionaries was allowed for current and former limited English proficient students only. No other reference materials or tools were allowed during either ELA Composition test session.

Cross-Reference Information

Framework general standards 19–22 are assessed by the ELA Composition.
Grade 10 Writing Prompt

**WRITING PROMPT**

Often in works of literature, a character's life is affected by a single act or mistake.

From a work of literature you have read in or out of school, select a character whose life is affected by a single act or mistake. In a well-developed composition, identify the character, describe how he or she is affected by a single act or mistake, and explain how the character's experience relates to the work as a whole.

Grade 10 Make-Up Writing Prompt

**WRITING PROMPT**

Often in works of literature, characters gain wisdom through experience.

From a work of literature you have read in or out of school, select a character who gains wisdom through experience. In a well-developed composition, identify the character, describe how the character gains wisdom through experience, and explain how this wisdom relates to the work as a whole.
B. Reading Comprehension

The spring 2010 grade 10 MCAS English Language Arts Reading Comprehension test was based on learning standards in the two content strands of the Massachusetts English Language Arts Curriculum Framework (2001) listed below. Page numbers for the learning standards appear in parentheses.

- Language (Framework, pages 19–26)
- Reading and Literature (Framework, pages 35–64)

The English Language Arts Curriculum Framework is available on the Department website 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, ELA Reading Comprehension test results are reported under two MCAS reporting categories: Language and Reading and Literature, which are identical to the two framework content strands listed above.

Test Sessions and Content Overview

The MCAS grade 10 ELA Reading Comprehension test included three separate test sessions. Sessions 1 and 2 were both administered on the same day, and Session 3 was administered on the following day. Each session included selected readings, followed by multiple-choice and open-response questions. Common reading passages and test items are shown on the following pages as they appeared in test booklets. Due to copyright restrictions, certain reading passages cannot be released to the public on the website. For further information, contact Student Assessment Services at 781-338-3625.

Reference Materials and Tools

The use of bilingual word-to-word dictionaries was allowed for current and former limited English proficient students only, during all three ELA Reading Comprehension test sessions. No other reference materials were allowed during any ELA Reading Comprehension test session.

Cross-Reference Information

The table at the conclusion of this chapter indicates each item’s reporting category and the framework general standard it assesses. The correct answers for multiple-choice questions are also displayed in the table.
The majestic spire of the Empire State Building is familiar to many people throughout the world, but not many know that the original purpose of the mast was to serve as a landing spot for dirigibles, also known as blimps. Read the excerpt from “The Mooring Mast” and answer the questions that follow.

THE MOORING MAST
by Marcia Amidon Lusted

1. When the Empire State Building was conceived, it was planned as the world’s tallest building, taller even than the new Chrysler Building that was being constructed at Forty-second Street and Lexington Avenue in New York. At seventy-seven stories, it was the tallest building before the Empire State began construction, and Al Smith* was determined to outstrip it in height.

2. The architect building the Chrysler Building, however, had a trick up his sleeve. He secretly constructed a 185-foot spire inside the building, and then shocked the public and the media by hoisting it up to the top of the Chrysler Building, bringing it to a height of 1,046 feet, 46 feet taller than the originally announced height of the Empire State Building.

3. Al Smith realized that he was close to losing the title of world’s tallest building, and on December 11, 1929, he announced that the Empire State would now reach the height of 1,250 feet. He would add a top or a hat to the building that would be even more distinctive than any other building in the city. John Tauranac describes the plan:

[The top of the Empire State Building] would be more than ornamental, more than a spire or dome or a pyramid put there to add a desired few feet to the height of the building or to mask something as mundane as a water tank. Their top, they said, would serve a higher calling. The Empire State Building would be equipped for an age of transportation that was then only the dream of aviation pioneers.

* Al Smith — four-term governor of New York who headed efforts to construct the Empire State Building after his years in office
This dream of the aviation pioneers was travel by dirigible, or zeppelin, and the Empire State Building was going to have a mooring mast at its top for docking these new airships, which would accommodate passengers on already existing transatlantic routes and new routes that were yet to come.

**The Age of Dirigibles**

By the 1920s, dirigibles were being hailed as the transportation of the future. Also known today as blimps, dirigibles were actually enormous steel-framed balloons, with envelopes of cotton fabric filled with hydrogen and helium to make them lighter than air. Unlike a balloon, a dirigible could be maneuvered by the use of propellers and rudders, and passengers could ride in the gondola, or enclosed compartment, under the balloon.

Dirigibles had a top speed of eighty miles per hour, and they could cruise at seventy miles per hour for thousands of miles without needing refueling. Some were as long as one thousand feet, the same length as four blocks in New York City. The one obstacle to their expanded use in New York City was the lack of a suitable landing area. Al Smith saw an opportunity for his Empire State Building: A mooring mast added to the top of the building would allow dirigibles to anchor there for several hours for refueling or service, and to let passengers off and on. Dirigibles were docked by means of an electric winch, which hauled in a line from the front of the ship and then tied it to a mast. The body of the dirigible could swing in the breeze, and yet passengers could safely get on and off the dirigible by walking down a gangplank to an open observation platform.

The architects and engineers of the Empire State Building consulted with experts, taking tours of the equipment and mooring operations at the U.S. Naval Air Station in Lakehurst, New Jersey. The navy was the leader in the research and development of dirigibles in the United States. The navy even offered its dirigible, the Los Angeles, to be used in testing the mast. The architects also met with the president of a recently formed airship transport company that planned to offer dirigible service across the Pacific Ocean.

When asked about the mooring mast, Al Smith commented:

[It's] on the level, all right. No kidding. We're working on the thing now. One set of engineers here in New York is trying to dope out a practical, workable arrangement and the Government people in Washington are figuring on some safe way of mooring airships to this mast.
**Designing the Mast**

The architects could not simply drop a mooring mast on top of the Empire State Building’s flat roof. A thousand-foot dirigible moored at the top of the building, held by a single cable tether, would add stress to the building’s frame. The stress of the dirigible’s load and the wind pressure would have to be transmitted all the way to the building’s foundation, which was nearly eleven hundred feet below. The steel frame of the Empire State Building would have to be modified and strengthened to accommodate this new situation. Over sixty thousand dollars’ worth of modifications had to be made to the building’s framework.

Rather than building a utilitarian mast without any ornamentation, the architects designed a shiny glass and chrome-nickel stainless steel tower that would be illuminated from inside, with a stepped-back design that imitated the overall shape of the building itself. The rocket-shaped mast would have four wings at its corners, of shiny aluminum, and would rise to a conical roof that would house the mooring arm. The winches and control machinery for the dirigible mooring would be housed in the base of the shaft itself, which also housed elevators and stairs to bring passengers down to the eighty-sixth floor, where baggage and ticket areas would be located.

The building would now be 102 floors, with a glassed-in observation area on the 101st floor and an open observation platform on the 102nd floor. This observation area was to double as the boarding area for dirigible passengers.

Once the architects had designed the mooring mast and made changes to the existing plans for the building’s skeleton, construction proceeded as planned. When the building had been framed to the 85th floor, the roof had to be completed before the framing for the mooring mast could take place. The mast also had a skeleton of steel and was clad in stainless steel with glass windows. Two months after the workers celebrated framing the entire building, they were back to raise an American flag again—this time at the top of the frame for the mooring mast.

**The Fate of the Mast**

The mooring mast of the Empire State Building was destined to never fulfill its purpose, for reasons that should have been apparent before it was ever constructed. The greatest reason was one of safety: Most dirigibles from outside of the United States used hydrogen rather than helium, and hydrogen is highly flammable. When the German dirigible Hindenburg was destroyed by fire in Lakehurst, New Jersey, on May 6, 1937, the owners of the Empire State Building realized how much worse that accident could have been if it had taken place above a densely populated area such as downtown New York.

The greatest obstacle to the successful use of the mooring mast was nature itself. The winds on top of the building were constantly shifting due to violent air currents. Even if the dirigible were tethered to the mooring mast, the back of the ship would swivel around and around the mooring mast. Dirigibles moored in open landing fields could be weighted down in the back with lead weights, but using these at the Empire State Building, where they would be dangling high above pedestrians on the street, was neither practical nor safe.
The other practical reason why dirigibles could not moor at the Empire State Building was an existing law against airships flying too low over urban areas. This law would make it illegal for a ship to ever tie up to the building or even approach the area, although two dirigibles did attempt to reach the building before the entire idea was dropped. In December 1930, the U.S. Navy dirigible Los Angeles approached the mooring mast but could not get close enough to tie up because of forceful winds. Fearing that the wind would blow the dirigible onto the sharp spires of other buildings in the area, which would puncture the dirigible’s shell, the captain could not even take his hands off the control levers.

Two weeks later, another dirigible, the Goodyear blimp Columbia, attempted a publicity stunt where it would tie up and deliver a bundle of newspapers to the Empire State Building. Because the complete dirigible mooring equipment had never been installed, a worker atop the mooring mast would have to catch the bundle of papers on a rope dangling from the blimp. The papers were delivered in this fashion, but after this stunt the idea of using the mooring mast was shelved. In February 1931, Irving Clavan of the building’s architectural office said, “The as yet unsolved problems of mooring air ships to a fixed mast at such a height made it desirable to postpone to a later date the final installation of the landing gear.”

By the late 1930s, the idea of using the mooring mast for dirigibles and their passengers had quietly disappeared. Dirigibles, instead of becoming the transportation of the future, had given way to airplanes. The rooms in the Empire State Building that had been set aside for the ticketing and baggage of dirigible passengers were made over into the world’s highest soda fountain and tea garden for use by the sightseers who flocked to the observation decks. The highest open observation deck, intended for disembarking passengers, has never been open to the public.
1. Based on paragraphs 1–3, Al Smith's attitude is best described as
   A. sneaky.
   B. sociable.
   C. generous.
   D. competitive.

2. According to paragraphs 3 and 4, what was the “higher calling” for which the mooring mast was built?
   A. to make New York the most important city in the world
   B. to put New York on the forefront of modern travel
   C. to serve as a means to harness electricity
   D. to serve as a weather observation center

3. According to paragraph 5, what is the main difference between dirigibles and balloons?
   A. The fabric used in dirigibles is lighter.
   B. Dirigibles can carry fewer passengers.
   C. Dirigibles use different gases to stay aloft.
   D. The movements of dirigibles can be controlled.

4. In paragraph 8, what is the effect of including Al Smith's comments?
   A. It shows the uncertainty of the times.
   B. It shows how unrealistic Smith's idea was.
   C. It shows the reader how seriously the idea was taken.
   D. It shows how dishonest Smith was about the building plans.

5. Which of the following best describes the transition between paragraphs 12 and 13?
   A. from opinions to facts
   B. from theory to reality
   C. from past to present
   D. from cause to effect
6. Read the sentence from paragraph 13 in the box below.

The mooring mast of the Empire State Building was destined to never fulfill its purpose, for reasons that should have been apparent before it was ever constructed.

What does the author imply in the sentence?
A. The building was a failure without the use of the mast.
B. The building should not have been built in the first place.
C. The architects did not try hard enough to solve the problems.
D. The architects were blind to the potential problems of the mast.

7. Read the quotations from Al Smith and Irving Clavan in the box below.

- [It's] on the level, all right. No kidding. We're working on the thing now. (paragraph 8)
- “The as yet unsolved problems of mooring air ships to a fixed mast at such a height made it desirable to postpone to a later date the final installation of the landing gear.” (paragraph 16)

What does the contrast between the quotations mainly reveal?
A. the change in the political climate
B. the advances of technology over time
C. the differences in the men's personalities
D. the change in the expectations for the project

8. In paragraph 3, John Tauranac says that the mooring mast would have a higher calling than merely hiding “something as mundane as a water tank.” What is the meaning of mundane in the sentence?
A. useful
B. unstable
C. ordinary
D. decorative
Question 9 is an open-response question.

- Read the question carefully.
- Explain your answer.
- Add supporting details.
- Double-check your work.

Write your answer to question 9 in the space provided in your Student Answer Booklet.

9 Based on the excerpt, describe the obstacles the builders of the Empire State Building faced in attempting to allow dirigibles to dock there. Support your answer with relevant and specific information from the excerpt.
In one of William Shakespeare’s best-known sonnets, the speaker addresses a person with whom he shares a close relationship. Read the sonnet and answer the questions that follow.

SONNET 73

That time of year thou mayst in me behold
When yellow leaves, or none, or few, do hang
Upon those boughs which shake against the cold,
Bare ruined choirs where late the sweet birds sang.

In me thou seest the twilight of such day
As after sunset fadeth in the west,
Which by and by black night doth take away,
Death’s second self, that seals up all in rest.

In me thou seest the glowing of such fire
That on the ashes of his youth doth lie
As the death-bed whereon it must expire,
Consumed with that which it was nourished by.

This thou perceiv’st, which makes thy love more strong,
To love that well which thou must leave ere long.

— William Shakespeare

In the public domain.
10. What do the images in the sonnet suggest is happening to the speaker as he ages?
   A. He is declining in strength.
   B. He is losing his conviction.
   C. He is sharpening his judgment.
   D. He is developing his imagination.

11. What aspect of the season does the poet most emphasize in the first four lines of the sonnet?
   A. the brilliant colors of foliage
   B. the dreaded approach of winter
   C. the abundant harvest of autumn
   D. the cautious movements of wildlife

12. Which line from the sonnet describes sleep?
   A. “When yellow leaves, or none, or few, do hang”
   B. “In me thou seest the twilight of such day”
   C. “Death’s second self, that seals up all in rest”
   D. “As the death-bed whereon it must expire”

13. What is the main theme of the sonnet?
   A. Age differences are no barrier to love.
   B. People need to be loved as they grow older.
   C. Happiness changes to worry as loved ones grow older.
   D. People love more intensely when they know life is ending.
In this excerpt from Joseph Conrad's *Heart of Darkness*, Marlow tells a group of sailors about his river journey through the African jungle at the end of the nineteenth century. Read the excerpt and answer the questions that follow.

**from *Heart of Darkness***
**by Joseph Conrad**

"Going up that river was like travelling back to the earliest beginnings of the world, when vegetation rioted on the earth and the big trees were kings. An empty stream, a great silence, an impenetrable forest. The air was warm, thick, heavy, sluggish. There was no joy in the brilliance of sunshine. The long stretches of the waterway ran on, deserted, into the gloom of over-shadowed distances. On silvery sand-banks hippos and alligators sunned themselves side by side. The broadening waters flowed through a mob of wooded islands; you lost your way on that river as you would in a desert, and butted all day long against shoals, trying to find the channel, till you thought yourself bewitched and cut off for ever from everything you had known once—somewhere—far away—in another existence perhaps. There were moments when one's past came back to one, as it will sometimes when you have not a moment to spare to yourself; but it came in the shape of an unrestful and noisy dream, remembered with wonder amongst the overwhelming realities of this strange world of plants, and water, and silence. And this stillness of life did not in the least resemble a peace. It was the stillness of an implacable force brooding over an inscrutable intention. It looked at you with a vengeful aspect. I got used to it afterwards; I did not see it any more; I had no time. I had to keep guessing at the channel; I had to discern, mostly by inspiration, the signs of hidden banks; I watched for sunken stones; I was learning to clap my teeth smartly before my heart flew out, when I shaved by a fluke some infernal sly old snag that would have ripped the life out of the tin-pot steamboat and drowned all the pilgrims; I had to keep a lookout for the signs of dead wood we could cut up in the night for next day's steaming. When you have to attend to things of that sort, to the mere incidents of the surface, the reality—the reality, I tell you—fades. The inner truth is hidden—luckily, luckily. But I felt it all the same; I felt often its mysterious stillness watching me at my monkey tricks, just as it watches you fellows performing on your respective tightropes for—what is it? half-a-crown a tumble—"
14. What is emphasized by the description in lines 1–6?
   A. the beauty of the day
   B. the dominance of nature
   C. the behavior of the animals
   D. the excitement of the narrator

15. Based on lines 16–19, why does the narrator stop seeing the “vengeful aspect”?
   A. He is preoccupied with events from his past.
   B. He wants to show the pilgrims he is in control.
   C. He is learning to enjoy the mystery of the jungle.
   D. He needs to focus on the dangers the river presents.
16. Read the sentences from line 24 in the box below.

“... the reality—the reality, I tell you—fades. The inner truth is hidden—luckily, luckily.”

What is the effect of the repetition in the sentences?
A. It highlights the narrator's forgetfulness.
B. It emphasizes the distance the narrator has traveled.
C. It intensifies the sinister atmosphere for the listeners.
D. It emphasizes the listeners' lack of interest in the story.

17. In line 2, the narrator says the “vegetation rioted,” meaning it
A. grew wildly.
B. died quickly.
C. attacked fatally.
D. shook violently.
Question 18 is an open-response question.

- Read the question carefully.
- Explain your answer.
- Add supporting details.
- Double-check your work.

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

18 Based on the excerpt, explain how the narrator is affected by the jungle environment. Support your answer with relevant and specific information from the excerpt.
In this excerpt from *Love in the Time of Cholera*, Florentino Ariza has fallen madly in love with the wealthy Fermina Daza. He has written her a letter to announce his feelings and has waited an excruciating month for her reply. Read the excerpt and answer the questions that follow.

from *Love in the Time of Cholera*  
by Gabriel García Márquez

1. He had given Fermina Daza the letter a month before, and since then he had often broken his promise not to return to the little park, but he had been very careful not to be seen. Nothing had changed. The reading lesson under the trees ended at about two o’clock, when the city was waking from its siesta, and Fermina Daza embroidered with her aunt until the day began to cool. Florentino Ariza did not wait for the aunt to go into the house, and he crossed the street with a martial stride that allowed him to overcome the weakness in his knees, but he spoke to her aunt, not to Fermina Daza.

2. “Please be so kind as to leave me alone for a moment with the young lady,” he said. “I have something important to tell her.”

3. “What impertinence!” her aunt said to him. “There is nothing that has to do with her that I cannot hear.”

4. “Then I will not say anything to her,” he said, “but I warn you that you will be responsible for the consequences.”

5. That was not the manner Escolástica Daza expected from the ideal sweetheart, but she stood up in alarm because for the first time she had the overwhelming impression that Florentino Ariza was speaking under the inspiration of the Holy Spirit. So she went into the house to change needles and left the two young people alone under the almond trees in the doorway.

6. In reality, Fermina Daza knew very little about this taciturn1 suitor who had appeared in her life like a winter swallow and whose name she would not even have known if it had not been for his signature on the letter. She had learned that he was the fatherless son of an unmarried woman who was hardworking and serious but forever marked by the fiery stigma2 of her single youthful mistake. She had learned that he was not a messenger, as she had supposed, but a well-qualified assistant with a promising future, and she thought that he had delivered the telegram to her father only as a pretext for seeing her. This idea moved her. She also knew that he was one of the musicians in the choir, and although she never dared raise her eyes to look at him during Mass, she had the revelation one Sunday that while the other instruments played for everyone, the

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1 taciturn — reserved  
2 stigma — a mark of disgrace
violin played for her alone. He was not the kind of man she would have chosen. His foundling’s eyeglasses, his clerical garb, his mysterious resources had awakened in her a curiosity that was difficult to resist, but she had never imagined that curiosity was one of the many masks of love.

She herself could not explain why she had accepted the letter. She did not reproach herself for doing so, but the ever-increasing pressure to respond complicated her life. Her father’s every word, his casual glances, his most trivial gestures, seemed set with traps to uncover her secret. Her state of alarm was such that she avoided speaking at the table for fear some slip might betray her, and she became evasive even with her Aunt Escolástica, who nonetheless shared her repressed anxiety as if it were her own. She would lock herself in the bathroom at odd hours and for no reason other than to reread the letter, attempting to discover a secret code, a magic formula hidden in one of the three hundred fourteen letters of its fifty-eight words, in the hope they would tell her more than they said. But all she found was what she had understood on first reading, when she ran to lock herself in the bathroom, her heart in a frenzy, and tore open the envelope hoping for a long, feverish letter, and found only a perfumed note whose determination frightened her.

At first she had not even thought seriously that she was obliged to respond, but the letter was so explicit that there was no way to avoid it. Meanwhile, in the torment of her doubts, she was surprised to find herself thinking about Florentino Ariza with more frequency and interest than she cared to allow, and she even asked herself in great distress why he was not in the little park at the usual hour, forgetting that it was she who had asked him not to return while she was preparing her reply. And so she thought about him as she never could have imagined thinking about anyone, having premonitions that he would be where he was not, wanting him to be where he could not be, awaking with a start, with the physical sensation that he was looking at her in the darkness while she slept, so that on the afternoon when she heard his resolute steps on the yellow leaves in the little park it was difficult for her not to think this was yet another trick of her imagination. But when he demanded her answer with an authority that was so different from his languor, she managed to overcome her fear and tried to dodge the issue with the truth: she did not know how to answer him. But Florentino Ariza had not leapt across an abyss only to be shooed away with such excuses.

“If you accepted the letter,” he said to her, “it shows a lack of courtesy not to answer it.”

That was the end of the labyrinth. Fermina Daza regained her self-control, begged his pardon for the delay, and gave him her solemn word that he would have an answer before the end of the vacation. And he did. On the last Friday in February, three days before school reopened, Aunt Escolástica went to the telegraph office to ask how much it cost to send a telegram to Piedras de Moler, a village that did not even appear on the list of places served by the telegraph, and she allowed Florentino Ariza to attend her as
if she had never seen him before, but when she left she pretended to forget a breviary\textsuperscript{3} covered in lizard skin, leaving it on the counter, and in it there was an envelope made of linen paper with golden vignettes.\textsuperscript{4} Delirious with joy, Florentino Ariza spent the rest of the afternoon eating roses and reading the note letter by letter, over and over again, and the more he read the more roses he ate, and by midnight he had read it so many times and had eaten so many roses that his mother had to hold his head as if he were a calf and force him to swallow a dose of castor oil.

It was the year they fell into devastating love. Neither one could do anything except think about the other, dream about the other, and wait for letters with the same impatience they felt when they answered them. Never in that delirious spring, or in the following year, did they have the opportunity to speak to each other. Moreover, from the moment they saw each other for the first time until he reiterated his determination a half century later, they never had the opportunity to be alone or to talk of their love. But during the first three months not one day went by that they did not write to each other, and for a time they wrote twice a day, until Aunt Escolástica became frightened by the intensity of the blaze that she herself had helped to ignite.

\textsuperscript{3} brev iary — a book of prayers

\textsuperscript{4} vignettes — decorative sketches
19. Read the phrase from paragraph 6 in the box below.

... but she had never imagined that curiosity was one of the many masks of love.

What is suggested by the phrase?
A. Fermina was pretending to be in love.
B. Fermina found other men more attractive.
C. Fermina wanted to keep her feelings private.
D. Fermina was unaware that she was falling in love.

20. In paragraph 7, what is mostly emphasized by the fact that Fermina knows the exact number of letters and words in Florentino's letter?
A. the shortness of the letter
B. the complexity of the language in the letter
C. the intensity with which she examines the letter
D. the fear she has that her father will discover the letter

21. Read the sentence from paragraph 8 in the box below.

But Florentino Ariza had not leapt across an abyss only to be shooed away with such excuses.

In the sentence, what does the metaphor “leapt across an abyss” suggest?
A. Florentino was not as kind as he should have been.
B. Florentino was not expecting Fermina to fall in love with him.
C. Florentino allowed Fermina too little time to respond.
D. Florentino took a risk by being honest about his feelings.

22. What best shows that Aunt Escolástica's initial feelings toward Florentino have changed?
A. She helps Fermina deliver her response.
B. She is worried he lacks a promising career.
C. She keeps the secret from Fermina's parents.
D. She is intimidated by his authoritative manner.
23. Based on paragraph 10, what does Florentino’s eating roses symbolize?
   A. his appreciation for Fermina’s manners
   B. his confusion over Fermina’s letter
   C. his irritation with Fermina’s aunt
   D. his desire for Fermina’s love

24. Based on paragraph 11, what is unusual about the love affair between Florentino and Fermina?
   A. It is mostly one-sided.
   B. It is disapproved of by others.
   C. It is slowly growing less serious.
   D. It is conducted entirely through letters.

25. Read the phrase from paragraph 6 in the box below.

   \[\ldots\text{she thought that he had delivered the telegram to her father only as a pretext for seeing her.}\]

Which of the following is the best replacement for *pretext* in the phrase above?
   A. excuse
   B. request
   C. substitute
   D. possibility

26. Read the phrases from the excerpt in the box below.

   \[\ldots\text{he crossed the street with a martial stride that allowed him to overcome the weakness in his knees, \ldots (paragraph 1)}\]
   \[\ldots\text{when she heard his resolute steps on the yellow leaves in the little park it was difficult for her not to think this was yet another trick of her imagination. (paragraph 8)}\]

Which word in the phrase from paragraph 1 is the **best** context clue for understanding the meaning of *resolute* in the phrase from paragraph 8?
   A. “crossed”
   B. “martial”
   C. “overcome”
   D. “weakness”
Question 27 is an open-response question.

- Read the question carefully.
- Explain your answer.
- Add supporting details.
- Double-check your work.

Write your answer to question 27 in the space provided in your Student Answer Booklet.

27 Based on the excerpt, explain Fermina's mixed feelings about Florentino's declaration of love. Support your answer with relevant and specific information from the excerpt.

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Gardeners use humus, a mixture of decayed animal and vegetable matter, to produce healthy flowers and vegetables. Read the article to discover how backyard composting provides them with a steady supply of this valuable material, and then answer the questions that follow.

**Making Humus by Composting**
by Liz Ball

Students read a selection titled “Making Humus by Composting” and then answered questions 28 through 36 that follow on pages 121 through 123 of this document.

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28. In the article, the author **mainly** appeals to which audience?
   A. organic chemists
   B. average gardeners
   C. commercial farmers
   D. devoted conservationists

29. Based on paragraph 2, how does composting “improve” nature’s decomposing?
   A. Composting is more complete.
   B. Composting is less expensive.
   C. Composting is cleaner.
   D. Composting is faster.
30. Based on paragraph 5, which of the following products would **most likely** add carbon to a compost pile?
   A. carrot peels
   B. fallen apples
   C. purified water
   D. shredded bark

31. Which of the following questions is **not** answered by the “Temperature Fluctuations of the Compost Pile” chart?
   A. What is the length of each decomposition phase?
   B. Which organism is present at the lowest temperature?
   C. Which organisms are active during the degradation phase?
   D. What temperature changes occur during the phases of decomposition?

32. Based on the chart “Temperature Fluctuations of the Compost Pile,” in which phases of decomposition can psychrophiles be found?
   A. oxidation, reduction, degradation, conversion
   B. oxidation, reduction, conversion, maturation
   C. degradation, conversion, maturation
   D. reduction, degradation, conversion

33. Based on the article, which of the following **best** explains the low temperature of the maturation phase?
   A. Most of the organic activity is complete.
   B. The compost pile has become smaller.
   C. The compost pile is affected by autumn weather.
   D. Heat is dispersed as the humus is spread on the garden.

34. Which two terms are used interchangeably throughout the article?
   A. “fresh” and “aged”
   B. “bacteria” and “fungi”
   C. “humus” and “compost”
   D. “nutrient” and “fertilizer”

35. Based on the names of the microorganisms in the article, what would **most likely** be true of photophilic bacteria?
   A. They would be large enough to be seen.
   B. They would grow best in light.
   C. They would be able to see.
   D. They would produce light.
Question 36 is an open-response question.

- Read the question carefully.
- Explain your answer.
- Add supporting details.
- Double-check your work.

Write your answer to question 36 in the space provided in your Student Answer Booklet.

36. Explain how the structure and format of the article help the reader understand the process of composting. Support your answer with relevant and specific examples from the article.
After the death of their father, a famous mathematician, two sisters meet to discuss the future. Hal was a student of Claire and Catherine’s father. Read the excerpt from Proof and answer the questions that follow.

from Proof
by David Auburn

CLAIRE: We’re selling the house.
(Beat.)
CATHERINE: What?
CLAIRE: We—I’m selling it.
CATHERINE: When?
CLAIRE: I’m hoping to do the paperwork this week. I know it seems sudden.
CATHERINE: No one was here looking at the place, who are you selling it to?
CLAIRE: The university. They’ve wanted the block for years.
CATHERINE: I live here.
CLAIRE: Honey, now that Dad’s gone it doesn’t make sense. It’s in bad shape. It costs a fortune to heat. It’s time to let it go. Mitch agrees, it’s a very smart move. We’re lucky, we have a great offer—
CATHERINE: Where am I supposed to live?
CLAIRE: Come to New York.
CATHERINE: I can’t believe this.
CLAIRE: It’ll be so good. You deserve a change. This would be a whole new adventure for you.
CATHERINE: Why are you doing this?
CLAIRE: I want to help.
CATHERINE: By kicking me out of my house?
CLAIRE: It was my house too.
CATHERINE: You haven’t lived here for years.
CLAIRE: I know that. You were on your own. I really regret that, Katie.
CATHERINE: Don’t.
CLAIRE: I know I let you down. I feel awful about it. Now I’m trying to help.
CATHERINE: You want to help now?
CLAIRE: Yes.
CATHERINE: Dad is dead.
CLAIRE: I know.
CATHERINE: He’s dead. Now that he’s dead you fly in for the weekend and decide you want to help? You’re late. Where have you been?
CLAIRE: I—
CATHERINE: Where were you five years ago? You weren’t helping then.
CLAIRE: I was working.
CATHERINE: I was here. I lived with him alone.
CLAIRE: I was working fourteen-hour days. I paid every bill here. I paid off the mortgage on this three-bedroom house while I was living in a studio in Brooklyn.
CATHERINE: You had your life. You got to finish school.
CLAIRE: You could have stayed in school!

CATHERINE: How?
CLAIRE: I would have done anything—I told you that. I told you a million times to do anything you wanted.

CATHERINE: What about Dad? Someone had to take care of him.
CLAIRE: He was ill. He should have been in a full-time professional-care situation.

CATHERINE: He didn’t belong in the nuthouse.
CLAIRE: He might have been better off.

CATHERINE: How can you say that?

CLAIRE: This is where I’m meant to feel guilty, right?

CATHERINE: Sure, go for it.

CLAIRE: I’m heartless. My own father.

CATHERINE: He needed to be here. In his own house, near the university, near his students, near everything that made him happy.

CLAIRE: Maybe. Or maybe some real professional care would have done him more good than rattling around in a filthy house with you looking after him.

I’m sorry, Catherine, it’s not your fault. It’s my fault for letting you do it.

CATHERINE: I was right to keep him here.

CLAIRE: No.

CATHERINE: What about his remission? Four years ago. He was healthy for almost a year.

CLAIRE: And then he went right downhill again.

CATHERINE: He might have been worse in a hospital.

CLAIRE: And he might have been better. Did he ever do any work again?

CATHERINE: No.

CLAIRE: No. (Beat.) And you might have been better.

CATHERINE: (Keeping her voice under control) Better than what?

CLAIRE: Living here with him didn’t do you any good. You said that yourself.

You had so much talent . . .

CATHERINE: You think I’m like Dad.

CLAIRE: I think you have some of his talent and some of his tendency toward . . . instability.

(Beat.)

CATHERINE: Claire, in addition to the “cute apartments” that you’ve “scouted” for me in New York, would you by any chance also have devoted some of your considerable energies toward scouting out another type of—

CLAIRE: No.

CATHERINE: — living facility for your bughouse little sister?

CLAIRE: No! Absolutely not. That is not what this is about.

CATHERINE: Don’t lie to me, Claire. I’m smarter than you.

(Beat.)

CLAIRE: The resources . . . I’ve investigated—
Catherine: Oh my God.
Claire: — if you wanted to, all I’m saying is, the doctors in New York and the people
are the best, and they—

Catherine: I hate you.
Claire: Don’t yell, please. Calm down.

Catherine: I hate you. I—
(Hal enters, holding a notebook. Claire and Catherine stop suddenly. Beat.)
Claire: What are you doing here? . . .
(Claire stares at Catherine.)

Hal: How long have you known about this?
Catherine: A while.
Hal: Why didn’t you tell me about it?
Catherine: I wasn’t sure I wanted to.
(Beat.)

Hal: Thank you.
Catherine: You’re welcome.
Claire: What’s going on?
Hal: God, Catherine, thank you.
Catherine: I thought you’d like to see it.

Claire: What is it?
Hal: It’s incredible.
Claire: What is it?
Hal: Oh, uh, it’s a result. A proof. I mean it looks like a proof. I mean it is a proof,
a very long proof, I haven’t read it all of course, or checked it, I don’t even know
if I could check it, but if it is a proof of what I think it’s a proof of, it’s . . . a very
. . . important . . . proof.

Claire: What does it prove?
Hal: It looks like it proves a theorem . . . a mathematical theorem about prime numbers,
something mathematicians have been trying to prove since . . . since there were
mathematicians, basically. Most people thought it couldn’t be done.

Claire: Where did you find it?
Hal: In your father’s desk. Cathy told me about it.
Catherine: You know what this is?
Catherine: Sure.

Claire: Is it good?
Catherine: Yes.

Claire: It’s historic. If it checks out.

Claire: What does it say?
Hal: I don’t know yet. I’ve just read the first few pages.

Claire: But what does it mean?
Hal: It means that during a time when everyone thought your dad was crazy . . . or
barely functioning . . . he was doing some of the most important mathematics in
the world. If it checks out, it means you publish instantly. It means newspapers all over the world are going to want to talk to the person who found this notebook.

125  **CLAIRE**: Cathy.
    **HAL**: Cathy.
    **CATHERINE**: I didn’t find it.
    **HAL**: Yes you did.
    **CATHERINE**: No.
130  **CLAIRE**: Well did you find it or did Hal find it?
    **HAL**: I didn’t find it.
    **CATHERINE**: I didn’t find it.
    I wrote it.

Curtain

---

**37** In the excerpt, what are the italics in Catherine’s lines used to express?
A. her sadness
B. her outrage
C. her curiosity
D. her eagerness

**38** In the excerpt, what is the effect of the relatively short lines?
A. They emphasize the sisters’ sorrow about their father.
B. They emphasize the heated pace of the sisters’ argument.
C. They show how tired the sisters are of fighting.
D. They show how interested the sisters are in the proof.
39. Read the lines from the excerpt in the box below.

CLAIRE: I think you have some of his talent and some of his tendency toward . . . instability. (lines 69 and 70)

CLAIRE: The resources . . . I’ve investigated— (line 80)

What do the ellipses in the lines show about Claire?
A. She is being evasive.
B. She has a lot of energy.
C. She has a generous nature.
D. She is jealous of her sister.

40. In line 87, what is the main effect of Hal’s entrance?
A. The focus of the scene shifts.
B. The sisters become reconciled.
C. The father’s illness is revealed.
D. The setting of the play changes.
# Grade 10 Language Arts
## Reading Comprehension
### Spring 2010 Released Items:
#### Reporting Categories, Standards, and Correct Answers*

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<td>117</td>
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<td>C</td>
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<td>B</td>
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</tr>
<tr>
<td>40</td>
<td>128</td>
<td>Reading and Literature</td>
<td>17</td>
<td>A</td>
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</table>

* 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 website later this year.
IX. Mathematics, Grade 3
Grade 3 Mathematics Test


- Number Sense and Operations (Framework, pages 22–23; Supplement, pages 3–4)
- Patterns, Relations, and Algebra (Framework, page 32; Supplement, page 4)
- Geometry (Framework, page 40; Supplement, pages 4–5)
- Measurement (Framework, page 48; Supplement, page 5)
- Data Analysis, Statistics, and Probability (Framework, page 56; Supplement, pages 5–6)

The Mathematics Curriculum Framework and Supplement are available on the Department website 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, Mathematics test results are reported under five MCAS reporting categories, which are identical to the five Mathematics Curriculum Framework content strands listed above.

Test Sessions

The MCAS grade 3 Mathematics test included two separate test sessions. Each session included multiple-choice, short-answer, and open-response questions. Approximately half of the common test items are shown on the following pages as they appeared in grade 3 test & answer booklets.

Reference Materials and Tools

Each student taking the grade 3 Mathematics test was provided with a plastic ruler and a grade 3 Mathematics Tool Kit. A copy of the tool kit pieces used by students to answer question 14 immediately follows the last question in this chapter. An image of the ruler is not reproduced in this publication.

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

Cross-Reference Information

The tables at the conclusion of this chapter indicate each released and unreleased common item’s reporting category and the framework learning standard it assesses. The correct answers for released multiple-choice and short-answer questions are also displayed in the released item table.
Mathematics
SESSION 1

You may use your tool kit and MCAS ruler during this session.
You may not use a calculator during this session.

DIRECTIONS
This session contains six multiple-choice questions and one open-response question. For multiple-choice questions, mark your answers by filling in the circle next to the best answer. For the open-response question, write your answer in the space provided below the question.

1. What is the missing number that makes the number sentence below true?

\[ ? + 19 + 7 = 33 \]

- A 6
- B 7
- C 58
- D 59

2. The chart below shows the numbers of visitors at four parks last year.

<table>
<thead>
<tr>
<th>Park</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>River Park</td>
<td>8346</td>
</tr>
<tr>
<td>Oak Park</td>
<td>9103</td>
</tr>
<tr>
<td>Lake Park</td>
<td>9088</td>
</tr>
<tr>
<td>Green Park</td>
<td>6299</td>
</tr>
</tbody>
</table>

Which park had the most visitors last year?

- A River Park
- B Oak Park
- C Lake Park
- D Green Park
3. Tammy has 5 boxes of markers. There are 8 markers in each box. Which of these shows two ways to find the total number of markers that Tammy has?

- A. $5 + 8 = \square$ and $8 + 5 = \square$
- B. $5 + 8 = \square$ and $8 - 5 = \square$
- C. $8 \times 5 = \square$ and $8 \div 5 = \square$
- D. $8 \times 5 = \square$ and $5 \times 8 = \square$

4. Ms. Duff wrote how many seconds it took each of 12 students to complete a set of math problems. The times are shown below.

<table>
<thead>
<tr>
<th>Times in Seconds</th>
</tr>
</thead>
<tbody>
<tr>
<td>39 38 58</td>
</tr>
<tr>
<td>48 37 47</td>
</tr>
<tr>
<td>59 49 58</td>
</tr>
<tr>
<td>43 50 46</td>
</tr>
</tbody>
</table>

Ms. Duff is writing tally marks for the times in the chart below.

<table>
<thead>
<tr>
<th>Times to Complete Math Problems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time in Seconds</td>
</tr>
<tr>
<td>-----------------</td>
</tr>
<tr>
<td>30–39</td>
</tr>
<tr>
<td>40–49</td>
</tr>
<tr>
<td>50–59</td>
</tr>
</tbody>
</table>

How many tally marks should Ms. Duff write in the row for 50–59 seconds?

- A. \|
- B. \|\|
- C. \|\|
- D. \|\|\|
There is $\frac{3}{4}$ cup of milk in the measuring cup shown below.

Rachel poured $\frac{2}{4}$ cup of milk out of the measuring cup.

How much milk is left?

- A. $\frac{1}{4}$ cup
- B. $\frac{2}{4}$ cup
- C. $\frac{3}{4}$ cup
- D. $\frac{4}{4}$ cup
The table below shows the numbers of students with blue, brown, or green eyes in Ms. Norton's class.

<table>
<thead>
<tr>
<th>Eye Color</th>
<th>Number of Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>blue</td>
<td>3</td>
</tr>
<tr>
<td>brown</td>
<td>15</td>
</tr>
<tr>
<td>green</td>
<td>6</td>
</tr>
</tbody>
</table>

Which pictograph correctly shows the numbers of students with blue, brown, or green eyes?
Jamie is measuring her pet mouse.

a. Should Jamie measure her mouse’s length in inches, yards, or pounds? Explain how you know your answer is correct.

b. Should Jamie measure her mouse’s weight in feet, ounces, or tons? Explain how you know your answer is correct.
8. Alex wrote the number pattern shown below.

   4, 7, 10, 13, 16

Which of these could be the rule for Alex’s pattern?

- multiply by 2
- subtract 3
- add 3
- multiply by 3

9. Points A, B, C, and D are shown on the grid below.

Which point is at (4, 3)?

- point A
- point B
- point C
- point D
10 Hector is reading a book that has 336 pages. He has read 154 pages so far.

How many pages does Hector have left to read?

A 172
B 182
C 222
D 282

11 The kinds and sizes of juice boxes Doug can choose are shown below.

**Juice Boxes**

<table>
<thead>
<tr>
<th>Kind</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>apple</td>
<td>small</td>
</tr>
<tr>
<td>grape</td>
<td>medium</td>
</tr>
<tr>
<td>orange</td>
<td>large</td>
</tr>
</tbody>
</table>

How many different ways can Doug choose 1 kind and 1 size of juice box?

A 3
B 6
C 9
D 12
Question 12 is a short-answer question. Write your answer to this question in the Answer Box provided.

12 Jessie has 13 acorns. Tina has 8 acorns.
In the Answer Box below, write a number sentence that can be used to find how many more acorns Jessie has than Tina has.

This is a number sentence:

$$1 + 2 = 3$$

This is not a number sentence:

$$\frac{1}{3} + 2$$

Answer Box
Question 13 is a short-answer question. Write your answer to this question in the Answer Box provided.

13 Point K is shown on the number line below.

In the Answer Box below, write the fraction that best names point K.
Write your answers to parts (a) and (b) of open-response question 14 in the spaces provided.

You may use the number cards labeled 2, 7, and 3 from your tool kit to help you answer question 14.

14 Charlie used cards to make the number shown below.

```
2  7  3
```

a. Round 273 to the nearest hundred.

Charlie used the same cards to make a new number.

- The new number is different from 273.
- The new number rounds to the same hundred as 273.

b. What is the new number Charlie made?
Question 15 is a short-answer question. Write your answer to this question in the Answer Box provided.

15 In the Answer Box below, draw an angle that is less than a right angle.
Mark your choices for multiple-choice questions 16 through 18 by filling in the circle next to the best answer.

16. Which symbol belongs in the ? below to make a true number sentence?

\[ 4 \times 8 \ ? \ 45 - 15 \]

- A >
- B =
- C <
- D -

17. The line plot below shows the ages of the dogs in an animal shelter.

How many dogs are more than 5 years old?

- A 4
- B 5
- C 6
- D 7

18. Miguel drew a shaded rectangle on a grid, as shown below.

What is the area of the shaded rectangle?

- A 11 square units
- B 22 square units
- C 26 square units
- D 30 square units
During testing, students were provided additional tool kit pieces to answer test items that are not released.
### Grade 3 Mathematics

#### Spring 2010 Released Items:
**Reporting Categories, Standards, and Correct Answers**

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<th>Standard</th>
<th>Correct Answer (MC/SA)*</th>
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<td>13 – 8 = □ or 13 – 8 = 5</td>
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*Answers are provided here for multiple-choice items and short-answer items only. Sample responses and scoring guidelines for open-response items, which are indicated by shaded cells, will be posted to the Department's website later this year.
## Grade 3 Mathematics
Spring 2010 Unreleased Common Items:
Reporting Categories and Standards

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</tr>
<tr>
<td>36</td>
<td>Patterns, Relations, and Algebra</td>
<td>3.P.1</td>
</tr>
</tbody>
</table>
X. Mathematics, Grade 4
Grade 4 Mathematics Test


- Number Sense and Operations (Framework, pages 22–23)
- Patterns, Relations, and Algebra (Framework, page 32)
- Geometry (Framework, page 40)
- Measurement (Framework, page 48)
- Data Analysis, Statistics, and Probability (Framework, page 56)

The Mathematics Curriculum Framework is available on the Department website 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, Mathematics test results are reported under five MCAS reporting categories, which are identical to the five Mathematics Curriculum Framework content strands listed above.

Test Sessions

The MCAS grade 4 Mathematics test included two separate test sessions. Each session included multiple-choice, short-answer, and open-response questions. Approximately half of the common test items are shown on the following pages as they appeared in test booklets.

Reference Materials and Tools

Each student taking the grade 4 Mathematics test was provided with a plastic ruler and a grade 4 Mathematics Tool Kit. A copy of the tool kit pieces used by students to answer question 9 immediately follows the last question in this chapter. An image of the ruler is not reproduced in this publication.

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

Cross-Reference Information

The tables at the conclusion of this chapter indicate each released and unreleased common item’s reporting category and the framework learning standard it assesses. The correct answers for released multiple-choice and short-answer questions are also displayed in the released item table.
The table below shows the populations of three cities.

**Populations of Three Cities**

<table>
<thead>
<tr>
<th>City</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jackson</td>
<td>63,203</td>
</tr>
<tr>
<td>Middleville</td>
<td>?</td>
</tr>
<tr>
<td>Carson</td>
<td>89,468</td>
</tr>
</tbody>
</table>

The population of Middleville is greater than the population of Jackson and is less than the population of Carson.

Which of the following could be the population of Middleville?

A. 62,785
B. 89,524
C. 60,300
D. 84,680

- There are 6 stickers on each page of Miguel's sticker book.

Which expression represents the number of stickers on □ pages of Miguel's sticker book?

A. $6 \times □$
B. $6 + □$
C. $6 \div □$
D. $6 \div □$
Fredric wants to measure how much water the pitcher shown below can hold.

Which of the following units of measurement should he use?

A. liter  
B. meter  
C. kilogram  
D. centimeter

Each rectangle below is divided into 8 equal parts. Altogether the shaded parts of the rectangles represent $1\frac{1}{8}$.

Which of the following is another way to write $1\frac{1}{8}$?

A. $\frac{8}{8}$  
B. $\frac{9}{8}$  
C. $\frac{10}{8}$  
D. $\frac{11}{8}$
5. Todd is exactly 6 years older than Rita. If $t$ represents Todd’s age and $r$ represents Rita’s age, which of the following is always a true statement?

A. $t < 6$
B. $r < 6$
C. $t > r$
D. $r > t$

6. Angelina made the input-output table below.

<table>
<thead>
<tr>
<th>Input</th>
<th>6</th>
<th>18</th>
<th>24</th>
<th>30</th>
<th>36</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output</td>
<td>2</td>
<td>6</td>
<td>?</td>
<td>10</td>
<td>12</td>
</tr>
</tbody>
</table>

What is the output when the input is 24?

A. 3
B. 7
C. 8
D. 9
Questions 7 and 8 are short-answer questions. Write your answers to these questions in the boxes provided in your Student Answer Booklet. Do not write your answers in this test booklet. You may do your figuring in the test booklet.

Use your MCAS ruler to answer question 7.

7 What is the perimeter, to the nearest centimeter, of the triangle below?

What is 98,257 rounded to the nearest 1,000?
Question 9 is an open-response question.

• **BE SURE TO ANSWER AND LABEL ALL PARTS OF THE 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 9 in the space provided in your Student Answer Booklet.**

Use the pieces labeled 1, 2, 3, 4, and 5 from your tool kit to answer question 9.

9. For all parts of this question, the tool kit pieces should be lying flat on your desk with the labeled sides facing up.

   a. Put pieces 1 and 3 together so that a side labeled \( x \) matches up to a side labeled \( o \). The pieces should touch but not overlap. What polygon did you make? Explain how you know.

   b. Put pieces 2 and 4 together so that they make the same polygon you made in part (a). In your Student Answer Booklet, trace or draw each piece to show how the pieces go together to make the polygon. Label each piece in your drawing with the correct number.

   c. Explain how you know the polygon you made in part (a) is congruent to the polygon you made in part (b).

   d. Which **two** pieces can be put together without overlapping to make a rectangle? In your Student Answer Booklet, trace or draw each piece to show how the pieces go together to make a rectangle. Label each piece in your drawing with the correct number.
Mathematics  

Mark your answers to multiple-choice questions 10 through 12 in the spaces provided in your Student Answer Booklet. Do not write your answers in this test booklet. You may do your figuring in the test booklet.

10 The chart below shows the numbers of markers in the desks of some students.

<table>
<thead>
<tr>
<th>Student</th>
<th>Number of Markers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sanjay</td>
<td>12</td>
</tr>
<tr>
<td>Hana</td>
<td>19</td>
</tr>
<tr>
<td>Lynn</td>
<td>13</td>
</tr>
<tr>
<td>Tommy</td>
<td>9</td>
</tr>
</tbody>
</table>

Which two students have a number of markers that could be shared equally among three students?

A. Lynn and Hana  
B. Lynn and Tommy  
C. Sanjay and Lynn  
D. Sanjay and Tommy

11 Janica uses 1 ink cartridge to print 75 pictures.

How many ink cartridges will Janica use to print 750 pictures?

A. 7  
B. 10  
C. 75  
D. 100

12 Hoshi is 139 centimeters tall. Her father is 171 centimeters tall.

Which of the following has a value that is closest to the difference between Hoshi’s height and her father’s height?

A. 170 – 130  
B. 170 – 140  
C. 180 – 130  
D. 180 – 140
The line plot below shows the numbers of books Marla’s classmates read over the summer.

Marla read 8 books.

Based on the line plot, how many of her classmates read fewer books than Marla read?

A. 6  
B. 7  
C. 8  
D. 9
Mr. Garcia had 40 marbles. He divided the marbles equally among 8 students by putting the marbles in bags.

Which model shows how the 40 marbles were divided?
15. Which of the following shows sixty-two thousand, nine hundred thirteen written in standard form?

A. 62,000,913  
B. 6,200,913  
C. 620,913  
D. 62,913

16. Leon’s number machine follows the same rule each time he puts in a number. When Leon put in the number 1, the number 2 came out, as shown below.

Leon puts the number 10 into his machine.
What number will come out?

A. 20  
B. 15  
C. 5  
D. 2
What is the value of □ that makes the number sentence below true?

□ ÷ 6 = 6
Four children each have a bag of grapes. The table below shows the number of grapes in each child’s bag.

<table>
<thead>
<tr>
<th>Child</th>
<th>Number of Grapes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greta</td>
<td>30</td>
</tr>
<tr>
<td>Karen</td>
<td>27</td>
</tr>
<tr>
<td>Nate</td>
<td>24</td>
</tr>
<tr>
<td>Dave</td>
<td>33</td>
</tr>
</tbody>
</table>

a. Use the information in the table to make a bar graph.
   - Be sure to label your graph and include a title.
   - Your scale must be greater than 1.

b. Use the data from your graph to write a question that compares the numbers of grapes in the children’s bags.

c. Answer the question you wrote in part (b).
Mark your answers to multiple-choice questions 19 through 21 in the spaces provided in your Student Answer Booklet. Do not write your answers in this test booklet. You may do your figuring in the test booklet.

19 At a local fair in Massachusetts, Jan had $10.00 to spend. She spent $4.75 on video games, $1.25 on a large popcorn, and $0.75 on a small lemonade. How much money did Jan have left?
   A. $3.25  
   B. $4.75  
   C. $6.75  
   D. $16.75

20 There are 29 students in a class. No more than 6 students can sit at a lunch table. What is the least number of tables needed to seat the 29 students?
   A. 4  
   B. 5  
   C. 6  
   D. 7

21 Fatima is making a poster. The list below shows the numbers of different pencils, markers, and crayons she can use.
   • 2 pencils
   • 4 markers
   • 4 crayons

   How many different combinations of 1 pencil, 1 marker, and 1 crayon can Fatima use to make her poster?
   A. 8  
   B. 10  
   C. 24  
   D. 32
During testing, students were provided additional tool kit pieces to answer test items that are not released.
<table>
<thead>
<tr>
<th>Item No.</th>
<th>Page No.</th>
<th>Reporting Category</th>
<th>Standard</th>
<th>Correct Answer (MC/SA)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>149</td>
<td>Number Sense and Operations</td>
<td>4.N.2</td>
<td>D</td>
</tr>
<tr>
<td>2</td>
<td>149</td>
<td>Patterns, Relations, and Algebra</td>
<td>4.P.2</td>
<td>A</td>
</tr>
<tr>
<td>3</td>
<td>150</td>
<td>Measurement</td>
<td>4.M.1</td>
<td>A</td>
</tr>
<tr>
<td>4</td>
<td>150</td>
<td>Number Sense and Operations</td>
<td>4.N.4</td>
<td>B</td>
</tr>
<tr>
<td>5</td>
<td>151</td>
<td>Patterns, Relations, and Algebra</td>
<td>4.P.2</td>
<td>C</td>
</tr>
<tr>
<td>6</td>
<td>151</td>
<td>Patterns, Relations, and Algebra</td>
<td>4.P.6</td>
<td>C</td>
</tr>
<tr>
<td>7</td>
<td>152</td>
<td>Measurement</td>
<td>4.M.4 15</td>
<td>centimeters</td>
</tr>
<tr>
<td>8</td>
<td>152</td>
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<td>4.N.16</td>
<td>98,000</td>
</tr>
<tr>
<td>9</td>
<td>153</td>
<td>Geometry</td>
<td>4.G.9</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>154</td>
<td>Number Sense and Operations</td>
<td>4.N.7</td>
<td>D</td>
</tr>
<tr>
<td>11</td>
<td>154</td>
<td>Patterns, Relations, and Algebra</td>
<td>4.P.5</td>
<td>B</td>
</tr>
<tr>
<td>12</td>
<td>154</td>
<td>Number Sense and Operations</td>
<td>4.N.17</td>
<td>B</td>
</tr>
<tr>
<td>13</td>
<td>155</td>
<td>Data Analysis, Statistics, and Probability</td>
<td>4.D.3</td>
<td>D</td>
</tr>
<tr>
<td>14</td>
<td>156</td>
<td>Number Sense and Operations</td>
<td>4.N.8</td>
<td>C</td>
</tr>
<tr>
<td>15</td>
<td>157</td>
<td>Number Sense and Operations</td>
<td>4.N.2</td>
<td>D</td>
</tr>
<tr>
<td>16</td>
<td>157</td>
<td>Patterns, Relations, and Algebra</td>
<td>4.P.4</td>
<td>C</td>
</tr>
<tr>
<td>17</td>
<td>158</td>
<td>Patterns, Relations, and Algebra</td>
<td>4.P.3</td>
<td>36</td>
</tr>
<tr>
<td>18</td>
<td>159</td>
<td>Data Analysis, Statistics, and Probability</td>
<td>4.D.3</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>160</td>
<td>Number Sense and Operations</td>
<td>4.N.10</td>
<td>A</td>
</tr>
<tr>
<td>20</td>
<td>160</td>
<td>Number Sense and Operations</td>
<td>4.N.13</td>
<td>B</td>
</tr>
<tr>
<td>21</td>
<td>160</td>
<td>Data Analysis, Statistics, and Probability</td>
<td>4.D.5</td>
<td>D</td>
</tr>
</tbody>
</table>

*Answers are provided here for multiple-choice items and short-answer items only. Sample responses and scoring guidelines for open-response items, which are indicated by shaded cells, will be posted to the Department’s website later this year.
<table>
<thead>
<tr>
<th>Item No.</th>
<th>Reporting Category</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>22</td>
<td>Data Analysis, Statistics, and Probability</td>
<td>4.D.2</td>
</tr>
<tr>
<td>23</td>
<td>Geometry</td>
<td>4.G.5</td>
</tr>
<tr>
<td>24</td>
<td>Patterns, Relations, and Algebra</td>
<td>4.P.3</td>
</tr>
<tr>
<td>25</td>
<td>Number Sense and Operations</td>
<td>4.N.18</td>
</tr>
<tr>
<td>26</td>
<td>Data Analysis, Statistics, and Probability</td>
<td>4.D.6</td>
</tr>
<tr>
<td>27</td>
<td>Number Sense and Operations</td>
<td>4.N.9</td>
</tr>
<tr>
<td>28</td>
<td>Number Sense and Operations</td>
<td>4.N.6</td>
</tr>
<tr>
<td>29</td>
<td>Patterns, Relations, and Algebra</td>
<td>4.P.1</td>
</tr>
<tr>
<td>30</td>
<td>Number Sense and Operations</td>
<td>4.N.10</td>
</tr>
<tr>
<td>31</td>
<td>Geometry</td>
<td>4.G.8</td>
</tr>
<tr>
<td>32</td>
<td>Number Sense and Operations</td>
<td>4.N.5</td>
</tr>
<tr>
<td>33</td>
<td>Data Analysis, Statistics, and Probability</td>
<td>4.D.1</td>
</tr>
<tr>
<td>34</td>
<td>Number Sense and Operations</td>
<td>4.N.11</td>
</tr>
<tr>
<td>35</td>
<td>Patterns, Relations, and Algebra</td>
<td>4.P.1</td>
</tr>
<tr>
<td>36</td>
<td>Data Analysis, Statistics, and Probability</td>
<td>4.D.3</td>
</tr>
<tr>
<td>37</td>
<td>Data Analysis, Statistics, and Probability</td>
<td>4.D.4</td>
</tr>
<tr>
<td>38</td>
<td>Number Sense and Operations</td>
<td>4.N.3</td>
</tr>
<tr>
<td>39</td>
<td>Geometry</td>
<td>4.G.6</td>
</tr>
<tr>
<td>40</td>
<td>Patterns, Relations, and Algebra</td>
<td>4.P.3</td>
</tr>
<tr>
<td>41</td>
<td>Patterns, Relations, and Algebra</td>
<td>4.P.4</td>
</tr>
<tr>
<td>42</td>
<td>Measurement</td>
<td>4.M.3</td>
</tr>
</tbody>
</table>
XI. Mathematics, Grade 5
Grade 5 Mathematics Test


- Number Sense and Operations (Framework, pages 25–26; Supplement, pages 7–8)
- Patterns, Relations, and Algebra (Framework, page 34; Supplement, page 8)
- Geometry (Framework, page 42; Supplement, page 9)
- Measurement (Framework, page 50; Supplement, pages 9–10)
- Data Analysis, Statistics, and Probability (Framework, page 58; Supplement, page 10)

The Mathematics Curriculum Framework and Supplement are available on the Department website 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, Mathematics test results are reported under five MCAS reporting categories, which are identical to the five Mathematics Curriculum Framework content strands listed above.

Test Sessions

The MCAS grade 5 Mathematics test included two separate test sessions. Each session included multiple-choice, short-answer, and open-response questions. Approximately half of the common test items are shown on the following pages as they appeared in test booklets.

Reference Materials and Tools

Each student taking the grade 5 Mathematics test was provided with a plastic ruler and a grade 5 Mathematics Reference Sheet. A copy of the reference sheet follows the final question in this chapter. An image of the ruler is not reproduced in this publication.

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

Cross-Reference Information

The tables at the conclusion of this chapter indicate each released and unreleased common item’s reporting category and the framework learning standard it assesses. The correct answers for released multiple-choice and short-answer questions are also displayed in the released item table.
DIRECTIONS
This session contains eight multiple-choice questions, two short-answer questions, and one open-response question. Mark your answers to these questions in the spaces provided in your Student Answer Booklet.

1. Elsa drew the quadrilateral shown below.

Which angle appears to be acute?
A. angle E
B. angle F
C. angle G
D. angle H

2. Which of the following is a common factor of 24 and 32?
A. 3
B. 4
C. 12
D. 16
3. Jack counted the numbers of cardinals and sparrows he saw in his yard during one week. His results are displayed in the bar graph below.

Birds in Jack’s Yard

<table>
<thead>
<tr>
<th>Number of Birds</th>
<th>Cardinal</th>
<th>Sparrow</th>
</tr>
</thead>
<tbody>
<tr>
<td>18</td>
<td>14</td>
<td>4</td>
</tr>
</tbody>
</table>

What fraction of the birds were sparrows?

A. $\frac{10}{24}$
B. $\frac{10}{14}$
C. $\frac{14}{24}$
D. $\frac{14}{10}$

4. Daryl drank 4 bottles of water one day. Each bottle held 500 milliliters of water. What was the total number of liters of water Daryl drank during that day?

A. 1 liter
B. 2 liters
C. 125 liters
D. 2000 liters
Laila measured her pulse, in beats per minute, 7 times during one day. Her results are listed below.

52, 68, 75, 98, 64, 75, 72

What is the range, in beats per minute, of Laila’s pulse measurements?

Marcus wants to make pudding. The table on the back of the pudding box is shown below.

<table>
<thead>
<tr>
<th>Servings</th>
<th>Pudding Mix</th>
<th>Milk</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>1/4 cup</td>
<td>1 cup</td>
</tr>
<tr>
<td>4</td>
<td>1/2 cup</td>
<td>2 cups</td>
</tr>
<tr>
<td>6</td>
<td>3/4 cup</td>
<td>3 cups</td>
</tr>
</tbody>
</table>

Marcus wants to make 16 servings of pudding.
Based on the table, what is the total number of cups of pudding mix that he should use?
Mark your answers to multiple-choice questions 7 through 10 in the spaces provided in your Student Answer Booklet. Do not write your answers in this test booklet. You may do your figuring in the test booklet.

7 Which of the following graphs shows temperature decreasing over time?
8. Mario shaded $\frac{1}{5}$ of the shapes in a group. Which of the following could be Mario's group?

A. [shapes A]
B. [shapes B]
C. [shapes C]
D. [shapes D]

9. Geri has a set of 9 cards numbered 1 through 9. The backs of the cards are blank. She puts the cards face-down so only the backs can be seen. Geri asks Simon to pick 1 card. Which of the following describes the probability that Simon will pick a card with an odd number?

A. He is more likely to pick a card with an odd number than with an even number.
B. He is equally likely to pick a card with an odd number or an even number.
C. He is unlikely to pick a card with an odd number.
D. He is certain to pick a card with an odd number.

10. The expression below can be used to calculate the total cost of □ adult tickets and △ child tickets to a movie.

$$ (\square \times 9.00) + (\triangle \times 7.50) $$

What is the total cost, in dollars, of 12 adult tickets and 10 child tickets?

A. $16.50
B. $38.50
C. $173.00
D. $183.00
Felipe is studying three-dimensional shapes. His teacher gives him the four shapes shown below to sort into groups.

- Cube
- Square pyramid
- Triangular prism
- Triangular pyramid

a. Group A contains shapes that have exactly 5 faces. Which shapes should Felipe sort into group A? Show or explain how you got your answer.

b. Group B contains shapes that have fewer than 10 edges. Which shapes should Felipe sort into group B? Show or explain how you got your answer.

c. Felipe's teacher gives him another pyramid. It has a base with 6 edges. What is the total number of edges of this pyramid? Show or explain how you got your answer.
Ms. Lindquist bought a rug with the dimensions shown below.

What is the area of the rug?

A. 19 square feet
B. 38 square feet
C. 42 square feet
D. 84 square feet

Which of the following is equivalent to the expression below?

\[35,720 + 0\]

A. \(35,720 + 490 \times 490\)
B. \(35,720 + 490 \div 490\)
C. \(35,720 + 490 + 490\)
D. \(35,720 + 490 - 490\)
Ron recorded the number of laps he ran each day for 5 days, as shown below.

2, 7, 8, 8, 5

What is the mean (average) number of laps that Ron ran each day for the 5 days?

A. 5  
B. 6  
C. 7  
D. 8

Which of the following has the same value as the expression below?

\[ 8 \times (7 - 2) \]

A. \( 8 \times 5 \)  
B. \( 8 \times 9 \)  
C. \( 56 - 2 \)  
D. \( 56 - 40 \)
Question 16 is a short-answer question. Write your answer to this question in the box provided in your Student Answer Booklet. Do not write your answer in this test booklet. You may do your figuring in the test booklet.

16 Jordan has a machine part that is thirty-two thousandths of an inch thick. What is thirty-two thousandths written as a decimal?
A coach is collecting a fee from each player on her soccer team. She collects the same amount of money from each player. The amount of money she collected over four days from some of the players is shown in the table below.

<table>
<thead>
<tr>
<th>Day</th>
<th>Number of Players</th>
<th>Amount Collected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday</td>
<td>4</td>
<td>$88</td>
</tr>
<tr>
<td>Tuesday</td>
<td>7</td>
<td>$154</td>
</tr>
<tr>
<td>Wednesday</td>
<td>6</td>
<td>$132</td>
</tr>
<tr>
<td>Thursday</td>
<td>3</td>
<td>$66</td>
</tr>
<tr>
<td>Friday</td>
<td>2</td>
<td>?</td>
</tr>
</tbody>
</table>

a. On Friday, the coach will collect fees from 2 more players. What is the total amount of money the coach will collect from the 2 players? Show or explain how you got your answer.

b. Use words or symbols to write or describe a rule that can be used to calculate the amount of money the coach will collect from p players.

c. After every player on her team has paid the fee, the coach will have collected a total of $550. What is the total number of players on the soccer team? Show or explain how you got your answer.
Melissa worked on a subtraction problem. When she rounded each number to the nearest whole number, the difference of the two numbers was 8.

Which of the following could be Melissa’s subtraction problem?

A. $24.89 - 16.16$
B. $24.89 - 16.38$
C. $24.89 - 17.16$
D. $24.89 - 17.68$

Which of the following is equivalent to the expression below?

$$5\frac{1}{4} - 2\frac{1}{2}$$

A. $2\frac{1}{2}$
B. $2\frac{3}{4}$
C. $3\frac{1}{4}$
D. $3\frac{1}{2}$

The table below shows the distances four balls rolled off a ramp.

<table>
<thead>
<tr>
<th>Ball</th>
<th>Distance (in meters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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<td>3</td>
<td>10.15</td>
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<td>4</td>
<td>10.23</td>
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</tbody>
</table>

Which of the following shows the distances in order from greatest to least?

A. 10.8, 10.23, 10.2, 10.15
B. 10.8, 10.2, 10.23, 10.15
C. 10.15, 10.2, 10.23, 10.8
D. 10.23, 10.15, 10.8, 10.2

The total weight of a shipment of 15 boxes was 2250 pounds. Each box had the same weight. How much did 1 box weigh?

A. 150 pounds
B. 160 pounds
C. 170 pounds
D. 180 pounds
PERIMETER (P) FORMULAS

perimeter = distance around

square............ P = 4 × s
(s = length of a side)

rectangle......... P = (2 × l) + (2 × w)
(l = length; w = width)

triangle......... P = a + b + c
(a, b, and c are the lengths of the sides)

AREA (A) FORMULAS

square............ A = s × s
(s = length of a side)

rectangle......... A = l × w
(l = length; w = width)

triangle......... A = \( \frac{1}{2} \times b \times h \)
(b = length of the base; h = height)

VOLUME (V) FORMULAS

rectangular prism . . . . . . V = l × w × h
(l = length; w = width; h = height)

cube . . . . . . . . . . . . . V = s × s × s
(s = length of an edge)
<table>
<thead>
<tr>
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<th>Reporting Category</th>
<th>Standard</th>
<th>Correct Answer (MC/SA)*</th>
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*Answers are provided here for multiple-choice items and short-answer items only. Sample responses and scoring guidelines for open-response items, which are indicated by shaded cells, will be posted to the Department’s website later this year.
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XII. Mathematics, Grade 6
Grade 6 Mathematics Test


- Number Sense and Operations (Framework, pages 25–26)
- Patterns, Relations, and Algebra (Framework, page 34)
- Geometry (Framework, page 42)
- Measurement (Framework, page 50)
- Data Analysis, Statistics, and Probability (Framework, page 58)

The Mathematics Curriculum Framework is available on the Department website 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, Mathematics test results are reported under five MCAS reporting categories, which are identical to the five Mathematics Curriculum Framework content strands listed above.

Test Sessions

The MCAS grade 6 Mathematics test included two separate test sessions. Each session included multiple-choice, short-answer, and open-response questions. Approximately half of the common test items are shown on the following pages as they appeared in test booklets.

Reference Materials and Tools

Each student taking the grade 6 Mathematics test was provided with a plastic ruler and a grade 6 Mathematics Reference Sheet. A copy of the reference sheet follows the final question in this chapter. An image of the ruler is not reproduced in this publication.

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

Cross-Reference Information

The tables at the conclusion of this chapter indicate each released and unreleased common item’s reporting category and the framework learning standard it assesses. The correct answers for released multiple-choice and short-answer questions are also displayed in the released item table.
Mathematics

SESSION 1

You may use your reference sheet and MCAS ruler during this session.
You may not use a calculator during this session.

DIRECTIONS
This session contains nine multiple-choice questions, one short-answer question, and one open-response question. Mark your answers to these questions in the spaces provided in your Student Answer Booklet.

1. What is the value of the 5 in the number below?

   6,523,091,487

   A. five billion  
   B. five million  
   C. five hundred million  
   D. five hundred thousand

2. Sergio paid for the items listed below with a $20 bill.

   - one jar of peanut butter that cost $2.39
   - one loaf of bread that cost $2.75

   What was the total amount of money Sergio got back after he paid for the items?

   A. $14.14  
   B. $14.86  
   C. $15.14  
   D. $15.86
Kate wrote the number pattern shown below.

5, 20, 80, 320, \ldots

Which of the following could be the rule for finding the next number in Kate's number pattern?
A. add 5 to the previous number
B. add 15 to the previous number
C. multiply the previous number by 4
D. multiply the previous number by 5

Which of the following tables shows a constant rate of change in the total amount of money saved during the four weeks shown?

A. **Amount of Money Saved**

<table>
<thead>
<tr>
<th>Week</th>
<th>Total Amount Saved</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$20</td>
</tr>
<tr>
<td>2</td>
<td>$40</td>
</tr>
<tr>
<td>3</td>
<td>$50</td>
</tr>
<tr>
<td>4</td>
<td>$55</td>
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</tbody>
</table>

B. **Amount of Money Saved**

<table>
<thead>
<tr>
<th>Week</th>
<th>Total Amount Saved</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$20</td>
</tr>
<tr>
<td>2</td>
<td>$30</td>
</tr>
<tr>
<td>3</td>
<td>$40</td>
</tr>
<tr>
<td>4</td>
<td>$60</td>
</tr>
</tbody>
</table>

C. **Amount of Money Saved**

<table>
<thead>
<tr>
<th>Week</th>
<th>Total Amount Saved</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$20</td>
</tr>
<tr>
<td>2</td>
<td>$40</td>
</tr>
<tr>
<td>3</td>
<td>$60</td>
</tr>
<tr>
<td>4</td>
<td>$80</td>
</tr>
</tbody>
</table>

D. **Amount of Money Saved**

<table>
<thead>
<tr>
<th>Week</th>
<th>Total Amount Saved</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$20</td>
</tr>
<tr>
<td>2</td>
<td>$50</td>
</tr>
<tr>
<td>3</td>
<td>$70</td>
</tr>
<tr>
<td>4</td>
<td>$90</td>
</tr>
</tbody>
</table>
Question 5 is a short-answer question. Write your answer to this question in the box provided in your Student Answer Booklet. Do not write your answer in this test booklet. You may do your figuring in the test booklet.

5 Book covers cost $0.15 each, including tax. Ms. Larkin bought 25 of them. What is the total amount of money that she spent on the book covers?
Mark your answers to multiple-choice questions 6 through 10 in the spaces provided in your Student Answer Booklet. Do not write your answers in this test booklet. You may do your figuring in the test booklet.

6. What is the value of the expression below?
   \((-4) + 6\)
   
   A. \(-10\)
   B. \(-2\)
   C. 2
   D. 10

7. Lazlo rents bicycles by the hour. The amount of money he charges for renting a bicycle is shown in the table below.

   **Bicycle Rental Charges**
   
<table>
<thead>
<tr>
<th>Rental Time (in hours)</th>
<th>Amount Charged</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$15</td>
</tr>
<tr>
<td>2</td>
<td>$25</td>
</tr>
<tr>
<td>3</td>
<td>$35</td>
</tr>
<tr>
<td>4</td>
<td>$45</td>
</tr>
</tbody>
</table>

   Based on the table, which of the following statements best describes the amount of money Lazlo charges for renting a bicycle?
   
   A. He charges $10 for each hour of rental time.
   B. He charges $15 for each hour of rental time.
   C. He charges $15 for the first hour plus $5 for each additional hour of rental time.
   D. He charges $15 for the first hour plus $10 for each additional hour of rental time.
One serving of Lara’s favorite yogurt contains 150 calories. Which of the following graphs shows the relationship between the number of calories and the number of servings of Lara’s favorite yogurt?

A.

Calories in Yogurt

B.

Calories in Yogurt

C.

Calories in Yogurt

D.

Calories in Yogurt
9. The scale shown below is balanced.

Which of the following will balance one block?

A. [Diagram: one block]
B. [Diagram: two blocks]
C. [Diagram: three blocks]
D. [Diagram: four blocks]

10. Points A, B, C, and D are shown on the number line below.

Which point best represents the location of $-5.75$?

A. point A
B. point B
C. point C
D. point D
Question 11 is an open-response question.

- BE SURE TO ANSWER AND LABEL ALL PARTS OF THE 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 11 in the space provided in your Student Answer Booklet.

A triangular prism and a rectangular prism are shown below.

11

A. How many edges does a triangular prism have?

B. How many more **faces** does a rectangular prism have than a triangular prism has? Show or explain how you got your answer.

C. How many faces does a hexagonal prism have? Show or explain how you got your answer.
What is the value of the expression below?

\[ 18 - 12 \div 2 + 1 \]

A. 2  
B. 4  
C. 11  
D. 13

Point P is shown on the number line below.

Which of the following fractions is best represented by point P?

A. \( \frac{1}{2} \)  
B. \( \frac{1}{4} \)  
C. \( \frac{3}{4} \)  
D. \( \frac{3}{8} \)

Ms. Beltran wrote the equation below on a chalkboard.

\[ \square \div 11 = 23 \]

If the equation Ms. Beltran wrote is true, which of the following equations must also be true?

A. \( \square = 23 \div 11 \)  
B. \( \square = 23 \times 11 \)  
C. \( \square = 11 \div 23 \)  
D. \( \square = 11 + 23 \)

Which of the following numbers has the greatest value?

A. 58.125  
B. 5.8125  
C. 58.15  
D. 5.815
Questions 16 and 17 are short-answer questions. Write your answers to these questions in the boxes provided in your Student Answer Booklet. Do not write your answers in this test booklet. You may do your figuring in the test booklet.

16. What is the value of the expression below when \( x = 3 \)?

\[ 7x - 4 \]

17. What is the area, in square feet, of the triangle shown below?

[Diagram of a triangle with a grid, labeled 1 ft. by 1 ft.]
Question 18 is an open-response question.

- BE SURE TO ANSWER AND LABEL ALL PARTS OF THE 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 Paul bowled 6 games today. His scores are listed in the table below.

<table>
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<th>Game</th>
<th>Score</th>
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<tr>
<td>2</td>
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<td>3</td>
<td>110</td>
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<td>167</td>
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<tr>
<td>5</td>
<td>146</td>
</tr>
<tr>
<td>6</td>
<td>165</td>
</tr>
</tbody>
</table>

a. What was Paul’s median score for the 6 games? Show or explain how you got your answer.

b. What was Paul’s mean score for the 6 games? Show or explain how you got your answer.

c. Paul will bowl one more game. What is the minimum score Paul must achieve in the next game so that his mean score for all 7 games is at least 150? Show or explain how you got your answer.
Mark your answers to multiple-choice questions 19 through 21 in the spaces provided in your Student Answer Booklet. Do not write your answers in this test booklet. You may do your figuring in the test booklet.

19. A sixth-grade class will clean a beach that is $3\frac{1}{2}$ miles long.
   - The class will divide into 4 groups.
   - Each group will clean an equal length of beach.

What is the length of beach each group will clean?

A. $\frac{1}{14}$ mile
B. $\frac{3}{8}$ mile
C. $\frac{7}{8}$ mile
D. $1\frac{1}{7}$ miles

20. A rectangular prism has a volume of 56 cubic feet. The rectangular prism has a length of 7 feet and a width of 4 feet. What is the height of the rectangular prism?

A. 2 feet
B. 11 feet
C. 22 feet
D. 28 feet
Anita and Jerry are reading the same book. The graphs below show the numbers of pages Anita and Jerry read each day for five days.

What is the relationship between the number of pages Anita read each day and the number of pages Jerry read each day?

A. Anita read half the number of pages Jerry read each day.
B. Anita read the same number of pages Jerry read each day.
C. Anita read two times the number of pages Jerry read each day.
D. Anita read three times the number of pages Jerry read each day.
PERIMETER FORMULAS

perimeter = distance around

square........... P = 4s

rectangle........ P = 2b + 2h
    OR
    P = 2l + 2w

triangle........ P = a + b + c

AREA FORMULAS

square........... A = s \times s

rectangle........ A = bh
    OR
    A = lw

parallelogram.... A = bh

triangle......... A = \frac{1}{2}bh

circle.......... A = \pi r^2

VOLUME FORMULAS

rectangular prism ..... V = lwh

cube ............... V = s \times s \times s
    (s = \text{length of an edge})

CIRCLE FORMULAS

C = 2\pi r
    OR
    C = \pi d

A = \pi r^2
Grade 6 Mathematics
Spring 2010 Released Items:
Reporting Categories, Standards, and Correct Answers*

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<th>Standard</th>
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<td>6.P.6</td>
<td>C</td>
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* Answers are provided here for multiple-choice items and short-answer items only. Sample responses and scoring guidelines for open-response items, which are indicated by shaded cells, will be posted to the Department's website later this year.
<table>
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<th>Item No.</th>
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XIII. Mathematics, Grade 7
Grade 7 Mathematics Test


- Number Sense and Operations (Framework, page 62; Supplement, page 11)
- Patterns, Relations, and Algebra (Framework, page 63; Supplement, page 12)
- Geometry (Framework, page 64; Supplement, pages 12–13)
- Measurement (Framework, page 65; Supplement, page 13)
- Data Analysis, Statistics, and Probability (Framework, page 66; Supplement, page 14)

The Mathematics Curriculum Framework and Supplement are available on the Department website 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, Mathematics test results are reported under five MCAS reporting categories, which are identical to the five Mathematics Curriculum Framework content strands listed above.

Test Sessions

The MCAS grade 7 Mathematics test included two separate test sessions. Each session included multiple-choice, short-answer, and open-response questions. Approximately half of the common test items are shown on the following pages as they appeared in test booklets.

Reference Materials and Tools

Each student taking the grade 7 Mathematics test was provided with a plastic ruler and a grade 7 Mathematics Reference Sheet. A copy of the reference sheet follows the final question in this chapter. An image of the ruler is not reproduced in this publication.

During session 2, each student had sole access to a calculator with at least four functions and a square root key. Calculator use was not allowed during session 1.

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

Cross-Reference Information

The tables at the conclusion of this chapter indicate each released and unreleased common item’s reporting category and the framework learning standard it assesses. The correct answers for released multiple-choice and short-answer questions are also displayed in the released item table.
The graph below shows a linear relationship between $x$ and $y$.

Which of the following statements describes the relationship between $x$ and $y$?

A. As $x$ increases by 1, $y$ increases by 2.

B. As $x$ increases by 1, $y$ decreases by 2.

C. As $x$ increases by 2, $y$ increases by 1.

D. As $x$ increases by 2, $y$ decreases by 1.

Which of the following fractions is greater than $\frac{3}{4}$ but less than $\frac{4}{5}$?

A. $\frac{37}{50}$

B. $\frac{19}{25}$

C. $\frac{17}{20}$

D. $\frac{7}{10}$

What is the value of the expression below?

$\left| -16 \right| - \left| 8 \right|$

A. $-24$

B. $-8$

C. $8$

D. $24$
4. The table below shows the one-day changes in the prices of four different companies’ stocks on Tuesday.

**Stock Price Changes on Tuesday**

<table>
<thead>
<tr>
<th>Company</th>
<th>Amount of Price Change (in $)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>-1.32</td>
</tr>
<tr>
<td>B</td>
<td>+0.76</td>
</tr>
<tr>
<td>C</td>
<td>-0.83</td>
</tr>
<tr>
<td>D</td>
<td>+1.25</td>
</tr>
</tbody>
</table>

Which company's stock price changed the most on Tuesday?

A. Company A  
B. Company B  
C. Company C  
D. Company D

5. Which of the following estimates is closest to the value of the expression below?

\[
161.18 \div 7.8
\]

A. 0.02  
B. 0.2  
C. 2  
D. 20

6. The table below represents a linear relationship.

<table>
<thead>
<tr>
<th>x</th>
<th>y</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-3</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>6</td>
<td>12</td>
</tr>
</tbody>
</table>

Based on the table, what is the value of x when y = 22?

A. 52  
B. 16  
C. 10  
D. 8
A rectangular prism and some of its dimensions are shown below.

The volume of the rectangular prism is 40 cubic inches. What is \( h \), the height, in inches, of the rectangular prism?
Question 8 is an open-response question.

- **BE SURE TO ANSWER AND LABEL ALL PARTS OF THE 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 8 in the space provided in your Student Answer Booklet.

8 Madison plans to sew one button and one ribbon on a clown costume. She has one each of the following colors of buttons in her pocket:

- black
- green
- red
- white

All the buttons are the same size and shape.

Madison will select one button from her pocket without looking.

a. What is the probability that she will select a red button? Show or explain how you got your answer.

Madison has one each of the following colors of ribbon in a bag:

- black
- white
- yellow

All the ribbons are the same size and material.

She will select one button from her pocket and one ribbon from her bag without looking.

b. Make an organized list or a tree diagram showing all the possible color combinations that Madison could select.

c. What is the probability that Madison will select a black button and a black ribbon? Show or explain how you got your answer.

d. What is the probability that Madison will select a button and a ribbon that are different colors from each other? Show or explain how you got your answer.
Mark your answers to multiple-choice questions 9 and 10 in the spaces provided in your Student Answer Booklet. Do not write your answers in this test booklet. You may do your figuring in the test booklet.

9. Amy used $2\frac{1}{2}$ cans of chicken broth to make soup. Each can contained $7\frac{1}{2}$ ounces of broth.

What was the total number of ounces of chicken broth that Amy used?

A. 10 ounces
B. $14\frac{1}{4}$ ounces
C. 18 ounces
D. $18\frac{3}{4}$ ounces

10. The number of different characters available for a computer game can be represented by $2^6$. What is the total number of different characters available for the computer game?

A. 12
B. 36
C. 64
D. 128
A chef has a frying pan that weighs \( 1 \frac{1}{2} \) pounds. Which of the following is closest to the weight, in kilograms, of the frying pan? (1 pound ≈ 0.454 kilogram)

A. 0.303 kilogram  
B. 0.681 kilogram  
C. 0.954 kilogram  
D. 1.046 kilograms

The top of an office desk is in the shape of a semicircle, as shown in the figure below.

Based on the dimension given in the figure, which of the following is closest to the area of the top of the office desk? (Use \( 3.14 \) for \( \pi \).)

A. 9.42 square feet  
B. 14.13 square feet  
C. 18.84 square feet  
D. 56.52 square feet
The manager of a theater surveyed 500 people to determine their favorite type of play. Each person selected one type of play. The manager started to make the circle graph below to show the results of her survey.

**Favorite Type of Play**

- Comedy: 60%
- Mystery

The percentage of people who selected drama was the same as the percentage of people who selected mystery. Based on the information in the circle graph, what was the total number of people who selected drama?

A. 100
B. 125
C. 150
D. 200

A sporting goods store charges different prices for sewing uppercase letters and lowercase letters on a jacket. The expression below shows the cost, in dollars, for sewing \( x \) uppercase letters and \( y \) lowercase letters.

\[ 1.5x + 0.75y \]

What is the cost for sewing 2 uppercase letters and 10 lowercase letters on a jacket?

A. $3.75
B. $4.50
C. $10.50
D. $16.50
Questions 15 and 16 are short-answer questions. Write your answers to these questions in the boxes provided in your Student Answer Booklet. Do not write your answers in this test booklet. You may do your figuring in the test booklet.

15 Quadrilateral \(ABCD\) is congruent to quadrilateral \(GHEF\), as shown in the diagrams below.

![Quadrilateral Diagram](image1)

Which side of quadrilateral \(GHEF\) must be congruent to \(AB\)?

16 Two sides and three vertices of a square are shown on the coordinate plane below.

![Coordinate Plane](image2)

What are the coordinates of the fourth vertex of the square?
A n almanac states that it is possible to determine the temperature by counting the number of times a cricket chirps. To use cricket chirps to determine the temperature in degrees Celsius, the almanac gives the steps below.

- Count the number of times a cricket chirps in 25 seconds.
- Divide that number by 3.
- Then add 4 to get the temperature in degrees Celsius.

a. Use the information from the almanac to show that when a cricket chirps 27 times in 25 seconds, the temperature is 13 degrees Celsius.

b. In your Student Answer Booklet, copy the table below, and fill in the missing numbers using the information from the almanac. Show or explain how you got your answers.

<table>
<thead>
<tr>
<th>Number of Chirps in 25 Seconds</th>
<th>Temperature (degrees Celsius)</th>
</tr>
</thead>
<tbody>
<tr>
<td>27</td>
<td>13</td>
</tr>
<tr>
<td>48</td>
<td>?</td>
</tr>
<tr>
<td>?</td>
<td>28</td>
</tr>
</tbody>
</table>

c. Based on your table, write an expression that can be used to calculate the temperature in degrees Celsius when a cricket chirps \( n \) times in 25 seconds.
Casey has a cylindrical container with an inside diameter of 6 inches. He filled it with water to a depth of 4 inches, as shown below.

To the nearest cubic inch, what is the volume of water in Casey's container? (Use 3.14 for \( \pi \).)

A. 75 cubic inches  
B. 113 cubic inches  
C. 151 cubic inches  
D. 452 cubic inches

Donnie has a spool that contains 18 yards of wire. What is the total number of inches of wire that the spool contains?

A. 162  
B. 216  
C. 540  
D. 648
Fran had her picture taken at a studio. The table below shows the studio’s prices for purchasing a photo album plus different numbers of 5-inch by 7-inch prints.

### Price List for Photo Album and Prints

<table>
<thead>
<tr>
<th>Number of Prints</th>
<th>Total Price for Album Plus Prints</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$17</td>
</tr>
<tr>
<td>2</td>
<td>$22</td>
</tr>
<tr>
<td>3</td>
<td>$27</td>
</tr>
<tr>
<td>4</td>
<td>$32</td>
</tr>
</tbody>
</table>

Based on the linear pattern shown in the table, what is the price for purchasing a photo album plus 6 of the prints?

A. $38  
B. $42  
C. $54  
D. $66  

A florist sells 8 roses for a total of $10. Each rose costs the same amount. What is the cost of 12 roses?

A. $9.60  
B. $10.40  
C. $14.00  
D. $15.00
PERIMETER FORMULAS

square............ P = 4s
rectangle.......... P = 2b + 2h
                   OR
                   P = 2l + 2w
triangle.......... P = a + b + c

AREA FORMULAS

square............ A = s^2
rectangle.......... A = bh
                   OR
                   A = lw
parallelogram..... A = bh
triangle.......... A = \frac{1}{2} bh
trapezoid.......... A = \frac{1}{2} h(b_1 + b_2)
circle............ A = \pi r^2

TOTAL SURFACE AREA FORMULAS

rectangular prism . . SA = 2(lw) + 2(hw) + 2(lh)
cylinder ........... SA = 2\pi r^2 + 2\pi rh

VOLUME FORMULAS

rectangular prism .... V = lwh
                   OR
                   V = Bh
                   (B = area of a base)
cube................. V = s^3
                   (s = length of an edge)
cylinder ............ V = \pi r^2 h

CIRCLE FORMULAS

C = 2\pi r
   OR
   C = \pi d
A = \pi r^2
## Grade 7 Mathematics
### Spring 2010 Released Items:
#### Reporting Categories, Standards, and Correct Answers*

<table>
<thead>
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<th>Item No.</th>
<th>Page No.</th>
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<td>GH</td>
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<td>209</td>
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<td>D</td>
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## Grade 7 Mathematics
### Spring 2010 Unreleased Common Items:
#### Reporting Categories and Standards

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<td>Patterns, Relations, and Algebra</td>
<td>7.P.6</td>
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<td>28</td>
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</tr>
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<td>30</td>
<td>Measurement</td>
<td>7.M.3</td>
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<td>Number Sense and Operations</td>
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<td>39</td>
<td>Geometry</td>
<td>7.G.6</td>
</tr>
<tr>
<td>40</td>
<td>Data Analysis, Statistics, and Probability</td>
<td>7.D.2</td>
</tr>
<tr>
<td>41</td>
<td>Data Analysis, Statistics, and Probability</td>
<td>7.D.2</td>
</tr>
<tr>
<td>42</td>
<td>Number Sense and Operations</td>
<td>7.N.2</td>
</tr>
</tbody>
</table>
XIV. Mathematics, Grade 8
Grade 8 Mathematics Test

The spring 2010 grade 8 MCAS Mathematics test was based on learning standards in the Massachusetts Mathematics Curriculum Framework (2000). The Framework identifies five major content strands, listed below.

- Number Sense and Operations
- Patterns, Relations, and Algebra
- Geometry
- Measurement
- Data Analysis, Statistics, and Probability

The grades 7–8 learning standards for each of these strands appear on pages 62–66 of the Mathematics Curriculum Framework, which is available on the Department website at www.doe.mass.edu/frameworks/current.html.

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Cross-Reference Information

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DIRECTIONS
This session contains eight multiple-choice questions and two short-answer questions. Mark your answers to these questions in the spaces provided in your Student Answer Booklet.

1 The list below shows the number of pages Marian read in her library book each day for one week.

11, 13, 11, 15, 20, 17, 11

What is the mode of the number of pages that Marian read each day?
A. 9
B. 11
C. 13
D. 14

2 Dan earned some money working for his uncle. He spent \( \frac{1}{3} \) of the money on magazines and \( \frac{1}{4} \) of the money on a snack. Which of the following fractions represents the part of Dan’s money he did not spend?
A. \( \frac{5}{12} \)
B. \( \frac{1}{2} \)
C. \( \frac{2}{3} \)
D. \( \frac{5}{7} \)

3 Which of the following inequalities is true?
A. \( \sqrt{3} > \pi \)
B. \( \sqrt{9} > \pi \)
C. \( \sqrt{5} > 2 \)
D. \( \sqrt{6} > 3 \)

4 The table below shows a linear pattern.

<table>
<thead>
<tr>
<th>Term</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>...</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>5</td>
<td>7</td>
<td>9</td>
<td>...</td>
<td>?</td>
</tr>
</tbody>
</table>

Which of the following expressions represents the value of the nth term in the pattern?
A. \( n + 2 \)
B. \( 2n + 3 \)
C. \( 3n + 2 \)
D. \( 4n + 1 \)
Question 5 is a short-answer question. Write your answer to this question in the box provided in your Student Answer Booklet. Do not write your answer in this test booklet. You may do your figuring in the test booklet.

5 What is the solution to the equation below?

\[ 3x + 9 = -6 \]
The students in an eighth-grade class had a dance. They spent $500 for a local band. The equation below can be used to find the total profit, \( y \), if the students sold \( x \) tickets to the dance.

\[
y = 4x - 500
\]

What does the 4 represent in the equation?

A. the price per ticket  
B. the cost of the band  
C. the number of tickets sold  
D. the profit made from selling \( x \) tickets
8 Mr. Jamison is the principal at a new school with an enrollment of 430 students. He surveyed 10% of the students at his school to find out which colors they would like as the school colors. What is the number of students in the sample size of the principal’s survey?
9 The rate of interest paid on savings accounts at a bank increased by \( \frac{1}{2} \% \). Which of the following shows \( \frac{1}{2} \% \) written as a decimal?

A. 0.0012  
B. 0.005  
C. 0.12  
D. 0.5

10 What is the value of the expression below?

\[ |8| + |-3| - |7| \]

A. −12  
B. −2  
C. 4  
D. 18
The table below shows the area of a trapezoid when the lengths of the bases stay the same but the height is changed.

**Area of Trapezoid**

<table>
<thead>
<tr>
<th>Height (in meters)</th>
<th>Area (in square meters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>7.5</td>
</tr>
<tr>
<td>5</td>
<td>12.5</td>
</tr>
<tr>
<td>7</td>
<td>17.5</td>
</tr>
<tr>
<td>9</td>
<td>22.5</td>
</tr>
</tbody>
</table>

What is the area of the trapezoid when the height is 17 meters?

A. 47.5 square meters  
B. 42.5 square meters  
C. 39.5 square meters  
D. 37.5 square meters

A box of identically shaped light bulbs contains the following:
- 11 red light bulbs
- 13 blue light bulbs
- 10 green light bulbs
- 16 orange light bulbs

If 1 light bulb is chosen at random from the box, what is the probability that it will be green?

A. \( \frac{1}{4} \)  
B. \( \frac{1}{5} \)  
C. \( \frac{1}{10} \)  
D. \( \frac{1}{50} \)
Elena and Kristen started new jobs at the same time. The table below shows their annual salaries for the first 4 years.

### Annual Salaries

<table>
<thead>
<tr>
<th>Number of Years</th>
<th>Elena's Salary</th>
<th>Kristen's Salary</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$15,000</td>
<td>$22,000</td>
</tr>
<tr>
<td>2</td>
<td>$17,500</td>
<td>$23,000</td>
</tr>
<tr>
<td>3</td>
<td>$20,000</td>
<td>$24,000</td>
</tr>
<tr>
<td>4</td>
<td>$22,500</td>
<td>$25,000</td>
</tr>
</tbody>
</table>

Elena’s salary continued to increase by the same amount each year, and Kristen’s salary continued to increase by the same amount each year. Which of the following statements is true for year 6?

A. Elena’s salary was $30,000.
B. Kristen’s salary was $26,000.
C. Elena’s salary was $500 more than Kristen’s salary.
D. Kristen’s salary was $500 more than Elena’s salary.
David drew $\triangle ABC$ on a coordinate plane, as shown below.

David reflected $\triangle ABC$ over the $x$-axis. What are the coordinates of the image of point A?
The chart below shows the number of goals scored by the Sharks soccer team and their opponents for 5 games.

<table>
<thead>
<tr>
<th>Game</th>
<th>Number of Goals Scored by the Sharks</th>
<th>Number of Goals Scored by Opponents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>2nd</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>3rd</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>4th</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>5th</td>
<td>5</td>
<td>1</td>
</tr>
</tbody>
</table>

In what percent of the games did the Sharks score more goals than their opponents?

A. 40%
B. 50%
C. 80%
D. 100%
16. The relationship between the perimeter and side length of a regular hexagon is shown on the graph below.

Relationship between Perimeter and Side Length of a Regular Hexagon

What happens to the perimeter of a regular hexagon as its side length increases by 1?

A. The perimeter increases by 1.
B. The perimeter increases by 2.
C. The perimeter increases by 3.
D. The perimeter increases by 6.

17. The formula below can be used to find \( S \), the sum of all integers from 1 to \( n \), where \( n \) is any positive integer.

\[
S = \frac{n(n + 1)}{2}
\]

What is the value of \( S \) when \( n = 50 \)?

A. 1250
B. 1275
C. 2500
D. 2550
A cafeteria has a recycling container for cans. The recycling container has a lid that is in the shape of a circle with an opening in the center that is also in the shape of a circle. The lid and some of its dimensions are shown in the diagram below.

The shaded part of the diagram represents the opening in the lid.

a. What is the circumference, in inches, of the lid of the recycling container? Show or explain how you got your answer. (Use 3.14 for \( \pi \).)

b. What is the area, in square inches, of the lid, including the opening? Show or explain how you got your answer. (Use 3.14 for \( \pi \).)

c. What is the area, in square inches, of the lid, not including the opening? Show or explain how you got your answer. (Use 3.14 for \( \pi \).)
The mean height, in inches, of 5 girls on the middle school basketball team is exactly 66 inches. The table below lists the heights of 4 of the girls.

**Girls’ Heights**

<table>
<thead>
<tr>
<th>Name</th>
<th>Height (in inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jessica</td>
<td>65</td>
</tr>
<tr>
<td>Ali</td>
<td>65</td>
</tr>
<tr>
<td>Sina</td>
<td>70</td>
</tr>
<tr>
<td>Amanda</td>
<td>66</td>
</tr>
<tr>
<td>Becky</td>
<td>?</td>
</tr>
</tbody>
</table>

Which of the following is the height of Becky?

A. 64 inches  
B. 65.5 inches  
C. 66 inches  
D. 66.5 inches

What is $150\%$ of 48?

A. 72  
B. 32  
C. 7.2  
D. 3.2
Danielle measured two of the computer screens in her school's computer lab. The two screens and some of their dimensions are shown below.

a. What is the area, in square inches, of Screen 1? Show or explain how you got your answer.

b. What is $x$, the diagonal length in inches of Screen 1? Show or explain how you got your answer.

c. Which computer screen, Screen 1 or Screen 2, has the greater area? Show your work or explain how you got your answer.
PERIMETER FORMULAS

square............. P = 4s
rectangle.......... P = 2b + 2h
                   OR
                   P = 2l + 2w
triangle.......... P = a + b + c

AREA FORMULAS

square............. A = s^2
rectangle.......... A = bh
                   OR
                   A = lw
parallelogram..... A = bh
triangle.......... A = \frac{1}{2}bh
trapezoid......... A = \frac{1}{2}h(b_1 + b_2)
circle............ A = \pi r^2

TOTAL SURFACE AREA FORMULAS

rectangular prism \ . \ SA = 2(lw) + 2(hw) + 2(1h)
cylinder ........ SA = 2\pi r^2 + 2\pi rh
sphere........... SA = 4\pi r^2

VOLUME FORMULAS

rectangular prism . . . . V = lwh
                   OR
                   V = Bh
                   (B = area of a base)
cube................. V = s^3
                   (s = length of an edge)
cylinder ............ V = \pi r^2 h
sphere ............ V = \frac{4}{3}\pi r^3

CIRCLE FORMULAS

C = 2\pi r
   OR
   C = \pi d
A = \pi r^2

PYTHAGOREAN THEOREM

a^2 + b^2 = c^2
# Grade 8 Mathematics

Spring 2010 Released Items:
Reporting Categories, Standards, and Correct Answers*

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Page No.</th>
<th>Reporting Category</th>
<th>Standard</th>
<th>Correct Answer (MC/SA)*</th>
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<td>B</td>
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<tr>
<td>2</td>
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<td>3</td>
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<td>21</td>
<td>227</td>
<td>Geometry</td>
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<td></td>
</tr>
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</table>

* Answers are provided here for multiple-choice items and short-answer items only. Sample responses and scoring guidelines for open-response items, which are indicated by shaded cells, will be posted to the Department’s website later this year.
## Grade 8 Mathematics

### Spring 2010 Unreleased Common Items:
**Reporting Categories and Standards**

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Reporting Category</th>
<th>Standard</th>
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<tbody>
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<td>8.N.8</td>
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<td>27</td>
<td>Geometry</td>
<td>8.G.2</td>
</tr>
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<td>28</td>
<td>Measurement</td>
<td>8.M.1</td>
</tr>
<tr>
<td>29</td>
<td>Patterns, Relations, and Algebra</td>
<td>8.P.5</td>
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<td>30</td>
<td>Number Sense and Operations</td>
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<td>32</td>
<td>Number Sense and Operations</td>
<td>8.N.3</td>
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<td>33</td>
<td>Data Analysis, Statistics, and Probability</td>
<td>8.D.2</td>
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<td>Patterns, Relations, and Algebra</td>
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<td>Number Sense and Operations</td>
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</tr>
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<tr>
<td>42</td>
<td>Data Analysis, Statistics, and Probability</td>
<td>8.D.4</td>
</tr>
</tbody>
</table>
XV. Mathematics, Grade 10
Grade 10 Mathematics Test

The spring 2010 grade 10 MCAS Mathematics test was based on learning standards in the Massachusetts Mathematics Curriculum Framework (2000). The Framework identifies five major content strands listed below.

- Number Sense and Operations
- Patterns, Relations, and Algebra
- Geometry
- Measurement
- Data Analysis, Statistics, and Probability

The grades 9–10 learning standards for each of these strands appear on pages 72–75 of the Mathematics Curriculum Framework, which is available on the Department website 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, Mathematics test results are reported under five MCAS reporting categories, which are identical to the five Mathematics Curriculum Framework content strands listed above.

Test Sessions

The MCAS grade 10 Mathematics test included two separate test sessions, which were administered on consecutive days. Each session included multiple-choice and open-response questions. Session 1 also included short-answer questions.

Reference Materials and Tools

Each student taking the grade 10 Mathematics test was provided with a grade 10 Mathematics Reference Sheet. A copy of the reference sheet follows the final question in this chapter.

During session 2, each student had sole access to a calculator with at least four functions and a square root key. Calculator use was not allowed during session 1.

The use of bilingual word-to-word dictionaries was allowed for current and former limited English proficient students only, during both Mathematics 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 and short-answer questions are also displayed in the table.
DIRECTIONS
This session contains fourteen multiple-choice questions, four short-answer questions, and three open-response questions. Mark your answers to these questions in the spaces provided in your Student Answer Booklet.

1. What is the median of the data set below?
   \[30, 37, 19, 42, 33, 37\]
   A. 31
   B. 33
   C. 35
   D. 37

2. What is the value of the expression below?
   \[2(5 - 3 \cdot 4)\]
   A. \(-14\)
   B. \(-2\)
   C. 14
   D. 16

3. The approximate lengths of two major rivers are listed below.
   • Nile River: \(2.2 \times 10^7\) feet
   • Snake River: \(5.5 \times 10^6\) feet

   Based on these lengths, the length of the Nile River is how many times the length of the Snake River?
   A. 0.4
   B. 2.5
   C. 4
   D. 25
Allen surveyed the 18 students in his class about the number of DVDs each of them rented last week. The table below shows how many students rented each number of DVDs. For example, 10 students rented 1 DVD each.

**Number of Students Renting Each Number of DVDs**

<table>
<thead>
<tr>
<th>Number of DVDs Rented</th>
<th>Number of Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
</tr>
</tbody>
</table>

What is the mean number of DVDs rented per student?

A. 1  
B. 2  
C. 3  
D. 6

A sphere has a volume of \(\frac{500}{3}\pi\) cubic centimeters. What is the total surface area, in square centimeters, of the sphere?

A. 25\(\pi\)  
B. 40\(\pi\)  
C. 100\(\pi\)  
D. 400\(\pi\)

During an event on Saturday, 29,089 seats in a sports arena were occupied. The arena has a total of 39,598 seats. Which of the following estimates is closest to the fraction of seats that were occupied during the event on Saturday?

A. \(\frac{1}{10}\)  
B. \(\frac{1}{2}\)  
C. \(\frac{2}{3}\)  
D. \(\frac{3}{4}\)

What is the value of the expression below?

\[-7 \left| 2^4 - 10 \right| + 3\]

A. \(-53\)  
B. \(-39\)  
C. 17  
D. 45
8. Parallel lines \( r \) and \( s \) are cut by transversal \( t \), as shown in the diagram below.

Which of the following must be true?

A. \( m\angle 1 + m\angle 5 = 180^\circ \)
B. \( m\angle 2 + m\angle 8 = 180^\circ \)
C. \( m\angle 1 = m\angle 7 \)
D. \( m\angle 3 = m\angle 8 \)

9. Which of the following is equivalent to the expression below?

\[ \sqrt{6} + \sqrt{6} \]

A. \( 2\sqrt{6} \)
B. \( 12 \)
C. 6
D. 12

10. What are the solutions of the equation below?

\[ p^2 + 5 = 6p \]

A. 1 and 5
B. 2 and 3
C. \(-1\) and \(-5\)
D. \(-2\) and \(-3\)
Which of the following scatterplots is most likely to have a line of best fit represented by the equation below?

\[ y = \frac{1}{2}x \]
12. A monthly phone bill consists of a fixed monthly fee of $19 and a charge of $0.25 per minute of use. Which of the following equations can be used to determine the total monthly bill, \( t \), for \( m \) minutes of use?

A. \( t = 0.25m + 19 \)
B. \( t = 0.25m - 19 \)
C. \( t = 19m + 0.25 \)
D. \( t = 19m - 0.25 \)

13. Point \( P(6, 7) \) and point \( Q(6, 4) \) are plotted on the coordinate grid below.

Point \( P \) is rotated \( 180^\circ \) clockwise about point \( Q \). What are the coordinates of the image of point \( P \) after this rotation?

A. \((3, 4)\)
B. \((6, 1)\)
C. \((6, 10)\)
D. \((9, 4)\)

14. Which of the following equations does \textbf{not} have a real number solution?

A. \( n + 1 = n \)
B. \( n \cdot 1 = n \)
C. \( n + 0 = n \)
D. \( n - 0 = n \)
Questions 15 and 16 are short-answer questions. Write your answers to these questions in the boxes provided in your Student Answer Booklet. Do not write your answers in this test booklet. You may do your figuring in the test booklet.

15 What is the value of $x$ in the solution of the system of equations below?

\[
\begin{align*}
8x - y &= 20 \\
y &= 3x
\end{align*}
\]

16 Yoshi is designing a monument that has a triangular base. He drew $\triangle JKR$ to represent the base of the monument, as shown in the diagram below.

Based on the measurements in the diagram, what is the area, in square meters, of $\triangle JKR$?
Question 17 is an open-response question.

- **BE SURE TO ANSWER AND LABEL ALL PARTS OF THE 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 17 in the space provided in your Student Answer Booklet.**

When Nuri buys an item from a catalog, the total amount he pays is made up of the following three amounts of money:

- the price of the item
- sales tax of 5% of the price of the item
- a fixed shipping fee that is always the same regardless of the cost or size of the order

Nuri bought a game with a price of $100 from the catalog.

a. What was the sales tax, in dollars, that Nuri paid on the game? Show or explain how you got your answer.

b. The total amount, including the sales tax and the shipping fee, that Nuri paid for the game was $120. What was the shipping fee, in dollars? Show or explain how you got your answer.

c. Nuri bought an item with a price of $400 from the catalog. What is the total amount he paid, in dollars, including the sales tax and the shipping fee? Show or explain how you got your answer.

d. Write an equation that expresses the relationship between $y$, the total amount paid for an item from the catalog including the sales tax and shipping fee, and $x$, the price of the item. Show or explain how you got your equation.
Questions 18 and 19 are short-answer questions. Write your answers to these questions in the boxes provided in your Student Answer Booklet. Do not write your answers in this test booklet. You may do your figuring in the test booklet.

18 The diagram below shows a right circular cone with a radius of 5 centimeters and a slant height of 10 centimeters.

![Diagram of a right circular cone]

What is the lateral surface area, in square centimeters, of the cone? (You may leave your answer in terms of \( \pi \).)

19 What is the value of the expression below?

\[ 4 + 2(5 + 1) \]
Mathematics  Session 1

Questions 20 and 21 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 20 in the space provided in your Student Answer Booklet.**

20 The line plot below shows the number of skateboards owned by each of the 10 members of the Skateboard Club.

![Line Plot]

<table>
<thead>
<tr>
<th>Number of Skateboards</th>
<th>0</th>
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<th>2</th>
<th>3</th>
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<td>X</td>
<td></td>
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<tr>
<td>XX</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. What is the range of the numbers of skateboards owned by the Skateboard Club members? Show or explain how you got your answer.

b. What is the mode of the numbers of skateboards owned by the Skateboard Club members? Show or explain how you got your answer.

c. What is the mean number of skateboards owned by the Skateboard Club members? Show or explain how you got your answer.

d. What is the median number of skateboards owned by the Skateboard Club members? Show or explain how you got your answer.

Two people became new members of the Skateboard Club. However, the **median** number of skateboards owned by the 12 club members did not change.

e. What could be the number of skateboards each of the two new club members owns? Explain your reasoning.
Gloria manages an apartment building. The building has only two sizes of apartments: small and large. The table below shows the rental income per month for each apartment size.

<table>
<thead>
<tr>
<th>Apartment Size</th>
<th>Rental Income per Month</th>
</tr>
</thead>
<tbody>
<tr>
<td>small</td>
<td>$800</td>
</tr>
<tr>
<td>large</td>
<td>$1200</td>
</tr>
</tbody>
</table>

a. What is the total rental income for one month when 3 small apartments and 4 large apartments are rented? Show or explain how you got your answer.

For parts (b), (c), and (d), define x and y as follows:

- x = the number of small apartments in the building
- y = the number of large apartments in the building

b. Last month all the apartments in the building were rented. The total rental income for the month was $17,600. Write an equation in terms of x and y that represents this information.

c. The total number of small apartments and large apartments is 18. Write an equation in terms of x and y that represents this information.

d. Using the information in parts (b) and (c), determine the following:

- the number of small apartments in the building
- the number of large apartments in the building

Show or explain how you got each of your answers.
The diagram below shows a triangle and some of its dimensions.

What is the value of $t$?

A. 25  
B. 30  
C. 35  
D. 40

Jane played in 12 basketball games.

• For her first 8 games, the mean number of points she scored per game was 11.
• For her last 4 games, the mean number of points she scored per game was 15.

What was the total number of points Jane scored in all 12 games?

A. 148  
B. 156  
C. 228  
D. 312
What is the y-intercept of the line represented by the equation below?
\[10x + 5y = 20\]

A. $-4$
B. $-2$
C. $2$
D. $4$

Joshua is designing a rectangular mirror.
- He let $w = \text{the width, in inches, of the mirror.}$
- The length of the mirror will be 6 inches more than the width.
- The perimeter of the mirror will be less than 96 inches and greater than 76 inches.

Which of the following inequalities shows the possible widths, in inches, of the mirror?
A. $13 < w < 18$
B. $16 < w < 21$
C. $19 < w < 24$
D. $35 < w < 45$

Spinners P and Q shown below are divided into congruent sections.

The arrow on each spinner will be spun once. The number in the section where the arrow stops on Spinner P will be added to the number in the section where the arrow stops on Spinner Q.

What is the probability that the sum of the two numbers will be 5?
A. $\frac{1}{9}$
B. $\frac{2}{9}$
C. $\frac{1}{3}$
D. $\frac{2}{3}$
27 Which of the following inequalities is graphed on the number line below?

-1 0 1 2 3

A. \( x < 2 \)
B. \( x \leq 2 \)
C. \( x > 2 \)
D. \( x \geq 2 \)

28 Sarah walked at a speed of 3 miles per hour. Beneta rode her bicycle at a speed of 9 miles per hour. They both traveled the same distance, but it took Sarah 4 more hours than it took Beneta. How many hours did it take Beneta?

A. 2
B. 3
C. 4
D. 6

29 A circle has a diameter of 18 feet. Which of the following is closest to the circumference of the circle?

A. 28.3 feet
B. 56.5 feet
C. 113.1 feet
D. 254.5 feet

30 The bar graph below shows the number of pizzas a restaurant delivered each day during one week.

Pizzas Delivered One Week

- \( \text{Mon.} \)
- \( \text{Tue.} \)
- \( \text{Wed.} \)
- \( \text{Thu.} \)
- \( \text{Fri.} \)
- \( \text{Sat.} \)
- \( \text{Sun.} \)

Day

What is the range of the numbers of pizzas delivered during the week?

A. 18
B. 20
C. 24
D. 26
Adriana recently bought a new car and is keeping track of the miles she drives and the gas she uses.

a. One week Adriana drove 258 miles and used 6.2 gallons of gas. For that week, what was the average number of miles she drove per gallon of gas used? Show or explain how you got your answer.

b. When she goes on vacation, Adriana expects to drive 630 miles. She also expects to drive an average of 45 miles per gallon of gas used. How much gas, in gallons, should she expect to use on her vacation? Show or explain how you got your answer.

Adriana’s car has displays that show both speed and gas mileage, as defined below:
- Speed is the number of miles per hour at which the car is traveling.
- Gas mileage is the number of miles traveled per gallon of gas used.

c. On her drive to work one day, Adriana looked at her car’s displays.
- Her speed was 30 miles per hour.
- Her gas mileage was 40 miles per gallon.
At these rates, how many gallons of gas would she use in one hour? Show or explain how you got your answer.

d. The gas tank in Adriana’s car holds 18 gallons of gas when it is full. Based on the same speed and gas mileage as in part (c), how many hours could Adriana drive using one entire tankful of gas? Show or explain how you got your answer.
The table below shows the number of points Dmitri earned playing a game on each of the first 5 days of the week.

**Game Points Earned**

<table>
<thead>
<tr>
<th>Day</th>
<th>Number of Points Earned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday</td>
<td>800</td>
</tr>
<tr>
<td>Tuesday</td>
<td>1200</td>
</tr>
<tr>
<td>Wednesday</td>
<td>1500</td>
</tr>
<tr>
<td>Thursday</td>
<td>1000</td>
</tr>
<tr>
<td>Friday</td>
<td>1600</td>
</tr>
<tr>
<td>Saturday</td>
<td>?</td>
</tr>
</tbody>
</table>

What is the number of points Dmitri must earn on Saturday so that his mean number of points over the 6 days is exactly 1250?

A. 1020
B. 1220
C. 1300
D. 1400

The diagram below shows a parallelogram and its dimensions.

What is the area of the parallelogram?

A. 30 cm²
B. 36 cm²
C. 60 cm²
D. 72 cm²
34. In which of the following graphs does line h best represent a line with an undefined slope?

A. 

B. 

C. 

D. 

35. Gail drew square PQRS shown below.

What is the length, in inches, of SQ?

A. 6\sqrt{2}
B. 9
C. 6\sqrt{3}
D. 12

36. A technician earns $75 per hour working on computers. She has monthly business expenses of $800. Her profit is the difference between her monthly earnings and her monthly business expenses.

Which of the following inequalities can be used to find the number of hours, x, the technician will have to work on computers in a month to make a profit of more than $2000?

A. 800 − 75x < 2000
B. 75x − 800 < 2000
C. 800 − 75x > 2000
D. 75x − 800 > 2000
A community center offers classes for students.

- The range of the number of students in each class is 13.
- The median number of students in each class is 9.

Which of the following box-and-whisker plots could represent the numbers of students in the classes?

A. Numbers of Students in Classes
   ![Box-and-Whisker Plot A]

B. Numbers of Students in Classes
   ![Box-and-Whisker Plot B]

C. Numbers of Students in Classes
   ![Box-and-Whisker Plot C]

D. Numbers of Students in Classes
   ![Box-and-Whisker Plot D]

The diagrams below show the top view and the front view of a solid object.

Which of the following could be a diagram of the solid object?

A. ![Diagram A]

B. ![Diagram B]

C. ![Diagram C]

D. ![Diagram D]
Jan sets up tables and chairs for meetings. When she sets up 12 tables, she places 6 chairs at each table. Jan always sets up the same total number of chairs. When she sets up 8 tables, what is the number of chairs that she places at each table?

A. 4  
B. 9  
C. 10  
D. 16

Marcos has two cubes of different sizes. The length of each edge of the larger cube is 2 times the length of each edge of the smaller cube. The volume of the larger cube is how many times the volume of the smaller cube?

A. 4  
B. 6  
C. 8  
D. 16
Questions 41 and 42 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 41 in the space provided in your Student Answer Booklet.

41 The diagram below shows \( \triangle RST \).

- \( \triangle RST \) is an isosceles triangle with congruent sides \( \overline{RS} \) and \( \overline{ST} \).
- Point \( M \) lies on \( \overline{RS} \), and point \( N \) lies on \( \overline{ST} \).
- \( \overline{MN} \) is parallel to \( \overline{RT} \).
- The length of \( \overline{SN} \) is 23 feet, and the length of \( \overline{NT} \) is 10 feet.

a. What is the length of \( \overline{RS} \)? Show or explain how you got your answer.

b. What is \( m\angle T \)? Show or explain how you got your answer.

c. What is \( m\angle MNS \)? Show or explain how you got your answer.

d. Explain why \( \triangle MNS \) is similar to \( \triangle RTS \).

e. What is the length of \( \overline{MN} \)? Show or explain how you got your answer.
Paloma bought a block of wax in the shape of a right rectangular prism. The diagram below shows the block and its dimensions.

a. What is the volume, in cubic centimeters, of the block of wax? Show your work.

Paloma melted the block of wax to make candles. The first candle she made is in the shape of a right circular cylinder. The diagram below represents the candle and its dimensions.

b. What is the volume, in cubic centimeters, of the first candle? Show your work.

c. Paloma wanted to make a second candle in the shape of a right square pyramid with a side length of 10 centimeters and a height of 12 centimeters. Show that she does not have enough remaining wax to make this candle.

d. Paloma decided instead to make the second candle in the shape of a right square pyramid with a side length of 8 centimeters. If she uses all the remaining wax, what will be the height, in centimeters, of the candle? Show your work.
AREA FORMULAS

- square .................................. \( A = s^2 \)
- rectangle .......................... \( A = bh \)
- parallelogram .......... \( A = bh \)
- triangle .......................... \( A = \frac{1}{2}bh \)
- trapezoid .................. \( A = \frac{1}{2}h(b_1 + b_2) \)
- circle .......................... \( A = \pi r^2 \)

VOLUME FORMULAS

- cube ..................................... \( V = s^3 \)  
  \( s = \text{length of an edge} \)
- right rectangular prism ........ \( V = lwh \)
  \( \text{OR} \)
  \( V = Bh \)  
  \( B = \text{area of a base} \)
- sphere .................................. \( V = \frac{4}{3}\pi r^3 \)
- right circular cylinder .......... \( V = \pi r^2h \)
- right circular cone .............. \( V = \frac{1}{3}\pi r^2h \)
- right square pyramid .......... \( V = \frac{1}{3}s^2h \)

LATERAL SURFACE AREA FORMULAS

- right rectangular prism ........ \( LA = 2(hw) + 2(lh) \)
- right circular cylinder ........ \( LA = 2\pi rh \)
- right circular cone ............. \( LA = \pi r\ell \)  
  \( \ell = \text{slant height} \)
- right square pyramid .......... \( LA = 2s\ell \)  
  \( \ell = \text{slant height} \)

TOTAL SURFACE AREA FORMULAS

- cube ..................................... \( \text{SA} = 6s^2 \)
- right rectangular prism ........ \( \text{SA} = 2(lw) + 2(hw) + 2 lh \)
- sphere .................................. \( \text{SA} = 4\pi r^2 \)
- right circular cylinder ........ \( \text{SA} = 2\pi r^2 + 2\pi rh \)
- right circular cone ............. \( \text{SA} = \pi r^2 + \pi r\ell \)  
  \( \ell = \text{slant height} \)
- right square pyramid .......... \( \text{SA} = s^2 + 2s\ell \)  
  \( \ell = \text{slant height} \)

CIRCLE FORMULAS

- \( C = 2\pi r \)
- \( A = \pi r^2 \)

SPECIAL RIGHT TRIANGLES

- \( 45^\circ - 45^\circ - 90^\circ \)  
  \( x \) 
  \( x\sqrt{2} \)

- \( 60^\circ - 30^\circ - 90^\circ \)  
  \( y \) 
  \( 2y \) 
  \( y\sqrt{3} \)
<table>
<thead>
<tr>
<th>Item No.</th>
<th>Page No.</th>
<th>Reporting Category</th>
<th>Standard</th>
<th>Correct Answer (MC/SA)*</th>
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<td>C</td>
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<td>A</td>
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<td>48 square meters</td>
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<td>17</td>
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<td>18</td>
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<td>Measurement</td>
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<td>50π square centimeters</td>
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<td>16</td>
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</tr>
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<td>243</td>
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<td>10.M.2</td>
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</tbody>
</table>

*Answers are provided here for multiple-choice items and short-answer items only. Sample responses and scoring guidelines for open-response items, which are indicated by shaded cells, will be posted to the Department's website later this year.*
XVI. Science and Technology/Engineering, Grade 5
Grade 5 Science and Technology/Engineering Test


- 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 website 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 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. Approximately half of the common test items are shown on the following pages as they appeared in test booklets.

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 tables at the conclusion of this chapter indicate each released and unreleased common item’s reporting category and the framework learning standard it assesses. The correct answers for released multiple-choice questions are also displayed in the released item table.
Francis plugged a toaster into an electric outlet. He put a piece of bread in the toaster and turned the toaster on. While the toaster was on, it changed the electrical energy from the outlet into other forms of energy.

Which form of energy toasted the bread?

A. chemical
B. heat
C. magnetic
D. sound
Skyler is selecting the kind of paper he wants to use to make a greeting card. He wants to select paper that does not tear easily.

Which of the following features of the paper is most important for Skyler to consider?

A. color
B. size
C. smoothness
D. thickness

Which of the following is most likely a learned behavior?

A. using a fork to eat
B. jumping at a loud noise
C. squinting in a bright light
D. sneezing when smelling a flower
The students in an engineering class built a robot that stacks wooden blocks. A built-in computer controls the movement of the robot. The computer in the robot performs a function most similar to which part of the human body?

A. lungs  
B. heart  
C. brain  
D. arms
In which of the following locations is new soil likely to form at the slowest rate over time?

A. Desert

B. Forest

C. Hillside

D. Marsh
7 The diagram below shows a screw on the bottom of a toy.

Which of the following questions can best be answered by using this diagram?

A. How strong is the screw?
B. What material is the screw made of?
C. Which tool should be used to turn the screw?
D. How many times should the screw be turned?
Which of the following characteristics will best prevent a tree from being blown over by high winds during a storm?

A. deep roots  
B. long branches  
C. thick bark  
D. wide leaves

All the ponds in an area dried up during a drought. The population of which of the following animals that live in the area is most affected by the drought?

A. deer  
B. frog  
C. hawk  
D. squirrel

Which of the following best describes the climate of an area?

A. the high temperature and wind speed for six months  
B. the high temperature and wind speed each day for one year  
C. the temperature and precipitation every hour for one day  
D. the average temperature and total precipitation each month for ten years

The diagram below shows the life cycle of an organism.

Which of the following organisms has a life cycle like the one shown in the diagram?

A. a bird  
B. a butterfly  
C. a frog  
D. a snake
12. Owen tested a physical property of a mineral. He rubbed a mineral sample on a piece of white tile. The mineral left a red mark on the tile.

Which of the following physical properties of the mineral was Owen most likely testing?

A. cleavage  
B. hardness  
C. luster  
D. streak

13. Which of the following must all plant and animal species do in order for each species to survive?

A. migrate  
B. reproduce  
C. make food  
D. change color

14. Which of the following metals will be attracted to a magnet?

A. copper  
B. gold  
C. iron  
D. silver
Corals are small marine organisms that live in groups and make hard outer skeletons to protect their bodies. Over time, these outer skeletons can build up to make large coral reefs.

Which of the following statements best describes one way the formation of a coral reef changes the ocean ecosystem?

A. It makes the ocean water saltier.
B. It removes sand from the ocean floor.
C. It causes ocean waves to become stronger.
D. It creates a habitat for some ocean animals.

In which circuit are both bulbs lit?

A.

B.

C.

D.
An athlete is choosing a material for his eyeglass frames. He wants a material that will not be easily damaged when he plays sports. The table below shows some characteristics of four different materials.

<table>
<thead>
<tr>
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<th>Strength</th>
<th>Flexibility</th>
<th>Damaged by Heat or Cold?</th>
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<tr>
<td>1</td>
<td>very strong</td>
<td>slightly flexible</td>
<td>yes</td>
</tr>
<tr>
<td>2</td>
<td>strong</td>
<td>flexible, can be bent or twisted easily</td>
<td>no</td>
</tr>
<tr>
<td>3</td>
<td>very strong</td>
<td>very flexible, goes back into shape after twisting or crushing</td>
<td>no</td>
</tr>
<tr>
<td>4</td>
<td>strong</td>
<td>slightly flexible</td>
<td>no</td>
</tr>
</tbody>
</table>

Which material would be best for the athlete to choose for his eyeglass frames?

A. material 1  
B. material 2  
C. material 3  
D. material 4
A morning glory is a type of flowering vine that climbs trees and fences. Which of the following behaviors most helps a morning glory plant climb a fence?

A. stems curling in response to touch  
B. stems swelling in response to water  
C. flowers opening in response to light  
D. roots growing in response to gravity

A student observed the Moon on a Tuesday. She drew a picture of its shape in her journal, as shown below.

Approximately how long will the student have to wait before she can see the Moon with this same shape and position again?

A. 7 days  
B. 14 days  
C. 28 days  
D. 365 days
Some of the water in Lake Erie may one day fall as rain in the city of Boston. The map below shows the locations of Lake Erie and Boston.

Describe how the water cycle could cause some of the water in Lake Erie to one day fall as rain in the city of Boston. Be sure to identify each part of the water cycle in your response.
Write your answer to question 21 in the space provided in your Student Answer Booklet.

21 Each picture below shows a ray of light interacting with a different surface. One surface is a shiny metal, one surface is clear plastic, and one surface is painted black.

a. Identify which surface is most likely made of a shiny metal. Explain your answer.

b. Identify which surface is most likely made of clear plastic. Explain your answer.

c. Identify which surface is most likely painted black. Explain your answer.
Grade 5 Science and Technology/Engineering  
Spring 2010 Released Items:  
Reporting Categories, Standards, and Correct Answers*

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<th>Standard</th>
<th>Correct Answer (MC)*</th>
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*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 website later this year.
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XVII. Science and Technology/Engineering, Grade 8
Grade 8 Science and Technology/Engineering Test


- Earth and Space Science (Framework, pages 32–33)
- Life Science (Biology) (Framework, pages 51–53)
- Physical Sciences (Chemistry and Physics) (Framework, pages 67–68)
- Technology/Engineering (Framework, pages 87–89)

The Science and Technology/Engineering Curriculum Framework is available on the Department website 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 framework content strands listed above.

Test Sessions

The MCAS grade 8 Science and Technology/Engineering test included two separate test sessions. Each session included multiple-choice and open-response questions. Approximately half of the common test items are shown on the following pages as they appeared in test booklets.

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 tables at the conclusion of this chapter indicate each released and unreleased common item’s reporting category and the framework learning standard it assesses. The correct answers for released multiple-choice questions are also displayed in the released item table.
The diagram below shows a side view of a landform with different elevations.

Which of the following maps best represents this landform?

A. [Diagram A]

B. [Diagram B]

C. [Diagram C]

D. [Diagram D]
2. Substances enter any plant or animal cell by passing through which of the following structures?

A. nucleus  
B. cell membrane  
C. vacuole  
D. chloroplast

3. Four different-colored blocks are placed outside in bright sunlight. The blocks are identical except for color. The diagram below shows the amount of light reflected from each block.

```
<table>
<thead>
<tr>
<th>Block 1</th>
<th>Block 2</th>
<th>Block 3</th>
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<tr>
<td>90%</td>
<td>60%</td>
<td>40%</td>
<td>10%</td>
</tr>
</tbody>
</table>
```

Which block will increase in temperature most rapidly?

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

4. In the design process, a trade-off occurs when a problem is solved but a feature is sacrificed. Which of the following is an example of a trade-off?

A. A car’s gas mileage is increased and the engine has less power.  
B. An airplane uses a more efficient engine and has higher performance.  
C. A sports drink’s taste is improved and has the same nutritional content.  
D. A computer company upgrades the hardware and the price remains unchanged.

5. The Appalachian Mountains, which extend from Canada to Alabama, were much taller in the past than they are today. Which of the following two processes are most responsible for the decrease in the height of the Appalachian Mountains?

A. weathering and erosion  
B. sedimentation and flooding  
C. volcanic eruptions and landslides  
D. tectonic collisions and earthquakes
The diagram below shows four layers of Earth. Each layer is identified by a number.

Which layer of Earth is composed primarily of solid iron?

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

What is the smallest unit of a chemical compound that still has the properties of that compound?

A. a nucleus  
B. a molecule  
C. an element  
D. an atom
8. The diagram below shows the beaks of five species of birds that developed over time from one parent species. The five species of birds can be found living in the same area.

Which of the following best explains why the beak shape of each species of bird developed differently?

A. Each beak shape helps the birds to produce different songs.
B. Each beak shape is an adaptation to a specific source of food.
C. Each beak shape is designed to construct a different type of nest.
D. Each beak shape helps protect the birds from a different predator.

9. Some species of bacteria produce a substance that is toxic to insects but harmless to humans. Scientists have isolated the gene that controls production of this substance.

Which of the following is the best reason for inserting this gene into corn plants?

A. The corn will grow faster.
B. Less fertilizer will be needed.
C. Fewer pesticides will be needed.
D. The corn will be more nutritious.
10. The picture below shows a machine used in a factory to make metal parts for toy cars.

What is the most likely purpose of this machine in making the metal parts?

A. to sand the parts  
B. to make holes in the parts  
C. to fasten the parts together  
D. to measure the size of the parts

11. Which of the following statements best describes a result of using interchangeable parts to manufacture automobiles?

A. The automobiles are identical.  
B. The automobiles wear out quickly.  
C. The automobiles are difficult to design.  
D. The automobiles can be produced on an assembly line.

12. Which of the following correctly lists the structures in space from smallest to largest?

A. star, galaxy, solar system, universe  
B. star, solar system, galaxy, universe  
C. star, solar system, universe, galaxy  
D. star, universe, solar system, galaxy
One of the most common types of adaptations in plants involves the shape and structure of each plant’s leaves. The surface area of leaves is related to the amount of water a plant loses.

Based on this information, which of the following plants is probably best adapted for living in a hot, dry climate?
14. Which of the following planets is always closer to the Sun than it is to Earth?

A. Jupiter  
B. Mercury  
C. Saturn  
D. Uranus

15. Company X makes 100 custom buses each year. Company Y makes 10,000 of one type of bus each year.

Which of the following is the most likely reason a customer would buy a bus from company X instead of company Y?

A. to keep the cost of the bus low  
B. to ensure that the bus will be easy to replace  
C. to provide ideas about how the bus will be built  
D. to ensure that people know how to drive the bus

16. A student is investigating potential and kinetic energy by stretching a spring across a table. When the student lets go, the spring recoils.

At which time is potential energy in the spring being converted into kinetic energy in this system?

A. when the spring is stretching  
B. when the spring is fully stretched  
C. when the spring is recoiling  
D. when the spring is fully recoiled
A stone arch bridge relies primarily on which of the following for its load strength?

A. bending  
B. compression  
C. tension  
D. torsion

A company is making prototypes for a new computer system. Which of the following statements best describes an advantage of making several different prototypes?

A. They can be tested at the same time.  
B. They can be produced in large numbers.  
C. They will be bought by many different users.  
D. They will be sold for more than they cost to build.

The diagram below shows the relative positions of Earth and the Moon and rays of sunlight.

Based on the diagram, which of the following best represents how the Moon would appear as seen from Earth?
Questions 20 and 21 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 20 in the space provided in your Student Answer Booklet.

20. The partial food web below shows five different organisms that are found in a prairie ecosystem.

![Food Web Diagram]

a. Identify each organism in this food web as a producer, a primary consumer, or a secondary consumer.

b. Using only the organisms from this food web, describe one change in this prairie ecosystem that would result in a decrease in the grasshopper population. Explain the reasoning for your answer.
Write your answer to question 21 in the space provided in your Student Answer Booklet.

21. The picture below shows a sample of liquid in a graduated cylinder.

![Graduated Cylinder Image]

a. Identify what property of the sample is being measured with the graduated cylinder.

b. Identify the measurement of the sample in the graduated cylinder. Include units and use the correct number of significant digits in your answer.

The entire sample was transferred to a 100 mL beaker, as shown below.

![Beaker Image]

c. Identify the measurement of the sample in the beaker. Include units and use the correct number of significant digits in your answer.

d. Explain why the measurements would be recorded differently when the sample is in the graduated cylinder and when it is in the beaker.
Grade 8 Science and Technology/Engineering
Spring 2010 Released Items:
Reporting Categories, Standards, and Correct Answers*

<table>
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<tr>
<th>Item No.</th>
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XVIII. Biology, High School
High School Biology Test


The Science and Technology/Engineering Curriculum Framework is available on the Department website 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, Biology test results are reported under the following five MCAS reporting categories:

- Biochemistry and Cell Biology
- Genetics
- Anatomy and Physiology
- Ecology
- Evolution and Biodiversity

Test Sessions

The MCAS high school Biology test included two separate test sessions, which were administered on consecutive days. Each session included multiple-choice and open-response questions.

Reference Materials and Tools

The high school Biology test was designed to be taken without the aid of a calculator. Students were allowed to have calculators with them during testing, but calculators were not needed to answer questions.

The use of bilingual word-to-word dictionaries was allowed for current and former limited English proficient students only, during both Biology 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.
Every year, monarch butterflies from Canada and the United States spend the winter in central Mexico. The dry and mild climate in Mexico allows the monarch butterflies to survive the winter. One winter, a week of storms caused freezing temperatures and 43 cm of snow in Mexico. What was the most likely impact of these storms on the monarch butterflies?

A. Monarch butterflies died in large numbers.
B. Monarch butterflies immediately migrated back to the United States.
C. Monarch butterflies did not migrate from Canada and the United States the next year.
D. Monarch butterflies evolved several new adaptations to survive the winter in Mexico.

Which of the following activities occurs in the G1 phase?

A. growth of the cell
B. replication of the DNA
C. formation of the mitotic spindle
D. breakdown of the nuclear membrane
Part of a desert food web is diagrammed below.

Which of the following will most likely result if all of the primary consumers are removed from this ecosystem?

A. Prairie rattlesnakes will become herbivores.
B. Golden eagle and kit fox populations will decrease.
C. Sagebrush grasshoppers will consume soil bacteria.
D. Silk grass and sand sagebrush populations will decrease.
4. A researcher is studying a particular disease-causing agent. The agent has a protein coat, but it lacks a nucleus, contains no other organelles, and can reproduce only when it is inside an animal cell.

The researcher should classify the agent as which of the following?

A. a bacterium
B. a fungus
C. a protist
D. a virus

5. The diagram below represents steps in sexual reproduction.

\[ \begin{array}{c}
2n \\
\downarrow \\
n \\
\downarrow \\
Z \\
\downarrow \\
2n
\end{array} \]

Which of the following occurs in the step labeled Z?

A. fertilization
B. meiosis
C. mitosis
D. translocation

6. A pedigree is a diagram that traces the inheritance of a trait through a family. Which of the following patterns is typical in a pedigree for an autosomal dominant trait?

A. The trait affects only males.
B. The trait appears in every generation.
C. The trait appears in only one-fourth of the individuals.
D. The trait affects all the individuals of the second generation.

7. A lab technician needs to determine whether cells in a test tube are prokaryotic or eukaryotic. The technician has several dyes she could use to stain the cells. Four of the dyes are described in the table below.

<table>
<thead>
<tr>
<th>Dye</th>
<th>Test</th>
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<tbody>
<tr>
<td>acridine orange</td>
<td>stains DNA and RNA</td>
</tr>
<tr>
<td>osmium tetroxide</td>
<td>stains lipids</td>
</tr>
<tr>
<td>eosin</td>
<td>stains cell cytoplasm</td>
</tr>
<tr>
<td>Nile blue</td>
<td>stains cell nuclei</td>
</tr>
</tbody>
</table>

Which dye could the technician use to determine whether the cells are prokaryotic or eukaryotic?

A. acridine orange
B. osmium tetroxide
C. eosin
D. Nile blue
Sickle cell anemia is an autosomal recessive genetic disorder that affects thousands of people in the United States and millions worldwide. Sickle cell anemia commonly occurs in groups whose ancestors came from Africa, as well as South America, Cuba, Central America, Saudi Arabia, India, and the Mediterranean.

Sickle cell anemia is caused by a change in the hemoglobin protein in red blood cells. Sickle cell anemia results in paleness, fatigue, shortness of breath, and increased heart rate due to a deficiency in the oxygen-carrying component of the blood. When oxygen levels are low in an affected individual, the red blood cells become deformed into a curved, sickle shape. People with sickle cell anemia can experience swelling, pain, infection, and organ damage.

All individuals have two alleles for the gene that codes for the hemoglobin protein (Hb). Individuals with two HbA alleles have normal, round red blood cells. Heterozygous individuals, with one HbA allele and one HbS allele, do not experience symptoms of the disease, but they may produce some sickle-shaped red blood cells. Individuals with two HbS alleles have sickle cell anemia.

The diagrams to the right represent some of the steps in the formation of hemoglobin in two individuals, Y and Z. In these diagrams, only a small part of the hemoglobin gene sequence is represented.

Individual Y has two HbA alleles and therefore produces normal red blood cells. Individual Z has two HbS alleles and therefore produces sickle-shaped red blood cells.
**Individual Y**  
(normal hemoglobin)  

<table>
<thead>
<tr>
<th>DNA</th>
<th>mRNA</th>
<th>Amino acid sequence</th>
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</thead>
<tbody>
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</table>

**Immature red blood cell**

**Individual Z**  
(sickle cell hemoglobin)  

<table>
<thead>
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**Mature red blood cells**
8. Which of the following statements best describes why the change in only one DNA base of the hemoglobin gene results in a different protein product of the gene?
   A. The change prevents mRNA from being made.
   B. The change alters the amino acid sequence of the protein.
   C. The change causes the blood cells to divide in an uncontrolled way.
   D. The change creates a second strand of mRNA for each RNA molecule.

9. Which of the following cell structures carries out the process represented by the arrows labeled “2” in the diagrams?
   A. mitochondrion
   B. nucleus
   C. ribosome
   D. vacuole

10. Which of the following statements best summarizes a change that is represented by the arrows labeled “3” in the diagrams?
    A. A nucleus is formed in each cell.
    B. Each cell divides to form two daughter cells.
    C. A chain of amino acids is folded to form a protein in each cell.
    D. Proteins are transported through the plasma membrane of each cell.

11. Which of the following statements best compares individual Y and individual Z in terms of genotype and phenotype?
    A. The individuals have the same genotype and the same phenotype.
    B. The individuals have the same genotype but different phenotypes.
    C. The individuals have different genotypes but the same phenotype.
    D. The individuals have different genotypes and different phenotypes.
Question 12 is an open-response question.

- **BE SURE TO ANSWER AND LABEL ALL PARTS OF THE 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 12 in the space provided in your Student Answer Booklet.

In a bone marrow transplant, bone marrow from a healthy individual is transplanted into an individual with a blood disorder.

a. Explain why a successful bone marrow transplant could treat sickle cell anemia in an individual.

b. Suppose individual Z were treated for sickle cell anemia by receiving a bone marrow transplant. Could any children that individual Z has after the transplant inherit the gene for the sickle cell trait? Explain your answer.
About 70 years ago, cane toads were introduced to Australia. The toads are toxic to some species of snakes, such as Dendrelaphis punctulatus. The longer an individual snake is, the greater its chance of survival after eating a cane toad.

Which of the following did scientists most likely observe in the D. punctulatus snake population as a result of the presence of the cane toads?

A. The entire population was killed by the toads.
B. The entire population became resistant to the toads.
C. The average body length in the population increased.
D. The average body length in the population decreased.

Which of the following is a body system response that adjusts body temperature when it is higher than normal?

A. Breathing rate begins to decrease.
B. Blood vessels near the skin constrict.
C. Sweat glands produce and secrete sweat.
D. Hormones increase the metabolic rate of the liver.
The graph below shows the rate of activity for the enzyme catalase at different temperatures. Catalase helps convert hydrogen peroxide to oxygen and water. The rate of catalase activity is directly related to the percent increase in oxygen.

Based on the graph, which of the following conclusions can be made about the functioning of catalase?

A. Catalase works best at 34°C.
B. Catalase is destroyed at 34°C.
C. Catalase cannot function at 51°C.
D. Catalase functions most efficiently at 51°C.

Antibiotic resistance can vary within a population of bacteria. The diagram below represents the changes in a population of bacteria as a result of exposure to an antibiotic over time.

The changes in the population are most likely the result of which of the following?

A. exponential growth
B. genetic crosses
C. immigration
D. natural selection
17 An inherited metabolic disorder called phenylketonuria (PKU) can result in serious problems in infancy. The chance that two parents who are heterozygous will have a child with PKU is 25%. Which of the following terms best applies to the inheritance pattern for PKU?

A. codominant  
B. dominant  
C. recessive  
D. sex-linked

18 Which of the following describes plant cells but not animal cells?

A. The nucleus contains the chromosomes.  
B. The ribosomes assist in protein synthesis.  
C. Plastids store starch made during photosynthesis.  
D. Mitochondria produce energy through respiration.

19 The fossil record supports which of the following descriptions of the evolution of life on Earth?

A. Life first appeared with the diversity found today.  
B. The importance of natural selection diminished over time.  
C. Complex organisms evolved from more simple organisms.  
D. Large organisms appeared before single-celled organisms.

20 In a eukaryotic cell, which of the following processes directly involves DNA?

A. translation  
B. cellular respiration  
C. active transport of ions  
D. replication of chromosomes
Heartburn is pain that occurs when acidic gastric juice is forced out of the upper end of the stomach. In which of the following organs does a person experience heartburn?

A. pancreas  
B. esophagus  
C. small intestine  
D. large intestine

The size of a bird population increased by two percent in one year. Which of the following could have contributed to the population increase?

A. a decrease in the death rate of baby birds  
B. an increase in the number of the birds’ predators  
C. an increase in the average number of parasites per bird  
D. a decrease in the immigration of birds of the same species
Glucose is a simple carbohydrate that is important to living organisms.

a. Describe the primary function of glucose in cells.

b. Simple sugars like glucose can be used to make larger organic molecules. Identify two larger molecules made from simple sugars.

c. Identify a specific cellular process that would be affected by a glucose shortage, and discuss the effects of the shortage on the process you identified.
DIRECTIONS
This session contains nineteen multiple-choice questions and three open-response questions. Mark your answers to these questions in the spaces provided in your Student Answer Booklet. You may work out solutions to multiple-choice questions in the test booklet.

24 In a molecule of double-stranded DNA, the amount of adenine present is always equal to the amount of
A. cytosine.
B. guanine.
C. thymine.
D. uracil.

25 Which of the following statements best explains why oxygen diffuses from the alveoli into the blood?
A. The diaphragm draws oxygen into the alveoli at a rapid speed.
B. Alveoli cells contain hemoglobin to transfer gases to the blood.
C. The concentration of oxygen is greater in the alveoli than in the blood.
D. Red blood cells move one at a time through the capillaries surrounding the alveoli.
Plants absorb solar energy during photosynthesis. The graph below represents how this energy is distributed in some plants.

Which of the following statements describes what happens to the energy represented by the section labeled X?

A. It is recycled to the Sun.
B. It is consumed by decomposers.
C. It is lost to the soil and the atmosphere.
D. It is used for cellular respiration and maintenance.

Which of the following statements gives the most likely explanation for the presence of two very similar species of squirrels living on opposite sides of the Grand Canyon?

A. One squirrel traveled across the canyon and started a new population on the other side.
B. One squirrel traveled across the canyon and interbred with a different population on the other side.
C. Members of a single squirrel species were geographically separated by the formation of the canyon.
D. Members of two different squirrel species migrated from two different places to opposite sides of the canyon.
Energy for most chemical reactions in cells is supplied by which of the following molecules?

A. ATP  
B. DNA  
C. adrenaline  
D. hemoglobin

When locust populations grow too large for an area, the individual locusts are crowded and food becomes scarce. In response to these conditions, some of the locusts leave the area and find a new habitat.

Which of the following terms best applies to the response of the locusts that leave for the new habitat?

A. commensalism  
B. emigration  
C. hibernation  
D. mutualism

Which of the following statements best explains why offspring produced by sexual reproduction often look similar to, but not exactly the same as, their parents?

A. The offspring have genetic material from both the mother and the father.  
B. The cells of the offspring contain all the dominant genes from the parents.  
C. The cells of the offspring undergo mitosis many times as the offspring grow and develop.  
D. The offspring have a period of embryonic development, rather than being born immediately after fertilization.

In traditional landscaping, leaves are raked off the ground and bagged. In which of the following ways does this practice most significantly disrupt natural nutrient cycling?

A. It carries away microorganisms that can perform nitrogen fixation.  
B. It reduces the rate of oxygen and carbon cycling via photosynthesis.  
C. It prevents carbon, oxygen, and nitrogen from being returned to the soil.  
D. It increases the amount of carbon dioxide that is released to the atmosphere.
The table below shows the classifications of three different sea lions.

<table>
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<tr>
<th>Kingdom</th>
<th>California Sea Lion</th>
<th>Galápagos Sea Lion</th>
<th>New Zealand Sea Lion</th>
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<tr>
<td>Genus</td>
<td>Zalophus</td>
<td>Zalophus</td>
<td>Phocarctos</td>
</tr>
<tr>
<td>Species</td>
<td>californianus</td>
<td>wollebaeki</td>
<td>hookeri</td>
</tr>
</tbody>
</table>

a. Identify which two of the sea lions are most closely related.

b. Justify your answer to part (a).

c. Describe and explain two types of evidence scientists would have used to determine the proper classifications of these three sea lions.
In the past 100 years, levels of atmospheric carbon dioxide have increased as the result of the burning of fossil fuels. Other processes in the carbon cycle have absorbed some of the carbon released by this combustion.

Which of the following most likely have absorbed excess carbon released by combustion?

A. animals  
B. glaciers  
C. plants  
D. rocks

In fruit flies, the gene for eye color is located on the X chromosome, and the red eye allele (R) is dominant to the white eye allele (r). A female fly with genotype X^{R}X^{r} is mated with a male fly with genotype X^{r}Y.

Which of the following statements best describes the expected outcome of the cross?

A. The chance of an offspring having red eyes is 75%.  
B. The chance of an offspring having white eyes is 50%.  
C. The chance that a male offspring will have white eyes is 0%.  
D. The chance that a female offspring will have red eyes is 100%.

The Asian shore crab invaded parts of the eastern coast of the United States about 15 years ago. The Asian shore crab preys on blue mussels. In the time since the Asian shore crab arrived, the average shell thickness has increased in the blue mussel population.

Which of the following is the most likely reason that this increase in shell thickness has occurred?

A. Blue mussels with thick shells attract more crabs than mussels without thick shells.  
B. Blue mussels with thick shells grow in larger colonies than mussels without thick shells.  
C. Blue mussels with thick shells catch more food per day than mussels without thick shells.  
D. Blue mussels with thick shells survive and reproduce more successfully than mussels without thick shells.
The graph below shows changes in the sizes of four animal populations over a 16-year period.

In which population was birthrate most likely greater than death rate from year 8 to year 12?

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

The northern spotted owl is listed under the Endangered Species Act as a threatened species in its primary range of Washington, Oregon, and California. Which of the following most likely contributed to the northern spotted owl’s population decline?

A. increases in rodent populations
B. loss of trees from forest habitat
C. prevention of wildfires in forests
D. decreases in mountain lion populations

Which of the following elements is most common in the tissues of plants?

A. hydrogen
B. iron
C. potassium
D. sodium
To investigate selective pressures on fish populations, researchers set up three identical tanks, labeled X, Y, and Z. Each tank contained 1000 fish of the same species. Before the fish reproduced each generation, the researchers removed fish from some of the tanks. The graph below shows the changes in the mean weight of the fish in each tank over four generations.

Based on the graph, what did the researchers most likely do to tank Z each generation?

A. The researchers removed the 900 smallest fish.
B. The researchers removed the 900 largest fish.
C. The researchers removed 900 fish at random.
D. The researchers removed none of the fish.
40. If a cell’s lysosomes were damaged, which of the following would most likely occur?

A. The cell would produce more proteins than it needs.
B. The cell would have chloroplasts that appear yellow rather than green.
C. The cell would be less able to break down molecules in its cytoplasm.
D. The cell would be less able to regulate the amount of fluid in its cytoplasm.

41. A species of parasitic fly follows the sounds that male crickets make with their wings. The flies deposit their larvae in the crickets’ bodies. As the larvae develop and emerge from the crickets’ bodies, the crickets die. Researchers have discovered a genetic mutation in some crickets that changes their wing structure and makes them silent. The crickets with silent wings are found among crickets with normal wings when it is time to mate.

According to evolution by natural selection, which of the following will most likely occur in the cricket population, based on the selection pressure from the flies?

A. Male crickets with silent wings will increase in frequency.
B. The frequency of the silent wing mutation will stay the same.
C. Male crickets with normal wings will learn to make new sounds.
D. A new mutation will create spikes on the crickets’ wings to keep the flies away.
42 Which of the following is a function of the liver?

A. removing toxic compounds from the blood
B. secreting digestive enzymes into the stomach
C. producing white blood cells to fight infections
D. converting food into smaller nutrient molecules

43 In humans, the appendix is small and is not needed for digestion. In rabbits, the appendix is well developed and is used in the digestion of plant fibers.

Which of the following provides the best scientific explanation for the presence of the appendix in both humans and rabbits?

A. Rabbits and humans live in environments with similar conditions.
B. Rabbits and humans are both eukaryotes with similar cell structures.
C. The appendix is evolving into a new type of organ in rabbits and humans.
D. The appendix is inherited from a common ancestor of rabbits and humans.
Gregor Mendel developed an understanding of heredity through his experiments with pea plants. The diagram below shows a cell with two pairs of homologous chromosomes and a genotype of $AaBb$.

a. Identify all the possible allele combinations that could be formed if this cell undergoes meiosis.

b. Identify one of Mendel’s laws that is illustrated when you write out these allele combinations. Explain this law.
A small part of a food web for a forest ecosystem is shown below.

a. Classify each of the five organisms in the food web as a producer, a primary consumer, a secondary consumer, or a tertiary consumer.

b. Identify the type of ecological relationship between salamanders and birds in this food web.

c. Suppose there is a significant decrease in the bird population. Based on the relationships in the food web, explain why it would be difficult for ecologists to predict what would happen to the size of the salamander population.
<table>
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<th>Item No.</th>
<th>Page No.</th>
<th>Reporting Category</th>
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<th>Correct Answer (M C)*</th>
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<td>304</td>
<td>Biochemistry and Cell Biology</td>
<td>1.1</td>
<td>A</td>
</tr>
<tr>
<td>39</td>
<td>305</td>
<td>Evolution and Biodiversity</td>
<td>5.3</td>
<td>A</td>
</tr>
<tr>
<td>40</td>
<td>306</td>
<td>Biochemistry and Cell Biology</td>
<td>2.1</td>
<td>C</td>
</tr>
<tr>
<td>41</td>
<td>306</td>
<td>Evolution and Biodiversity</td>
<td>5.3</td>
<td>A</td>
</tr>
<tr>
<td>42</td>
<td>307</td>
<td>Anatomy and Physiology</td>
<td>4.2</td>
<td>A</td>
</tr>
<tr>
<td>Item No.</td>
<td>Page No.</td>
<td>Reporting Category</td>
<td>Standard</td>
<td>Correct Answer (M C)*</td>
</tr>
<tr>
<td>---------</td>
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</tr>
<tr>
<td>43</td>
<td>307</td>
<td>Evolution and Biodiversity</td>
<td>5.1</td>
<td>D</td>
</tr>
<tr>
<td>44</td>
<td>308</td>
<td>Genetics</td>
<td>3.5</td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>309</td>
<td>Ecology</td>
<td>6.3</td>
<td></td>
</tr>
</tbody>
</table>

* 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 website later this year.
XIX. Chemistry, High School
High School Chemistry Test


The Science and Technology/Engineering Curriculum Framework is available on the Department website 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, Chemistry test results are reported under the following four MCAS reporting categories:

- Atomic Structure and Periodicity
- Bonding and Reactions
- Properties of Matter and Thermochemistry
- Solutions, Equilibrium, and Acid-Base Theory

Test Sessions

The MCAS high school Chemistry test included two separate test sessions, which were administered on consecutive days. Each session included multiple-choice and open-response questions.

Reference Materials and Tools

Each student taking the high school Chemistry test was provided with a Chemistry Formula and Constants Sheet/Periodic Table of the Elements. Copies of both sides of this formula sheet follow the final question in this chapter.

Each student also had sole access to a calculator with at least four functions and a square-root key.

The use of bilingual word-to-word dictionaries was allowed for current and former limited English proficient students only, during both Chemistry 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.
DIRECTIONS
This session contains twenty-one multiple-choice questions and two open-response questions. Mark your answers to these questions in the spaces provided in your Student Answer Booklet. You may work out solutions to multiple-choice questions in the test booklet.

1. Which of the following statements describes all exothermic reactions?
   A. Exothermic reactions form gases.
   B. Exothermic reactions require a catalyst.
   C. The energy of the reactants is lower than the energy of the products.
   D. The energy of the reactants is higher than the energy of the products.

2. Which of the following statements best explains why potassium (K) reacts easily with bromine (Br)?
   A. Potassium and bromine both have valence electrons in the fourth energy level.
   B. Potassium and bromine have the same number of electrons in their highest energy levels.
   C. Potassium has one electron in its highest energy level, and bromine needs one electron to complete its highest energy level.
   D. Potassium needs one electron to complete its highest energy level, and bromine has an extra electron in its highest energy level.
3. Which of the following statements best explains why atoms bond?

A. Atoms bond to make new substances.
B. Atoms bond to become less chemically stable.
C. Atoms bond to change from a liquid to a solid.
D. Atoms bond to become more chemically stable.

4. Which of the following changes of state will increase the entropy of water molecules?

A. $\text{H}_2\text{O}(g) \rightarrow \text{H}_2\text{O}(s)$
B. $\text{H}_2\text{O}(g) \rightarrow \text{H}_2\text{O}(l)$
C. $\text{H}_2\text{O}(l) \rightarrow \text{H}_2\text{O}(s)$
D. $\text{H}_2\text{O}(s) \rightarrow \text{H}_2\text{O}(l)$

5. The diagram below shows gas inside a sealed container before and after force is applied to the container’s movable piston. The temperature inside the container remains the same after the force is applied.

Applying force to the piston results in compression of the gas particles and an increase in gas pressure. Which of the following statements best describes the change in gas particles after compression?

A. The kinetic energy of the gas particles increases.
B. The kinetic energy of the gas particles decreases.
C. The velocity with which the gas particles hit the container wall increases.
D. The frequency with which the gas particles hit the container wall increases.
The table below shows the procedures for and results of two experiments using copper(II) chloride, CuCl₂.

<table>
<thead>
<tr>
<th>Experiment 1</th>
<th>Experiment 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Procedure</strong></td>
<td><strong>Procedure</strong></td>
</tr>
<tr>
<td>Put 0.5 g of CuCl₂ in a crucible. Heat under a fume hood over a Bunsen burner flame.</td>
<td>Put 0.5 g of CuCl₂ in a beaker containing 50 mL of dilute sodium hydroxide (NaOH).</td>
</tr>
<tr>
<td><strong>Results</strong></td>
<td><strong>Results</strong></td>
</tr>
<tr>
<td>The crystals change from yellow-brown to white. A strong odor is given off.</td>
<td>A precipitate forms. The blue solution turns colorless. No odor is given off.</td>
</tr>
</tbody>
</table>

Which of the following conclusions can be made based on the results of the experiments?

A. Physical changes occurred in both experiments.
B. Chemical changes occurred in both experiments.
C. A chemical change occurred in experiment 1, and a physical change occurred in experiment 2.
D. A physical change occurred in experiment 1, and a chemical change occurred in experiment 2.

Hydrogen peroxide decomposes according to the equation below.

\[2\text{H}_2\text{O}_2(aq) \rightarrow \text{O}_2(g) + 2\text{H}_2\text{O}(l)\]

Which of the following actions will slow down the rate of this reaction?

A. adding a catalyst
B. adding more H₂O₂
C. decreasing the temperature
D. removing O₂ that is produced

When a sample of potassium chloride dissolves in water, it separates into potassium ions and chloride ions. Which of the following best accounts for the positive charge of the potassium ions?

A. They have extra mass.
B. They have a large volume.
C. They have fewer electrons than protons.
D. They have a high density of neutrons and protons.
The equation below shows the chemical reaction that occurs in a car battery.

\[
Pb(s) + PbO_2(s) + 2H_2SO_4(aq) \rightarrow 2PbSO_4(s) + 2H_2O(l)
\]

1.00 kg  1.15 kg  2.93 kg  0.17 kg

How much sulfuric acid (H$_2$SO$_4$) is consumed in the reaction?

A. 0.78 kg  
B. 0.95 kg  
C. 2.15 kg  
D. 3.10 kg

Which of the following characteristics allows blood to resist changes in pH?

A. acidity  
B. basicity  
C. buffering capacity  
D. clotting factors
Question 11 is an open-response question.

- **BE SURE TO ANSWER AND LABEL ALL PARTS OF THE 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 11 in the space provided in your Student Answer Booklet.

11 The arrangement of particles in atoms is similar for all elements.

   a. In your Student Answer Booklet, draw a model of the structure of a helium (He) atom. Include and label all the major components of the atom.

   b. Describe where most of the mass is located in the helium atom.

   c. Describe where the charges are distributed in the helium atom.
Mark your answers to multiple-choice questions 12 through 22 in the spaces provided in your Student Answer Booklet. Do not write your answers in this test booklet, but you may work out solutions to multiple-choice questions in the test booklet.

12. Which of the following statements applies to a nuclear fission reaction?

A. The reaction has no commercial applications.
B. The reaction takes place only at very high temperatures.
C. The reaction produces only short-lived radioactive waste.
D. The reaction releases large amounts of energy when nuclei split apart.

13. A sealed flask contains $1.3 \times 10^{25}$ molecules of CO$_2$. How many moles of CO$_2$ are in the flask?

A. 0.046 mol
B. 22 mol
C. $3.0 \times 10^{23}$ mol
D. $7.8 \times 10^{48}$ mol

14. The chemical structure of formaldehyde is shown below.

What is the geometry around the carbon atom?

A. bent
B. linear
C. tetrahedral
D. trigonal planar
Gold-198 has a half-life of approximately 3 days. If a 100 g sample of gold-198 decays for 9 days, approximately how much gold-198 remains in the sample?

A. 13 g  
B. 25 g  
C. 33 g  
D. 50 g

Formaldehyde in solution is used as a preservative. It has a melting point of -92°C. When the temperature of a sample of formaldehyde rises from -93°C to -91°C, which of the following occurs?

A. The molecules move more freely.  
B. The molecules lose electrical charge.  
C. The molecules break apart into atoms.  
D. The molecules become fixed in a crystal structure.

Which of the following solutions has the highest concentration of solute?

A. 1.0 mol solute in 200 mL solvent  
B. 2.0 mol solute in 500 mL solvent  
C. 3.0 mol solute in 1 L solvent  
D. 4.0 mol solute in 1.5 L solvent

A pharmacist mixes together 20 g of crystals of compound A and 10 g of crystals of compound B. The mixture is then dissolved in 120 mL of water to make cough syrup. The mixture will most likely dissolve fastest under which of the following sets of conditions?

A. Size of Crystals (mm) | Temperature (°C) | Stirring (Y/N)  
--- | --- | ---  
0.01–0.02 | 22.3 | N

B. Size of Crystals (mm) | Temperature (°C) | Stirring (Y/N)  
--- | --- | ---  
0.1–0.2 | 49.9 | N

C. Size of Crystals (mm) | Temperature (°C) | Stirring (Y/N)  
--- | --- | ---  
0.1–0.2 | 22.3 | Y

D. Size of Crystals (mm) | Temperature (°C) | Stirring (Y/N)  
--- | --- | ---  
0.01–0.02 | 49.9 | Y
A hiker carries drinking water in a cloth-covered, metal container called a canteen. During the summer, the hiker wets the cloth covering so that the water in the canteen stays cool.

Which of the following statements explains why a wet covering keeps the water cool?

A. A wet covering transfers coolness to the water in the canteen.
B. A wet covering insulates the canteen better than a dry covering.
C. Evaporation of water from the covering transfers heat away from the canteen.
D. Condensation of water from the covering transfers heat away from the canteen.

The reaction below shows carbon monoxide burning in oxygen.

\[
2\text{CO} + \text{O}_2 \rightarrow 2\text{CO}_2
\]

What is the change in the oxidation number of carbon for this reaction?

A. +2 to +1
B. +2 to +4
C. +4 to +1
D. +4 to +2
The diagram below shows two gases maintained at STP in separate chambers by a closed valve.

N₂

O₂

After the valve is opened, the two gases form a homogeneous mixture. Which of the following changes in the system results when forming this mixture?

A. loss of heat
B. increase in entropy
C. chemical reaction of the gases
D. decrease in the total volume of the gases

The balanced equation below shows the reaction used to make calcium sulfate (CaSO₄), an ingredient in plaster.

\[ \text{CaCO}_3(s) + \text{H}_2\text{SO}_4(aq) \rightarrow \text{CaSO}_4(s) + \text{CO}_2(g) + \text{H}_2\text{O}(l) \]

In an experiment, 0.500 mol CaCO₃ reacted with excess sulfuric acid (H₂SO₄). The reaction produced 0.425 mol CaSO₄. What was the percent yield for the reaction?

A. 42.5%
B. 50.0%
C. 73.5%
D. 85.0%
The table below shows the pH values of some substances used in the chemical industry.

<table>
<thead>
<tr>
<th>Chemical Formula and Concentration of Substances</th>
<th>pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>HCN (0.1 M)</td>
<td>5.1</td>
</tr>
<tr>
<td>CH₃COOH (0.1 M)</td>
<td>2.9</td>
</tr>
<tr>
<td>KCl (0.1 M)</td>
<td>7.0</td>
</tr>
<tr>
<td>KOH (0.1 M)</td>
<td>13.0</td>
</tr>
<tr>
<td>NaHCO₃ (0.1 M)</td>
<td>8.5</td>
</tr>
</tbody>
</table>

a. Classify each of the five substances as acidic, basic, or neutral.

b. List the five substances in order of increasing hydrogen ion concentration.

c. Describe what would happen to the pH of the CH₃COOH if the concentration was increased from 0.1 M to 1.0 M. Explain your reasoning.
Chemistry
SESSION 2

DIRECTIONS
This session contains nineteen multiple-choice questions and three open-response questions. Mark your answers to these questions in the spaces provided in your Student Answer Booklet. You may work out solutions to multiple-choice questions in the test booklet.

24 Which element has the electron configuration 1s²2s²2p³?
   A. boron
   B. nitrogen
   C. fluorine
   D. phosphorus

25 The compound Mg(OH)₂ is classified as an Arrhenius base because, when the compound dissolves in water, there is an increase in the concentration of which of the following ions?
   A. hydrogen ions
   B. hydroxide ions
   C. magnesium ions
   D. oxide ions

26 Which of the following statements explains what happens to the gas inside a balloon as the external pressure on the balloon decreases and the temperature stays constant?
   A. The volume increases.
   B. The volume decreases.
   C. The molecular speed increases.
   D. The molecular speed decreases.

27 When pure N₂O₅ is heated under certain conditions, O₂ and NO₂ are produced. What type of reaction is this?
   A. combustion
   B. decomposition
   C. double displacement
   D. synthesis (combination)
The equation below shows the reaction of chloroform (CHCl₃) with hydrogen (H₂) to produce methane (CH₄) and chlorine (Cl₂).

$$2\text{CHCl}_3(g) + 3\text{H}_2(g) \xrightarrow{\text{heat}} 2\text{CH}_4(g) + 3\text{Cl}_2(g)$$

Which of the following changes will shift the equilibrium to the right, producing more methane?

A. raising the temperature of the reaction  
B. lowering the concentration of hydrogen  
C. increasing the total pressure of the gases  
D. increasing the volume of the reaction vessel

What is the volume of 0.25 mol of ammonia gas (NH₃) at 1.00 atm and 273 K?

A. 0.33 L  
B. 5.6 L  
C. 95 L  
D. 1530 L

Which of the following statements best explains why ice floats on water?

A. Water has a higher specific heat than ice.  
B. Ice has the same molecular mass as water.  
C. Heat is absorbed when water changes from the solid state to the liquid state.  
D. Hydrogen bonding causes water to be less dense in the solid state than in the liquid state.

Which of the following did scientists learn about the atom from Rutherford’s gold foil experiment?

A. Atoms combine in simple ratios to form compounds.  
B. Electrons travel around the nucleus of an atom in concentric circular paths.  
C. The mass of an atom and its positive charge are concentrated in the nucleus.  
D. The atomic mass of an atom is equal to the number of protons and neutrons in the nucleus.

Which of the following elements is a metalloid?

A. magnesium  
B. silicon  
C. phosphorus  
D. cobalt
Question 33 is an open-response question.

- **BE SURE TO ANSWER AND LABEL ALL PARTS OF THE 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 33 in the space provided in your Student Answer Booklet.

Incorrect Lewis dot structures for CO, O₂, and C₂H₄ are shown in the figures below.

\[
\begin{align*}
\text{CO} & :C=\text{O}: \\
\text{O₂} & :\text{O}−\text{O}: \\
\text{C₂H₄} & \text{H}−\text{C}=\text{C}−\text{H}
\end{align*}
\]

a. Select **two** of these Lewis dot structures and explain why each is incorrect.

b. In your Student Answer Booklet, draw the **correct** Lewis dot structure for each compound you selected in part (a).
Barium and iodine combine to form an ionic compound. What is the chemical formula for this compound?

A. BaI
B. BaI₂
C. Ba₂I
D. Ba₂I₂

Two elements in a molecule have the same electronegativity values. Which of the following most likely holds the elements together and why?

A. an ionic bond, because electrons transfer from one element to the other
B. a nonpolar covalent bond, because the elements share electrons equally
C. a polar covalent bond, because the elements do not share electrons equally
D. an intermolecular force, because the elements do not form a chemical bond

A student dissolves 10.0 g of ammonium nitrate (NH₄NO₃) crystals in a calorimeter containing 100.0 g of water. The equation for the dissolution process is shown below.

\[ \text{NH}_4\text{NO}_3(s) \rightarrow \text{NH}_4^+(aq) + \text{NO}_3^-(aq) \]

The student records the temperature of the solution every 5 s. The table below shows the collected data.

<table>
<thead>
<tr>
<th>Time (s)</th>
<th>Temperature (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>22.2</td>
</tr>
<tr>
<td>5</td>
<td>17.5</td>
</tr>
<tr>
<td>10</td>
<td>17.0</td>
</tr>
<tr>
<td>15</td>
<td>16.6</td>
</tr>
<tr>
<td>20</td>
<td>16.6</td>
</tr>
</tbody>
</table>

Which of the following conclusions about dissolving the crystals can be made based on the data?

A. Dissolution added energy to the water, so the process is exothermic.
B. Dissolution added energy to the water, so the process is endothermic.
C. Dissolution absorbed energy from the water, so the process is exothermic.
D. Dissolution absorbed energy from the water, so the process is endothermic.
37 What is the empirical formula for \( \text{C}_4\text{Br}_2\text{F}_8 \)?

A. \( \text{CBrF} \)
B. \( \text{C}_2\text{BrF}_4 \)
C. \( \text{C}_2\text{BrF}_6 \)
D. \( \text{C}_8\text{Br}_8\text{F}_8 \)

38 A crystal of table salt (NaCl) is dissolved in water. Which of the following statements explains why the dissolved salt does not recrystallize as long as the temperature and the amount of water stay constant?

A. \( \text{Na}^+ \) and \( \text{Cl}^- \) ions lose their charges in the water.
B. Water molecules surround the \( \text{Na}^+ \) and \( \text{Cl}^- \) ions.
C. \( \text{Na}^+ \) and \( \text{Cl}^- \) ions leave the water through vaporization.
D. Water molecules chemically react with the \( \text{Na}^+ \) and \( \text{Cl}^- \) ions.

39 The illustration below represents a portion of the periodic table with electronegativity values given for four of the elements.

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>O</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.5</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>P</td>
<td></td>
<td>S</td>
<td></td>
</tr>
<tr>
<td>2.1</td>
<td></td>
<td>3.0</td>
<td></td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Se</td>
<td></td>
</tr>
<tr>
<td>2.4</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Based on electronegativity trends in the periodic table, which of the following is the most likely value for the electronegativity of sulfur?

A. 1.5
B. 2.0
C. 2.5
D. 3.0

40 Which of the following equations represents the law of conservation of mass?

A. \( \text{H}_2\text{O} \rightarrow \text{H}_2 + \text{O}_2 \)
B. \( 2\text{H} + 2\text{O} \rightarrow 2\text{H}_2\text{O} \)
C. \( 2\text{H}_2\text{O} \rightarrow 2\text{H}_2 + \text{O}_2 \)
D. \( \text{H}_2 + \text{O}_2 \rightarrow \text{H}_2\text{O} + \text{H}_2\text{O}_2 \)
A radioactive source emits a beam containing alpha, beta, and gamma radiation. The beam passes between two charged plates before striking a detection screen. One plate is negatively charged and the other plate is positively charged, as shown in the diagram below.

Which of the following tables indicates the location where each type of radiation will most likely strike the detection screen after passing between the charged plates?

A. 
| Location 1 | Alpha |
| Location 2 | Beta  |
| Location 3 | Gamma |

B. 
| Location 1 | Beta  |
| Location 2 | Gamma |
| Location 3 | Alpha |

C. 
| Location 1 | Gamma |
| Location 2 | Alpha |
| Location 3 | Beta  |

D. 
| Location 1 | Alpha |
| Location 2 | Gamma |
| Location 3 | Beta  |
42 Which of the following statements best explains why water vapor condenses as temperature decreases?

A. Collisions between water vapor molecules become elastic.
B. Water vapor molecules chemically react when they collide.
C. Water vapor molecules are pulled together by the force of gravity.
D. Attractive forces between water vapor molecules overcome molecular motion.

43 Which of the following elements is a member of the halogen family and is located in period 3?

A. argon (Ar)
B. bromine (Br)
C. chlorine (Cl)
D. sulfur (S)
Questions 44 and 45 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 44 in the space provided in your Student Answer Booklet.

Octane ($C_8H_{18}$) is a major component of gasoline. The burning of octane produces carbon dioxide ($CO_2$), as shown in the equation below.

$$2C_8H_{18} + 25O_2 \rightarrow 16CO_2 + 18H_2O$$

a. Calculate the molar masses of octane ($C_8H_{18}$) and carbon dioxide ($CO_2$). Show your calculations and include units in your answer.

b. Calculate the amount of $CO_2$, in grams, produced by the combustion of 100.0 g of octane. Show your calculations and include units in your answer.

Many people think it is important to reduce the amount of $CO_2$ being released by fuel combustion because $CO_2$ is a greenhouse gas. Propane ($C_3H_8$) is another hydrocarbon fuel used to power some motor vehicles. The combustion of propane is shown in the equation below.

$$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$$

The combustion of 100.0 g of propane produces 299.4 g of carbon dioxide. Assume the combustion of propane produces the same amount of energy per gram as the combustion of octane.

c. Based on this information and your calculations, identify which fuel, octane or propane, is less harmful to the environment. Justify your answer.
All substances are classified as elements, compounds, or mixtures. Mixtures may be homogeneous or heterogeneous. A chemistry class collected and classified the samples listed below.

- table salt
- dirt from the woods
- classroom air
- copper wire

a. Identify the sample that is classified as an element. Explain your reasoning.

b. Identify the sample that is classified as a single compound. Explain your reasoning.

c. Identify the sample that is classified as a homogeneous mixture. Explain your reasoning.

d. Identify the sample that is classified as a heterogeneous mixture. Explain your reasoning.
Common Polyatomic Ions

<table>
<thead>
<tr>
<th>Ion</th>
<th>Ionic Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ammonium</td>
<td>NH$_4^+$</td>
</tr>
<tr>
<td>Carbonate</td>
<td>CO$_3^{2-}$</td>
</tr>
<tr>
<td>Hydroxide</td>
<td>OH$^-$</td>
</tr>
<tr>
<td>Nitrate</td>
<td>NO$_3^-$</td>
</tr>
<tr>
<td>Phosphate</td>
<td>PO$_4^{3-}$</td>
</tr>
<tr>
<td>Sulfate</td>
<td>SO$_4^{2-}$</td>
</tr>
</tbody>
</table>

Combined Gas Law: \[
\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}
\]

Ideal Gas Law: \[PV = nRT\]

Dilution Formula: \[M_1V_1 = M_2V_2\]

Molar Volume of Ideal Gas at STP: \[22.4 \text{ L/mol}\]

Ideal Gas Constant: \[R = 0.0821 \text{ L \cdot atm/mol \cdot K} = 8.31 \text{ L \cdot kPa/mol \cdot K}\]

STP: \[1 \text{ atm (101.3 kPa), 273 K (0°C)}\]

Absolute Temperature Conversion: \[K = ^{\circ}\text{C} + 273\]

Definition of pH: \[\text{pH} = -\log[H_3O^+] = -\log[H^+]\]

Avogadro’s Number: \[6.02 \times 10^{23} \text{ particles/mol}\]

Nuclear Symbols

<table>
<thead>
<tr>
<th>Name</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alpha particle</td>
<td>$\alpha$ or $^4_2\text{He}$</td>
</tr>
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### Periodic Table of the Elements

**Key:**
- atomic weight
- Symbol
- atomic number
- Name

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**Mass numbers in parentheses are those of the most stable or most common isotope.**

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- Cerium (140.12)
- Praseodymium (140.91)
- Neodymium (144.24)
- Promethium (145.04)
- Samarium (150.36)
- Europium (151.96)
- Gadolinium (157.55)
- Terbium (162.50)
- Dysprosium (164.94)
- Holmium (167.26)
- Erbium (167.93)
- Thulium (174.04)
- Ytterbium (174.97)

**Actinide Series**
- Actinium (227)
- Thorium (232.04)
- Protactinium (231.04)
- Uranium (238.03)
- Neptunium (237)
- Plutonium (239)
- Americium (244)
- Curium (247)
- Berkelium (251)
- Californium (252)
- Einsteinium (257)
- Fermium (258)
- Mendelevium (269)
- Nobelium (277)
- Lawrencium (262)

*Revised based on IUPAC Commission on Atomic Weights and Isotopic Abundances, “Atomic Weights of the Elements 2007.”*
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*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 website later this year.*
XX. Introductory Physics, High School
High School Introductory Physics Test


The Science and Technology/Engineering Curriculum Framework is available on the Department website 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, Introductory Physics test results are reported under the following four MCAS reporting categories:

- Motion and Forces
- Heat and Heat Transfer
- Waves and Radiation
- Electromagnetism

Test Sessions

The MCAS high school Introductory Physics test included two separate test sessions, which were administered on consecutive days. Each session included multiple-choice and open-response questions.

Reference Materials and Tools

Each student taking the high school Introductory Physics test was provided with an Introductory Physics Formula Sheet. A copy of this formula sheet follows the final question in this chapter.

Each student also had sole access to a calculator with at least four functions and a square-root key.

The use of bilingual word-to-word dictionaries was allowed for current and former limited English proficient students only, during both Introductory Physics 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.
A balloon is inflated with room-temperature air and then put in a sunny place. The balloon expands slightly due to a rise in temperature. Which of the following best describes the molecules of air inside the balloon when the balloon is left in the sunlight as compared to when it was first inflated?

A. The molecules are moving faster.
B. There are more molecules in the balloon.
C. There are fewer interactions between the molecules.
D. The molecules stop colliding with the walls of the balloon.

Four students push on a block of wood with the forces shown in the diagram below. Assume friction is negligible.

The block slides horizontally. What is the net force acting on the block of wood?

A. 3 N to the left
B. 8 N to the left
C. 11 N to the right
D. 25 N to the right
A cup containing 25 mL of hot water and a similar cup containing 25 mL of cold water are placed on a table in a room at 21°C. Which of the following graphs shows the most likely change in temperature for each cup from 0 min to 40 min?
4. Which of the following properties is the same for all electromagnetic waves in a vacuum?
   A. amplitude
   B. frequency
   C. speed
   D. wavelength

5. An elevator in an office building completed the following trips:
   - 1st floor to 8th floor
   - 8th floor to 4th floor
   - 4th floor to 13th floor

The distance between each floor of the office building is 3.0 m.
Which table shows the total distance traveled and displacement of the elevator?

A. Distance  Displacement
   33 m      60 m

B. Distance  Displacement
   60 m      36 m

C. Distance  Displacement
   36 m      60 m

D. Distance  Displacement
   60 m      60 m
6. Which of the following conditions results in the buildup of static charge on an object?
   A. when neutrons outnumber electrons
   B. when there are more protons than neutrons
   C. when there are more electrons than protons
   D. when all neutrons have been removed from the object

7. What is the voltage across the terminals of a 23 Ω resistor that has 0.065 A of current flowing through it?
   A. 0.0028 V
   B. 0.097 V
   C. 1.5 V
   D. 350 V

8. The momentum of an object in space is
   A. dependent on its mass.
   B. independent of its inertia.
   C. independent of its velocity.
   D. dependent on its potential energy.

9. Which of the following is an example of heat transfer by conduction?
   A. sunlight heating a floor
   B. an electric stove heating an iron pan
   C. a wood stove heating nearby objects through electromagnetic waves
   D. an electric heater heating air, which rises and is replaced with cooler air
In a competition, weightlifter 1 lifts a 100 kg weight from the floor. Weightlifter 2 also lifts a 100 kg weight to the same height above the floor, but takes a longer time to do so.

Which of the following statements describes the work done and the power used by the weightlifters?

A. Weightlifter 2 does the same work and uses less power compared with weightlifter 1.
B. Weightlifter 2 does less work and uses the same power compared with weightlifter 1.
C. Weightlifter 2 does the same work and uses more power compared with weightlifter 1.
D. Weightlifter 2 does more work and uses the same power compared with weightlifter 1.

The graphs below give information for waves W and X. Both waves were produced in the same medium and are moving at the same speed.

Which of the following statements describes another property of these waves?

A. Wave W has a larger period than wave X.
B. Wave W has a lower frequency than wave X.
C. Wave W has a greater amplitude than wave X.
D. Wave W has a shorter wavelength than wave X.
Introductory Physics

Question 12 is an open-response question.

- **BE SURE TO ANSWER AND LABEL ALL PARTS OF THE 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 12 in the space provided in your Student Answer Booklet.

12 A car’s brakes absorb a large amount of energy and heat up as the car slows down and stops. Several materials with different thermal properties have been used for car brakes. In the table below, the specific heat capacities of three of these materials are shown.

<table>
<thead>
<tr>
<th>Material</th>
<th>Specific Heat Capacity (J/g °C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>aluminum</td>
<td>0.897</td>
</tr>
<tr>
<td>carbon-ceramic</td>
<td>1.123</td>
</tr>
<tr>
<td>steel</td>
<td>0.449</td>
</tr>
</tbody>
</table>

In an experiment, 500 g each of aluminum, carbon-ceramic, and steel are heated and their temperature changes are recorded. The amount of heat absorbed and the temperature change for the 500 g sample of steel are shown in the graph below.

a. In your Student Answer Booklet, copy the graph.
   - Draw a line on your graph to show the relationship expected for the 500 g sample of aluminum.
   - Draw a line on your graph to show the relationship expected for the 500 g sample of carbon-ceramic.
   - Identify each line on your graph, and explain why you drew each line where you did.

b. If brake materials get too hot they soften or melt, resulting in loss of braking power. Of the three materials in the table, which is best suited to resist large changes in temperature? Explain your answer.
Mark your answers to multiple-choice questions 13 through 22 in the spaces provided in your Student Answer Booklet. Do not write your answers in this test booklet, but you may work out solutions to multiple-choice questions in the test booklet.

13. Which of the following properties determines a color in the visible light region of the electromagnetic spectrum?
   A. acceleration  
   B. amplitude  
   C. frequency  
   D. speed

14. The source of a sound is moving away from an observer who is standing still. How do the sound waves received by the observer compare with those emitted by the source?
   A. They are heard as having a greater velocity. 
   B. They are heard as having a higher frequency. 
   C. They are heard as having a lower frequency. 
   D. They are heard as having a smaller wavelength.

15. The diagram below shows a simple electric circuit.

   ![Electric Circuit Diagram]

 Which of the following statements describes the function of the battery?
   A. It reduces the flow of electrons. 
   B. It transmits light through the circuit. 
   C. It pushes electrons through the circuit. 
   D. It releases light during a chemical reaction.

16. When a student listens to music, sound waves propagate from the speaker to her ear. Which of the following is a physical description of this process?
   A. Particles produced at the speaker move to the student's ear. 
   B. Energy is transported from the speaker to the student's ear. 
   C. Material is transferred from the speaker to the student's ear. 
   D. Clusters of air molecules are sent from the speaker to the student's ear.
17. Which of the following statements best describes the force of Earth’s gravity on a rocket moving upward?

A. The gravitational force is constant for all altitudes.
B. The gravitational force is weaker when the rocket is higher.
C. The gravitational force is stronger when the rocket is higher.
D. The gravitational force is zero when the altitude is greater than 10,000 miles.

18. A student swings a bat horizontally, making contact with a ball thrown to her. The ball leaves the bat, and the bat continues moving through the rest of the swing.

Which of the following statements describes the change in energy necessary to do work on the ball?

A. All the kinetic energy of the bat is converted to work.
B. All the potential energy of the bat is converted to work.
C. Some of the kinetic energy of the bat is converted to work.
D. Some of the potential energy of the bat is converted to work.

19. The diagram below shows copper wire wrapped around a cardboard tube, which is then attached to a galvanometer. A galvanometer detects and measures small amounts of electric current.

Which of the following would cause the galvanometer needle to move?

A. wrapping additional wire around the tube
B. uncoiling the wire wrapped around the tube
C. moving a magnet back and forth inside the tube
D. moving an aluminum block up and down inside the tube
A star suddenly explodes. Which of the following types of waves reach Earth’s surface?

A. light only
B. sound only
C. sound followed by light
D. light followed by sound

A ball is thrown straight upward. The ball’s initial speed is 30 m/s and its mass is 0.05 kg, resulting in an initial kinetic energy of 22.5 J.

If the initial potential energy of the ball is 10 J and there is no frictional force, what would be the ball’s total energy while it is moving?

A. 0.0 J
B. 10.0 J
C. 22.5 J
D. 32.5 J

At an amusement park, bumper car X moves at a speed of 2.5 m/s toward car Y, which is at rest, as shown in the diagram below.

Car X collides with car Y. How does the momentum of each car change after the collision?

A. Car X’s momentum increases, and car Y’s momentum decreases.
B. Car X’s momentum decreases, and car Y’s momentum increases.
C. Car X’s momentum is unchanged, and car Y’s momentum increases.
D. Car X’s momentum is unchanged, and car Y’s momentum decreases.
A student is conducting experiments with a block of wood. In experiment 1, the student pulls the block of wood with a constant force of 10 N along a horizontal surface. In experiment 2, the student pulls the same block of wood with a constant force of 10 N. The type of surface is different from that used in experiment 1. The results of experiments 1 and 2 are shown below.

<table>
<thead>
<tr>
<th>Time (s)</th>
<th>Distance (m)</th>
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<tbody>
<tr>
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<tr>
<td>0.2</td>
<td>0.25</td>
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<tr>
<td>0.6</td>
<td>0.75</td>
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<tr>
<td>0.8</td>
<td>1.00</td>
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<td>1.0</td>
<td>1.25</td>
</tr>
<tr>
<td>1.2</td>
<td>1.25</td>
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<tr>
<td>1.4</td>
<td>1.25</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Time (s)</th>
<th>Distance (m)</th>
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<tbody>
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<td>1.25</td>
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<tr>
<td>1.4</td>
<td>1.25</td>
</tr>
</tbody>
</table>

a. Using information from the graphs, compare the surface in experiment 2 with the surface in experiment 1.

b. Determine both the magnitude of the force of friction and the net force on the block that are required to achieve the results shown in the graph for experiment 2. Include units in your answer.

c. Without changing the type of surface used when pulling the block of wood, list one other change to experiment 1 that would produce the results of experiment 2. Explain your reasoning with reference to the frictional force.
DIRECTIONS
This session contains nineteen multiple-choice questions and three open-response questions. Mark your answers to these questions in the spaces provided in your Student Answer Booklet. You may work out solutions to multiple-choice questions in the test booklet.

24 Which of the following actions would increase the current through a circuit component?
   A. decreasing the power in the component
   B. increasing the resistance of the component
   C. increasing the voltage across the component
   D. placing another identical component in series in the circuit

25 The specific heat of wood is about 1,700 J/kg °C. How much energy is required to heat a 12 kg piece of wood from 20°C to 30°C?
   A. 1,400 J
   B. 17,000 J
   C. 204,000 J
   D. 612,000 J

26 A 2000 kg car is pulling a 1000 kg trailer. The car’s engine exerts a 6000 N force to move the car and the trailer. In addition, the car and the trailer each experience a 1000 N frictional force as they are being pulled, as represented below.

What is the magnitude of the net force on this system?
   A. 2000 N
   B. 4000 N
   C. 5000 N
   D. 8000 N
A teacher asks a group of students to use a ruler to measure the amplitude of the wave shown below.

Between which of the following points should the amplitude be measured?

A. points U and Z  
B. points V and X  
C. points W and Y  
D. points X and Z

The diagram below represents a bicyclist at the top of a hill, with four points labeled W, X, Y, and Z.

Assume that the bicyclist does not apply the brakes as he rides down the hill. At which point will the bicyclist’s kinetic energy be closest to zero?

A. point W  
B. point X  
C. point Y  
D. point Z
29. Which of the following is designed to produce an electromagnetic wave?
   A. elastic cord
   B. laser pointer
   C. metal spring
   D. ripple tank

30. Two full 2 L bottles of water are placed on a table. Bottle 1 was just removed from a refrigerator; bottle 2 is at room temperature.
   Which of the following statements describes the average molecular kinetic energy and the speed of the molecules in each bottle?
   A. Bottle 1 has the same average molecular kinetic energy as bottle 2, and the molecules have the same average speed in both bottles.
   B. Bottle 1 has a smaller average molecular kinetic energy than bottle 2, and the molecules have the same average speed in both bottles.
   C. Bottle 1 has a smaller average molecular kinetic energy than bottle 2, and the molecules have a slower average speed in bottle 1 than in bottle 2.
   D. Bottle 1 has a larger average molecular kinetic energy than bottle 2, and the molecules have a slower average speed in bottle 1 than in bottle 2.

31. Which of the following statements describes a result of Earth's gravitational pull on the Moon?
   A. The Moon has craters.
   B. The Moon orbits around Earth.
   C. The Moon lacks an atmosphere.
   D. The Moon has less gravity than Earth.
When some elements are put into a flame, they emit colored light. Yellow light is emitted from one element and violet light is emitted from another element.

a. Describe the differences between yellow light and violet light in terms of frequency and wavelength.

The diagram below represents violet light.

```
Violet light
```

b. Copy the diagram of violet light into your Student Answer Booklet. Below your diagram, draw and label a representation of yellow light that illustrates how its frequency and wavelength are different from that of violet light.

c. Yellow light and violet light are both in the visible range of the electromagnetic spectrum. Identify two other similarities between yellow light and violet light.
Mark your answers to multiple-choice questions 33 through 43 in the spaces provided in your Student Answer Booklet. Do not write your answers in this test booklet, but you may work out solutions to multiple-choice questions in the test booklet.

33 A microwave oven uses 10 A of current when connected to a wall outlet that provides 120 V of electricity. What is the resistance of the microwave oven?

A. $0.083 \, \Omega$
B. $12 \, \Omega$
C. $110 \, \Omega$
D. $1200 \, \Omega$

34 Two students are standing next to each other on a level field. One of the students throws a table tennis ball forward toward a line 2.0 m away. At the same time, the second student throws a bowling ball in the same direction. Both balls take the same time to travel the 2.0 m.

Only the second student feels a noticeable backward push when she throws her ball.

Which of the following statements explains why only the second student feels a noticeable backward push?

A. The bowling ball exerts a much larger reaction force.
B. The bowling ball undergoes a much larger acceleration.
C. The bowling ball requires more force to overcome gravity.
D. The bowling ball converts more inertia into kinetic energy.

35 A copper sphere, a glass sphere, a plastic sphere, and a rubber sphere are placed on individual insulating stands. A student touches each sphere with an electrically charged object.

The sphere made of which material will distribute the electric charge fastest over its entire surface area?

A. copper
B. glass
C. plastic
D. rubber

36 A person is using a force of 200 N to push a box. How much power does the person need to push the box a distance of 4 m in 10 s?

A. 40 W
B. 80 W
C. 200 W
D. 500 W
37. Which of the following will always change when an object accelerates?

A. mass
B. potential energy
C. velocity
D. weight

38. In a television set with a cathode ray tube display, a beam of negatively charged particles called cathode rays passes by a positively charged plate. The beam is deflected before it hits the television screen to produce an image. Which of the following changes would result in the greatest increase in the attraction between the negatively charged particles in the beam and the positively charged plate?

A. increasing the distance between the plate and the particles and increasing the charge on the plate
B. increasing the distance between the plate and the particles and decreasing the charge on the plate
C. decreasing the distance between the plate and the particles and increasing the charge on the plate
D. decreasing the distance between the plate and the particles and decreasing the charge on the plate

39. Which of the following would cause a change in the speed of a mechanical wave?

A. the wave moving through a liquid
B. the wave moving from a solid to a gas
C. the wave being made by a larger vibration
D. the wave being made by a smaller vibration

40. The table below shows the time it takes four cars to go from 0 to 60 km/h.

<table>
<thead>
<tr>
<th>Car</th>
<th>Time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.5</td>
</tr>
<tr>
<td>2</td>
<td>4.2</td>
</tr>
<tr>
<td>3</td>
<td>5.2</td>
</tr>
<tr>
<td>4</td>
<td>3.3</td>
</tr>
</tbody>
</table>

Based on the information given, which of the following quantities can be compared for the four cars?

A. average acceleration
B. instantaneous speed
C. stopping distance
D. stopping time
The diagram below shows a light ray striking the flat surface of a piece of clear hard plastic at an angle of 45°. Light travels faster in air than through plastic.

Which of the following diagrams shows how the ray is refracted after it travels through the plastic?

A. 

B. 

C. 

D. 

The graph below shows the speed of an object during a 10 s time interval.

In which of the following time intervals is the speed of the object decreasing?

A. between 0 s and 2 s  
B. between 2 s and 4 s  
C. between 6 s and 8 s  
D. between 8 s and 10 s

A string is tied on a spring. Two students then stretch out the spring, as shown below.

In which of the following ways does the string move when the students generate a longitudinal wave in the spring?

A.  
B.  
C.  
D.
Questions 44 and 45 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 44 in the space provided in your Student Answer Booklet.

44. A pendulum is made with a bowling ball as the bob and a wire attached to the ceiling, as shown in the illustration below. The person in the illustration pulls the bowling ball back until it touches his nose, then releases the bowling ball. Assume that he does not move.

![Diagram of a pendulum with a bowling ball as the bob and a wire attached to the ceiling. The person is pulling the bowling ball back until it touches his nose.]

a. Describe the changes in the potential energy and the kinetic energy of the bowling ball as it swings back and forth.

b. Explain whether the bowling ball will hit the person's nose. Include a discussion of energy changes in your explanation.

c. Explain what will happen if the person gives the bowling ball a small push as it is released. Include a discussion of energy changes in your explanation.
The diagram below shows a circuit with a 12 V battery connected in series with a 4 Ω resistor and a 2 Ω resistor. Two points in the circuit are labeled X and Y.

a. Calculate the current in the circuit. Show your calculations and include units in your answer.

b. Calculate the voltage drop across the 4 Ω resistor. Show your calculations and include units in your answer.

c. Determine the voltage drop between point X and point Y. Explain the reasoning for your answer.

d. Calculate the power of the entire circuit. Show your calculations and include units in your answer.
Formulas

Average Speed \( \frac{d}{\Delta t} \)

F = ma

p = mv

Average Acceleration \( \frac{\Delta v}{\Delta t} \)

F = G \frac{m_1 m_2}{d^2}

V = IR

Average Velocity \( \frac{\Delta x}{\Delta t} \)

F = k \frac{q_1 q_2}{d^2}

P = IV

\( v_f = v_i + a\Delta t \)

KE = \frac{1}{2}mv^2

Q = mc\Delta T

\( \Delta x = v_i \Delta t + \frac{1}{2}a \Delta t^2 \)

PE = mg\Delta h

v = f\lambda

\( v_f^2 = v_i^2 + 2a\Delta x \)

W = Fd

\( \lambda = \frac{c}{f} \)

Average Velocity \( \frac{v_i + v_f}{2} \)

P = \frac{W}{\Delta t}

T = \frac{1}{f}

Variables

a = acceleration

c = specific heat

d = distance

f = frequency

F = force

\( \Delta h = \) change in height

I = current

KE = kinetic energy

\( v_i = \) initial velocity

\( v_f = \) final velocity

m = mass

p = momentum

P = power

PE = gravitational potential energy

\( \Delta x = \) displacement

Definitions

\( c = \) speed of electromagnetic waves \( = 3.00 \times 10^8 \) m/s

G = Universal gravitational constant \( = 6.67 \times 10^{-11} \) \( \frac{N \cdot m^2}{kg^2} \)

k = Coulomb constant \( = 8.99 \times 10^9 \) \( \frac{N \cdot m^2}{C^2} \)

g \approx 10 \text{ m/s}^2 \quad 1 \text{ N} = 1 \frac{kg \cdot m}{s^2} \quad 1 \text{ J} = 1 \text{ N} \cdot \text{m} \quad 1 \text{ W (watt)} = 1 \frac{1}{s} \)
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<thead>
<tr>
<th>Item No.</th>
<th>Page No.</th>
<th>Reporting Category</th>
<th>Standard</th>
<th>Correct Answer (M C)*</th>
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<tbody>
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<td>339</td>
<td>Heat and Heat Transfer</td>
<td>3.3</td>
<td>A</td>
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* 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 website later this year.
XXI. Technology/Engineering, High School
High School Technology/Engineering Test


The Science and Technology/Engineering Curriculum Framework is available on the Department website 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, Technology/Engineering test results are reported under the following four MCAS reporting categories:

- Engineering Design
- Construction and Manufacturing
- Fluid and Thermal Systems
- Electrical and Communications Systems

Test Sessions

The MCAS high school Technology/Engineering test included two separate test sessions, which were administered on consecutive days. Each session included multiple-choice and open-response questions.

Reference Materials and Tools

Each student taking the high school Technology/Engineering test was provided with a plastic ruler and a Technology/Engineering Formula Sheet. A copy of this formula sheet follows the final question in this chapter. An image of the ruler is not reproduced in this publication.

Each student also had sole access to a calculator with at least four functions and a square-root key.

The use of bilingual word-to-word dictionaries was allowed for current and former limited English proficient students only, during both 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.
DIRECTIONS
This session contains twenty-one multiple-choice questions and two open-response questions. Mark your answers to these questions in the spaces provided in your Student Answer booklet. You may work out solutions to multiple-choice questions in the test booklet.

1. An architect is designing a house to be built in Maine. Which of the following features would maximize both passive solar heating and the amount of natural light inside the house?
   A. a high gable roof
   B. light-colored vinyl siding
   C. solar-electric panels on the roof
   D. a large number of south-facing windows

2. In a factory that manufactures automobiles, some workers have the job of installing doors on the cars. Which part of the manufacturing process is this job?
   A. forming
   B. finishing
   C. conditioning
   D. assembling

3. Sarah presented an idea for recycling used tires to an automotive company. If she followed the engineering design process, what was the first step in developing her idea?
   A. communicating the results of her research
   B. developing a prototype she wanted to make
   C. selecting the best possible solution to her problem
   D. identifying the specific problem she wanted to solve

4. The drawing below represents a metal bar subjected to forces at both ends. The dotted line indicates the axis along which the forces are applied.

Which of the following is the type of stress being exerted on the bar?
   A. compression
   B. shear
   C. tension
   D. torsion
5. A farmer places a sprinkler on top of a platform in the middle of a field. Water is pumped to the sprinkler from a water supply tank. The spray from the sprinkler, however, does not reach the edges of the field. Which of the following should the farmer do to increase the range of the sprinkler?

A. Place the sprinkler at ground level.
B. Reduce the diameter of the sprinkler nozzle.
C. Move the water supply tank closer to the field.
D. Increase the diameter of the water supply tank.

6. The diagram below shows the flow of water in a section of a piping system. Which zone has the highest resistance to the flow of water?

A. zone W
B. zone X
C. zone Y
D. zone Z
7. A DC to AC inverter allows people to use AC devices in a car. This inverter converts 12 V DC from a car outlet to 110 V AC.

Which of the following graphs best represents the output signal of the inverter?

A. 
```
+-----+-----+-----+-----+-----+-----+-----+
|     |     |     |     |     |     |     |
|  V   |     |     |     |     |     |     |
|      |     |     |     |     |     |     |
|      |     |     |     |     |     |     |
|      |     |     |     |     |     |     |
|      |     |     |     |     |     |     |
+-----+-----+-----+-----+-----+-----+-----+
```

B. 
```
+-----+-----+-----+-----+-----+-----+-----+
|     |     |     |     |     |     |     |
|  V   |     |     |     |     |     |     |
|      |     |     |     |     |     |     |
|      |     |     |     |     |     |     |
|      |     |     |     |     |     |     |
|      |     |     |     |     |     |     |
+-----+-----+-----+-----+-----+-----+-----+
```

C. 
```
+-----+-----+-----+-----+-----+-----+-----+
|     |     |     |     |     |     |     |
|  V   |     |     |     |     |     |     |
|      |     |     |     |     |     |     |
|      |     |     |     |     |     |     |
|      |     |     |     |     |     |     |
|      |     |     |     |     |     |     |
+-----+-----+-----+-----+-----+-----+-----+
```

D. 
```
+-----+-----+-----+-----+-----+-----+-----+
|     |     |     |     |     |     |     |
|  V   |     |     |     |     |     |     |
|      |     |     |     |     |     |     |
|      |     |     |     |     |     |     |
|      |     |     |     |     |     |     |
|      |     |     |     |     |     |     |
+-----+-----+-----+-----+-----+-----+-----+
```

8. A manufacturing company wants to increase its production. Which of the following is the best reason why the company should consider using robotic systems?

A. Robotic systems are easy to operate.
B. Robotic systems can function continuously.
C. Robotic systems are inexpensive to purchase.
D. Robotic systems are more intelligent than human workers.

9. How many views are usually necessary in order to describe an object using an orthographic projection?

A. 1 or 2
B. 2 or 3
C. 4 or 5
D. 5 or 6
DC voltage sources have a positive (+) terminal and a negative (−) terminal. Which of the following statements explains why AC voltage sources do not have positive and negative terminals?

A. AC voltage at each terminal is always changing.
B. AC current does not involve charged particles.
C. AC current is safe and warning labels are not needed.
D. AC voltage at each terminal is always higher than ground.
A single sheet of plywood can be cut to produce several smaller pieces.

a. On the grid provided in your Student Answer Booklet, draw a 4' × 8' piece of plywood using the scale \( \frac{1}{6}" = 6" \).

b. On your drawing, mark the lines necessary to obtain the following pieces (ignore blade thickness):
   - one 1' × 8'
   - two 1' × 4'
   - one 2' × 3'
   - two 1' × 2'
   - one 2' × 2'

c. Is there any wood left over? If so, what are the dimensions of the waste?
Which of the following is considered a nonrenewable energy source?

A. sunlight  
B. uranium  
C. wind  
D. wood

A series circuit with two resistors is shown below.

At which two points should a voltmeter be connected to measure the voltage of the circuit?

A. points Y and Z  
B. points W and X  
C. points X and Y  
D. points W and Z

A working diagram for a prototype of a motor is shown below.

What is the diameter of one of the rotor magnets?

A. 1.0 in.  
B. 2.0 in.  
C. 4.0 in.  
D. 8.0 in.
Information produced by technological devices can travel through optical fiber, air, and space. Which of the following statements describes what these media have in common?

A. Information travels through these media at the same speed.
B. Information travels through these media at a single frequency.
C. Information travels through these media using mechanical waves.
D. Information travels through these media using electromagnetic waves.

One type of hydraulic system is designed to lift heavy objects. Which of the following statements best explains this application?

A. The hydraulic system acts as a force multiplier.
B. The hydraulic system acts as a work multiplier.
C. The hydraulic system acts as a power multiplier.
D. The hydraulic system acts as an energy multiplier.

The electrical resistance of a wire may change depending on which of the following?

A. the luster of the wire
B. the elasticity of the wire
C. the malleability of the wire
D. the temperature of the wire

A simple circuit diagram is shown below.

What is the resistance of the circuit if the current is 0.5 A?

A. 3.0 Ω
B. 9.0 Ω
C. 12.0 Ω
D. 24.0 Ω
19. Meaghan is going to use the air-powered tool shown below. She has never used this tool before. Which of the following should Meaghan do first before using this tool?

A. release the safety trigger
B. read the operational manual thoroughly
C. use an extension cord to plug in the tool
D. make sure the tool is connected to an air supply

20. Before releasing a newly designed video game to the public, the developer distributes the game to a few hundred people free of charge. After playing the game, the people complete a survey and return it to the developer. What part of the engineering design process does this scenario represent?

A. redesign
B. testing and evaluation
C. selection of a solution
D. construction of prototypes
When calculators were first introduced, they were large and not very portable. Which of the following allowed for the development of pocket-size calculators?

A. direct current  
B. fewer function keys  
C. graphing software  
D. smaller microprocessors

For a manufacturing process, the cutting edges of the separating tool should typically have which of the following characteristics?

A. They should be harder than the material being cut.  
B. They should be cleaner than the material being cut.  
C. They should be more porous than the material being cut.  
D. They should be more flexible than the material being cut.
A thermostat for the heating system will control the temperature in the large room. Four possible locations for the thermostat are shown on the plan.

Explain why each of the four numbered locations either is or is not a good place for the thermostat. Include the relevant heat transfer methods for each location in your answer.
DIRECTIONS
This session contains nineteen multiple-choice questions and three open-response questions. Mark your answers to these questions in the spaces provided in your Student Answer Booklet. You may work out solutions to multiple-choice questions in the test booklet.

24. During World War II, signal lights were used to send Morse code messages between ships. A sailor would open and close a shutter over a light source to send “dots” and “dashes” of light to another ship. The sailor performed the function of which component of a communication system?
A. decoder
B. destination
C. encoder
D. receiver

25. A current of 1.2 A flows through a 5.0 Ω resistor in a circuit. What is the voltage across this resistor?
A. 0.24 V
B. 3.8 V
C. 6.0 V
D. 7.5 V

26. The figure below shows water being heated in a pan on a gas burner.

Water
Flame
Pan

Which of the following identifies a heat transfer primarily due to radiation?
A. from the wall of the pan to the cover
B. from the pan to the surface of the water
C. from the flame to the bottom of the pan
D. from the surface of the water to the handle of the pan
27. Telephone circuits were originally made of copper. Which of the following has replaced much of the copper circuitry that connected telephone switching stations over long distances?

A. fiberoptic cables
B. reinforced plastics
C. superconductors
D. tungsten wires

28. Which of the following causes the greatest resistance to water flowing through a PVC piping system?

A. elbows
B. gaskets
C. insulation
D. rust

29. Which of the following functions can a variable resistor perform?

A. storing electrical charge
B. adjusting light intensity
C. creating electrical energy
D. controlling current direction
30 Which of the following is an example of an open fluid system?

A. an irrigation system for a farm
B. a forced hot water heater for a house
C. a hydraulic braking system for a truck
D. a cooling system for an automobile engine

31 During a hurricane, winds can blow out windows and walls, or remove the roof from a house. According to Bernoulli’s principle, which of the following statements best explains why this can occur?

A. Wind blowing around and over a house creates convection currents outside the house.
B. Wind blowing around and over a house is at a lower pressure than the air inside the house.
C. Wind blowing around and over a house is at a higher temperature than the air inside the house.
D. Wind blowing around and over a house creates electrostatic charges in the air around the house.

32 Which of the following describes the primary function of an alkaline battery in the circuit of a typical flashlight?

A. It opens and closes the circuit path.
B. It provides resistance to generate light.
C. It converts chemical energy to electrical energy for the circuit.
D. It serves as a conductor through which electrical energy flows.
Question 33 is an open-response question.

- **BE SURE TO ANSWER AND LABEL ALL PARTS OF THE 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 33 in the space provided in your Student Answer Booklet.

33. The diagrams below represent a hydraulic system and a pneumatic system.

These two systems are similar in function, but system X uses oil while system Y uses air.

a. Identify which system is hydraulic and which system is pneumatic.

b. Describe one application of a hydraulic system and one application of a pneumatic system in manufacturing or transportation.

c. Describe one advantage and one disadvantage of each type of system.
34. Lasers produce coherent light. Which of the following drawings **best** represents coherent light?

A. ![Diagram A]
B. ![Diagram B]
C. ![Diagram C]
D. ![Diagram D]

35. The floor of a particular motel room should be able to support 50 lb. per sq. ft. of live load. If the dimensions of the room are 12 ft. \( \times \) 15 ft., what is the total live load that the floor should support?

A. 600 lb.
B. 750 lb.
C. 1350 lb.
D. 9000 lb.
36 Which of the following are represented using binary values?
A. analog signals  
B. digital signals  
C. gamma rays  
D. ultraviolet rays

37 Since the introduction of the cellular phone, many advances in wireless communication have been made. Which of the following features has been added to cellular phones for the purpose of finding someone who has placed an emergency call?
A. caller identification  
B. digital camera  
C. global positioning system  
D. text messaging

38 Which of the following matches a communication medium with a type of signal that can be readily transmitted through it?
A. copper wire—electric  
B. copper wire—infrared  
C. optical fiber—radio  
D. optical fiber—x-ray

39 Message signs and arrow boards are used to direct traffic and safeguard workers on roads and highways. These devices were originally run by diesel-powered generators. Which of the following provides a practical way to power these mobile devices and is more efficient than a generator?
A. natural gas  
B. water power  
C. a geothermal system  
D. a solar conversion system
The diagram below shows a basic construction diagram for framing a deck.

Which of the following statements best explains why the details shown in X and Y are provided?

A. The length of the deck may vary.
B. The width of the deck may vary.
C. The posts may sit on different types of foundations.
D. The deck may be attached to structures made of different materials.
A contractor needs to choose a low-density material for use in the construction of a building. When comparing two materials of the same size, the less dense material always gives a building structure which of the following characteristics?

A. lower weight
B. greater strength
C. lower flammability
D. greater electrical conductivity

A scale drawing of a rectangular storage tank has a scale of 1 cm = 0.5 m. The dimensions of the tank on the drawing are 24 cm × 32 cm × 20 cm. What are the dimensions of the actual storage tank?

A. 2.4 m × 3.2 m × 2.0 m
B. 4.8 m × 6.4 m × 4.0 m
C. 12 m × 16 m × 10 m
D. 48 m × 64 m × 40 m

The system is designed to transfer heat from the solar panel to the hot water tank. The heat is transferred to and from the water pipes through heat exchangers. The system will be most efficient if the heat exchangers are made of which of the following materials?

A. copper
B. glass
C. porcelain
D. plastic
John and Samantha are moving to a city. They would like to open a music store. The building they want to buy includes enough space for the store, living quarters for John and Samantha, and a room in which John can practice the drums after the store closes at night. Before agreeing to make an offer on the property, John and Samantha go to the city hall to check the city zoning laws.

a. Identify two specific zoning laws that John and Samantha should check.

b. Explain how each zoning law you identified in part (a) would affect John and Samantha's decision on purchasing the property.
A student looking into the front of a glass aquarium filled with water notices that she cannot see through the right or left sides of the aquarium. She investigates this observation by aiming a laser pointer at the front of the aquarium and observing the path of the light. Her results are shown in the diagram below.

a. Describe what happens to the light that strikes the front glass panel of the aquarium and the light that strikes the right glass panel of the aquarium.

b. Describe in detail how the behavior of light in the student's investigation relates to fiberoptic data transmission.
Formulas

\[ V = I \times R \]

\[ P = I \times V \]

Pressure = \( \frac{\text{Force}}{\text{Area}} \)

Area of a circle = \( \pi r^2 \)

Variables

\( I = \) current

\( r = \) radius

\( P = \) power

\( R = \) resistance

\( V = \) voltage

Definitions and Abbreviations

\( AC = \) alternating current

\( psi = \) pounds per square inch

\( DC = \) direct current

\( \pi \approx 3.14 \)
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*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 website later this year.