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## XIV. Mathematics, Grade 8

# Grade 8 Mathematics Test

The spring 2017 grade 8 Mathematics test was a next-generation assessment, featuring a new test design and new item types. The test was administered in two formats: a computer-based version and a paper-based version. The test included both operational items, which count toward a student's score, and matrix items. The matrix portion of the test consisted of field-test questions that do not count toward a student's score.

In general, all students were administered the same operational items, regardless of whether they took the computer-based test or the paper-based test. In some instances, the wording or content of a paper item differed slightly from the computer-based version. More information about the differences between the computer-based and paper-based tests will be posted to the MCAS website at [www.doe.mass.edu/mcas/](http://www.doe.mass.edu/mcas/).

This document displays the **paper-based versions** of the 2017 operational items that have been released. The **computer-based versions** of the released items are available on the MCAS Resource Center website at [mcas.pearsonsupport.com](http://mcas.pearsonsupport.com).

## Test Sessions and Content Overview

The grade 8 Mathematics test was made up of two separate test sessions. Each session included selected-response, short-answer, and constructed-response questions. On the paper-based test, the selected-response questions were multiple-choice items and multiple-select items, in which students select the correct answer(s) from among several answer options.

## Standards and Reporting Categories

The grade 8 Mathematics test was based on standards in the five domains for grade 8 in the *Massachusetts Curriculum Framework for Mathematics* (March 2011). The grade 8 standards can be found on pages 65–69 in the *Framework*, and the five domains are listed below.

- The Number System
- Expressions and Equations
- Functions
- Geometry
- Statistics and Probability

The *Massachusetts Curriculum Framework for Mathematics* is available on the Department website at [www.doe.mass.edu/frameworks/current.html](http://www.doe.mass.edu/frameworks/current.html).

Mathematics test results are reported under five MCAS reporting categories, which are identical to the five framework domains listed above.

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

## Reference Materials and Tools

Each student taking the paper-based version of the grade 8 Mathematics test was provided with a plastic ruler and a grade 8 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. Calculator use was not allowed during Session 1.

During both Mathematics test sessions, the use of bilingual word-to-word dictionaries was allowed for current and former English language learner students only. No other reference tools or materials were allowed.

# Grade 8 Mathematics

This session contains 5 questions.

*You may use your reference sheet during this session.  
You may use a calculator for questions 3–5.*

## Directions

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

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

For other questions, you will need to fill in an answer grid. Directions for completing questions with answer grids are provided on the next page.

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



## Mathematics

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- 1 Rae made a table of  $x$  and  $y$  values. The relationship between the  $x$  and  $y$  values in Rae's table is **not** a function. One of the values of  $x$  is missing from Rae's table, as shown.

$x$	$y$
-3	-8
5	11
-1	6
0	-4
	9

What is one value of  $x$  that Rae could use to complete her table to show that the relationship between  $x$  and  $y$  is **not** a function?

Enter your answer in the box.

## Mathematics

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- 2 Jason is comparing the sizes of Earth, Saturn, and a lacrosse ball. The radius of Earth is approximately 6,378,100 meters.

### Part A

What is the radius of Earth, in meters, written as a single-digit number multiplied by a power of 10?

Enter your answer in the space provided. Enter **only** your answer.

### Part B

The radius of Saturn is approximately  $6 \times 10^7$  meters.

Use your answer from Part A to estimate how many times greater the radius of Saturn is than the radius of Earth. Show or explain how you got your answer.

Enter your answer and your work or explanation in the space provided.

### Part C

The radius of a lacrosse ball is approximately 0.032 meter.

Estimate the radius of a lacrosse ball, in meters, by expressing the radius as a single-digit number multiplied by a power of 10.

Enter your answer in the space provided. Enter **only** your answer.

### Part D

Use your answers from Parts A and C to estimate how many times greater the radius of **Earth** is than the radius of a lacrosse ball. Show or explain how you got your answer.

Enter your answer and your work or explanation in the space provided.

## Mathematics

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3 A researcher surveyed 500 people and asked these two questions:

- Are you left-handed or right-handed?
- Do you prefer scary movies or comedies?

This table shows the results of the survey.

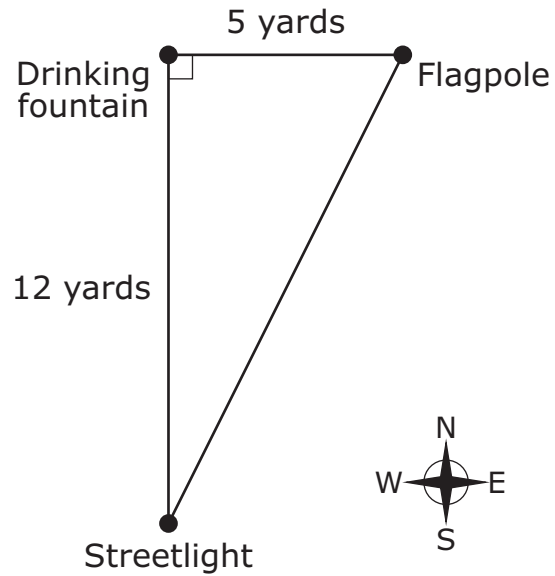
		Movie Preference	
		Scary Movies	Comedies
Handedness	Left-Handed	15	35
	Right-Handed	180	270

Based on the results of the survey, what is the relative frequency of left-handed people who prefer comedies to all people who prefer comedies?

- A.  $\frac{35}{500}$
- B.  $\frac{35}{305}$
- C.  $\frac{35}{270}$
- D.  $\frac{35}{50}$

## Mathematics

- 4 In a park, the locations of a drinking fountain, a streetlight, and a flagpole form a right triangle. The drinking fountain is 12 yards north of the streetlight, and the flagpole is 5 yards east of the drinking fountain, as shown in this diagram.



What is the shortest distance from the streetlight to the flagpole?

- A. 7 yards
- B. 11 yards
- C. 13 yards
- D. 17 yards



## Mathematics

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5 Which of the following is an irrational number?

A.  $7.\overline{1234}$

B. 7.9253481

C.  $\frac{2}{\sqrt{9}}$

D.  $\frac{\sqrt{2}}{9}$

**CONVERSIONS**

1 cup = 8 fluid ounces

1 pint = 2 cups

1 quart = 2 pints

1 gallon = 4 quarts

1 gallon  $\approx$  3.785 liters

1 liter  $\approx$  0.264 gallon

1 liter = 1000 cubic centimeters

1 inch = 2.54 centimeters

1 meter  $\approx$  39.37 inches

1 mile = 5280 feet

1 mile = 1760 yards

1 mile  $\approx$  1.609 kilometers

1 kilometer  $\approx$  0.62 mile

1 pound = 16 ounces

1 pound  $\approx$  0.454 kilogram

1 kilogram  $\approx$  2.2 pounds

1 ton = 2000 pounds

**AREA (*A*) 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 . . . . .  $A = \pi r^2$

**CIRCLE FORMULAS**

area . . . . .  $A = \pi r^2$

circumference . . . . .  $C = 2\pi r$

OR  
 $C = \pi d$

**VOLUME (*V*) FORMULAS**

cube . . . . .  $V = s^3$   
(*s* = length of an edge)

sphere . . . . .  $V = \frac{4}{3}\pi r^3$

cone . . . . .  $V = \frac{1}{3}\pi r^2h$

right circular cylinder . . . . .  $V = \pi r^2h$

right prism . . . . .  $V = Bh$

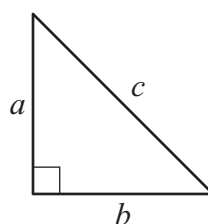
**TOTAL SURFACE AREA (*SA*) FORMULAS**

right rectangular prism . . . . .  $SA = 2(lw) + 2(hw) + 2(lh)$

right circular cylinder . . . . .  $SA = 2\pi r^2 + 2\pi rh$

sphere . . . . .  $SA = 4\pi r^2$

**PYTHAGOREAN THEOREM**



$a^2 + b^2 = c^2$

**Grade 8 Mathematics**  
**Spring 2017 Released Operational Items:**  
**Reporting Categories, Standards, Item Descriptions, and Correct Answers**

Item No.	Page No.	Reporting Category	Standard	Item Type*	Description	Correct Answer**
1	191	<i>Functions</i>	8.F.1.01	SA	Complete a given input-output table given that the relationship is not a function.	-3 or -1 or 0 or 5
2	192	<i>Expressions and Equations</i>	8.EE.1.03	CR	Solve a multi-step real-world problem involving single-digit numbers multiplied by powers of 10 and the relationships among them.	
3	193	<i>Statistics and Probability</i>	8.SP.1.04	SR	Interpret a given two-way table and select the relative frequency based on a given real-world context.	B
4	194	<i>Geometry</i>	8.G.2.07	SR	Apply Pythagorean Theorem to determine unknown lengths in a real-world context.	C
5	195	<i>The Number System</i>	8.NS.1.01	SR	Identify the number that is irrational.	D

\* Mathematics item types are: selected-response (SR), short-answer (SA), and constructed-response (CR).

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

**Grade 8 Mathematics**  
**Spring 2017 Unreleased Operational Items:**  
**Reporting Categories, Standards, and Item Descriptions**

Item No.	Reporting Category	Standard	Item Type*	Description
6	<i>Expressions and Equations</i>	8.EE.1.02	SR	Find the value of $x$ in a given equation of the form $x$ squared = $p$ .
7	<i>Statistics and Probability</i>	8.SP.1.04	SR	Interpret a given two-way table to solve a real-world problem.
8	<i>Geometry</i>	8.G.1.03	SA	Determine the $x$ -coordinate of the vertex of the image of a reflected triangle and select descriptions of relationships between the triangle and its reflection.
9	<i>The Number System</i>	8.NS.1.02	SR	Determine which point on a number line best approximates the location of the square root of a two-digit number.
10	<i>Functions</i>	8.F.2.04	SR	Solve problems involving finding and interpreting the rate of change, and constructing a function based on a given real-world context.
11	<i>The Number System</i>	8.NS.1.02	SR	Find the range of values for the given square root of a given one-digit whole number.

Item No.	Reporting Category	Standard	Item Type*	Description
12	<i>Expressions and Equations</i>	8.EE.3.07	SA	Find the value of the unknown variable in a given equation.
13	<i>Functions</i>	8.F.2.05	SR	Determine which graph represents a function that was described qualitatively.
14	<i>Expressions and Equations</i>	8.EE.1.04	SR	Solve a real-world problem that involves performing operations on two numbers expressed in scientific notation.
15	<i>Expressions and Equations</i>	8.EE.2.06	CR	Determine the equation of a line and explain how to find the slope and $y$ -intercept.
16	<i>Functions</i>	8.F.1.03	SR	Determine which equation is linear.
17	<i>Geometry</i>	8.G.1.04	SR	Determine which transformation must be included in the sequence of transformations that result in a given two-dimensional figure, and select the statements that are true about the figure and its image, after reflection.
18	<i>Statistics and Probability</i>	8.SP.1.02	SR	Determine which scatterplot best represents a line of best fit in a real-world context.
19	<i>Functions</i>	8.F.2.05	SR	Determine which statement best describes a given graph qualitatively.
20	<i>Expressions and Equations</i>	8.EE.2.05	SA	Determine and compare two rates of change in a given real-world context.
21	<i>Functions</i>	8.F.1.01	SR	Determine which ordered pair would make the relationship shown in a table not a function.
22	<i>Geometry</i>	8.G.1.02	SR	Determine the sequence of transformations on a given triangle and select the statement that best describes the congruency between the triangle and its image.
23	<i>Functions</i>	8.F.1.02	SR	Determine which equation has the same rate of change as a given function that is shown graphically.
24	<i>Expressions and Equations</i>	8.EE.2.05	SR	Determine which graph represents a proportional relationship with a given unit rate.
25	<i>Geometry</i>	8.G.3.09	SR	Solve a multi-step real-world problem involving volumes of cylinders and cones.
26	<i>Statistics and Probability</i>	8.SP.1.03	SR	Determine which statement describes the slope of a graph in a given real-world context.
27	<i>Geometry</i>	8.G.1.05	SR	Determine which angles must be congruent to a given angle when parallel lines are cut by a transversal.
28	<i>Expressions and Equations</i>	8.EE.3.08	CR	Determine which graph shows the solutions to a given system of equations, and explain the possible number of solutions the given line can have.
29	<i>Geometry</i>	8.G.3.09	SA	Find the radius of a sphere given its volume, and determine the radius of a cylinder given its height and volume.
30	<i>Geometry</i>	8.G.1.01	SA	Determine the measure of a given angle after rotation.
31	<i>Expressions and Equations</i>	8.EE.2.06	SR	Determine which statement best compares the slopes of three given lines on a coordinate plane.
32	<i>Statistics and Probability</i>	8.SP.1.04	SA	Complete a two-way table to solve a real-world problem.
33	<i>Geometry</i>	8.G.2.08	SA	Apply Pythagorean Theorem to determine distance between two vertices of a rectangle shown on a coordinate plane.
34	<i>Functions</i>	8.F.2.04	CR	Solve multi-step problems involving interpreting a given graph, finding the rate of change, and constructing a function based on a given real-world context.

\* Mathematics item types are: selected-response (SR), short-answer (SA), and constructed-response (CR).