

*Release of Spring 2023
MCAS Test Items*

from the

*Grade 8 Mathematics
Paper-Based Test*

**June 2023
Massachusetts Department of
Elementary and Secondary Education**



MASSACHUSETTS

Department of Elementary
and Secondary Education

This document was prepared by the
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Commissioner

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Overview of Grade 8 Mathematics Test

The spring 2023 grade 8 Mathematics test was a next-generation assessment that was administered in two formats: a computer-based version and a paper-based version. Most students took the computer-based test. The paper-based test was offered as an accommodation for eligible students who were unable to use a computer. More information can be found on the MCAS Test Administration Resources page at www.doe.mass.edu/mcas/admin.html.

Most of the operational items on the grade 8 Mathematics test were the same, regardless of whether a student took the computer-based version or the paper-based version. In places where a technology-enhanced item was used on the computer-based test, an adapted version of the item was created for use on the paper test. These adapted paper items were multiple-choice, multiple-select, or short-answer items that tested the same Mathematics content and assessed the same standard as the technology-enhanced item.

This document displays released items from the paper-based test. Released items from the computer-based test are available on the MCAS Resource Center website at mcas.pearsonsupport.com/released-items.

Test Sessions and Content Overview

The grade 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* (2017). 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.

Mathematics test results are reported under four MCAS reporting categories, which are based on the five framework domains listed above.

The tables at the conclusion of this document 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 document. An image of the ruler is not reproduced in the document.

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 learner students only. No other reference tools or materials were allowed.

Grade 8 Mathematics

SESSION 1

This session contains 10 questions.

*You may use your reference sheet during this session.
You may **not** use a calculator during this session.*



Directions

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

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

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. Only responses written within the provided space will be scored.

Directions for Completing Questions with Answer Grids

1. Work the question and find an answer.
2. Enter your answer in the answer boxes at the top of the answer grid.
3. Print only one number or symbol in each box. Do not leave a blank box in the middle of an answer.
4. Under each answer box, fill in the circle that matches the number or symbol you wrote above. Make a solid mark that completely fills the circle.
5. Do not fill in a circle under an unused answer box.
6. Fractions cannot be entered into an answer grid and will not be scored. Enter fractions as decimals.
7. If you need to change an answer, be sure to erase your first answer completely.
8. See below for examples of how to correctly complete an answer grid.

EXAMPLES

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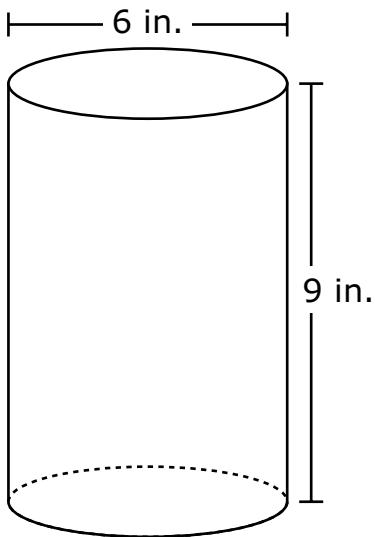
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- 1 What value of x makes this equation true?

$$7(x - 2) = 5x - 10$$

- (A) -4
- (B) -2
- (C) 2
- (D) 6

- 2 A right circular cylinder and some of its dimensions are shown in this diagram.



Which of the following is the volume, in cubic inches, of the cylinder?

- (A) 27π
- (B) 54π
- (C) 81π
- (D) 324π

- 3 A student will perform a sequence of transformations on triangle ABC on a coordinate plane. Which of the following sequences of transformations, if performed on triangle ABC , will result in an image that is **not** congruent to triangle ABC ?
- (A) translate 4 units down, and then reflect over the x -axis
(B) translate 4 units to the right, and then reflect over the y -axis
(C) rotate 90° counterclockwise about the origin, and then reflect over the line $y = x$
(D) rotate 180° clockwise about the origin, and then dilate by a scale factor of 3 with the center at the origin
- 4 Consider this expression.
- $$\sqrt{57}$$
- Which of the following statements about the expression are true?
- Select the **two** correct answers.
- (A) On a number line, the expression is located between 6 and 7.
(B) On a number line, the expression is located between 7 and 8.
(C) The approximate value of the expression is **closest** to 6.
(D) The approximate value of the expression is **closest** to 7.
(E) The approximate value of the expression is **closest** to 8.

This question has four parts. Be sure to label each part of your response.

- 5 A student created this table to represent a linear relationship between x and y .

x	y
-2	10.0
-1	7.5
0	5.0
1	2.5
2	0

- A. What is the y -intercept of the line represented by the x and y values shown in the table? Show or explain how you got your answer.
- B. What is the slope of the line represented by the x and y values shown in the table? Show or explain how you got your answer.
- C. Write an equation of the line represented by the relationship between x and y shown in the table.
- D. The student says the point $(9, -17.5)$ lies on the line represented by the relationship between x and y shown in the table.

Is the student correct? Show or explain how you got your answer.

5

- 6 The area of Europe is about 9.938×10^6 square kilometers, and the area of North America is about 2.4256×10^7 square kilometers.

What is the approximate total area, in square kilometers, of Europe and North America combined?

- (A) 3.4194×10^6
- (B) 3.4194×10^7
- (C) 1.23636×10^6
- (D) 1.23636×10^7

- 7 Consider this system of equations.

$$\begin{aligned}4x - 3y &= -7 \\-4x + 3y &= -7\end{aligned}$$

Which of the following statements about the system of equations is true?

- (A) The system has no solution.
- (B) The system has exactly one solution.
- (C) The system has exactly two solutions.
- (D) The system has infinitely many solutions.

- 8 Which of the following expressions has a value that is **greater than** 0?

- (A) $-(2^{-2})$
- (B) $-(3^{-3})$
- (C) $(-4)^{-4}$
- (D) $(-5)^{-5}$

- 9** Which of the following statements are true?

Select the **three** correct answers.

- (A) $0.\overline{72}$ is equivalent to $\frac{11}{15}$
- (B) $0.\overline{72}$ is equivalent to $\frac{8}{11}$
- (C) $0.\overline{73}$ is equivalent to $\frac{11}{15}$
- (D) $0.\overline{73}$ is equivalent to $\frac{26}{33}$
- (E) $0.\overline{78}$ is equivalent to $\frac{8}{11}$
- (F) $0.\overline{78}$ is equivalent to $\frac{26}{33}$

- 10** What is the value of $\sqrt[3]{8}$?

- (A) 2
- (B) 4
- (C) 5
- (D) 24

Grade 8 Mathematics

SESSION 2

This session contains 10 questions.

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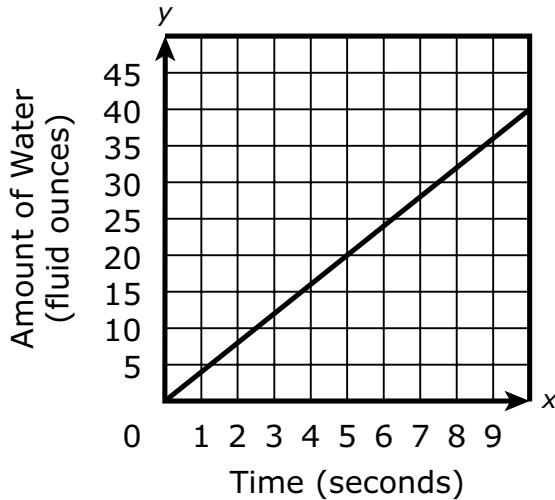
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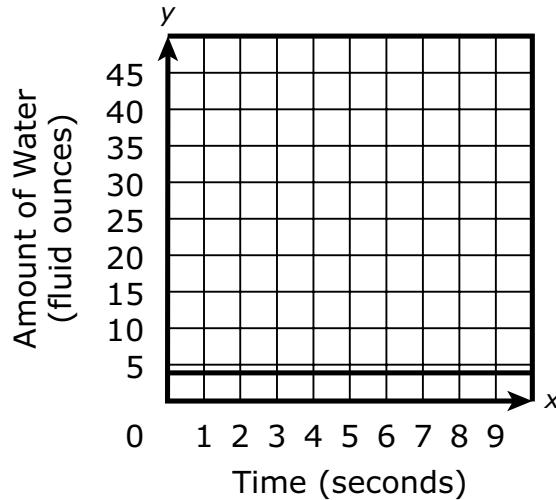
- 11 Myron is filling an empty teapot with water. The water fills the teapot at a rate of 4 fluid ounces per second.

Which of the following graphs shows how the amount of water, in fluid ounces, in the teapot changes over time?

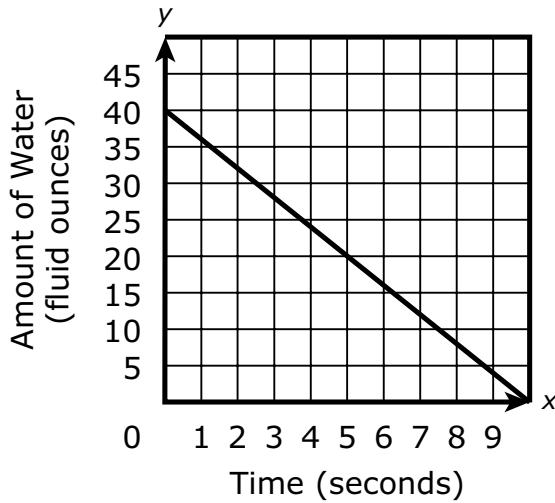
(A)



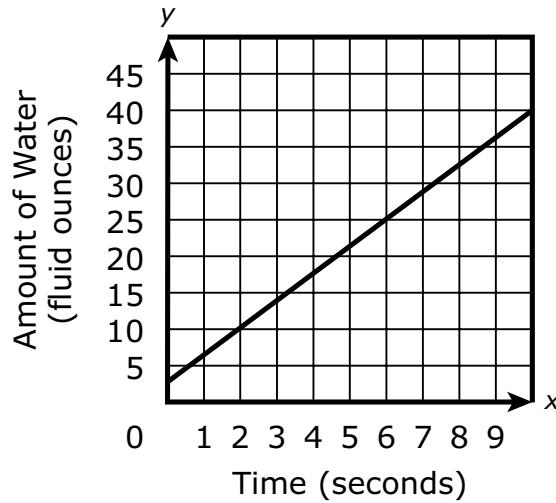
(B)



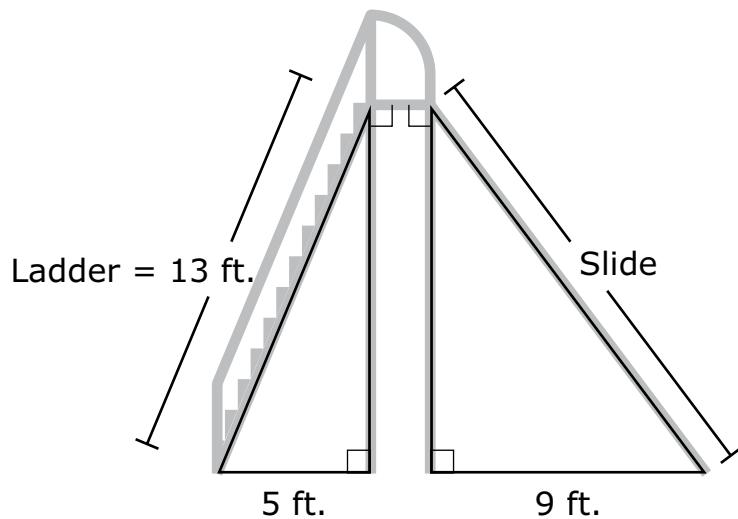
(C)



(D)



- 12 A slide has a ladder that is 13 feet long. This diagram shows the ladder, the slide, and some dimensions.

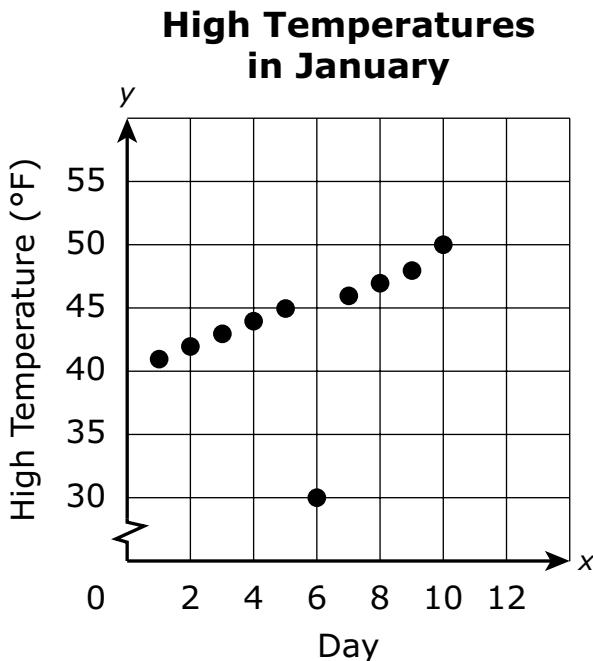


What is the length, in feet, of the slide?

- (A) 12.0 feet
- (B) 15.0 feet
- (C) 15.8 feet
- (D) 19.1 feet

This question has four parts. Be sure to label each part of your response.

- 13 A student recorded the high temperature, in degrees Fahrenheit, in his town on each day for the first 10 days in January. This scatter plot shows the data the student recorded.



- Based on the scatter plot, what was the high temperature, in degrees Fahrenheit, on day 5?
- Based on the scatter plot, on which day does the high temperature seem to be an outlier? Explain your reasoning.
- Determine whether the data in the scatter plot have a positive or a negative association. Explain your reasoning.
- The student says that, based on the trend in the data, the expected high temperature on day 15 will be greater than the high temperature on day 10. Is the student correct? Explain your reasoning.

13

- 14 One side of a right triangle has a length of 5 centimeters. Another side of the triangle has a length of 10 centimeters.

Which of the following could represent the length, in centimeters, of the third side of the triangle?

Select the **two** correct answers.

- (A) $\sqrt{50}$
- (B) $\sqrt{75}$
- (C) $\sqrt{125}$
- (D) 5
- (E) 15

- 15 Glenn bought a game system and 3 video games for \$375. Jim bought a game system and 4 video games at the same store for \$410.

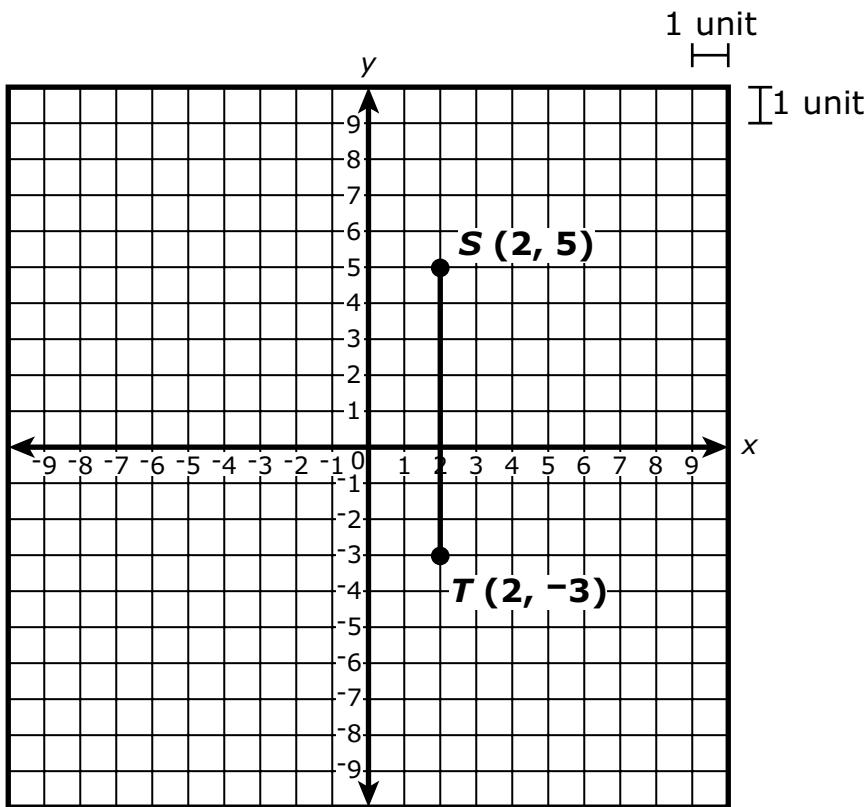
- Each game system costs the same.
- Each video game costs the same.

What is the cost, in dollars, of one **game system**?

Enter your answer in the answer boxes at the top of the answer grid **and** completely fill the matching circles.

(−)								
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(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
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(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)
(6)	(6)	(6)	(6)	(6)	(6)	(6)	(6)	(6)
(7)	(7)	(7)	(7)	(7)	(7)	(7)	(7)	(7)
(8)	(8)	(8)	(8)	(8)	(8)	(8)	(8)	(8)
(9)	(9)	(9)	(9)	(9)	(9)	(9)	(9)	(9)

- 16 Corine drew line segment ST on a coordinate plane, as shown.

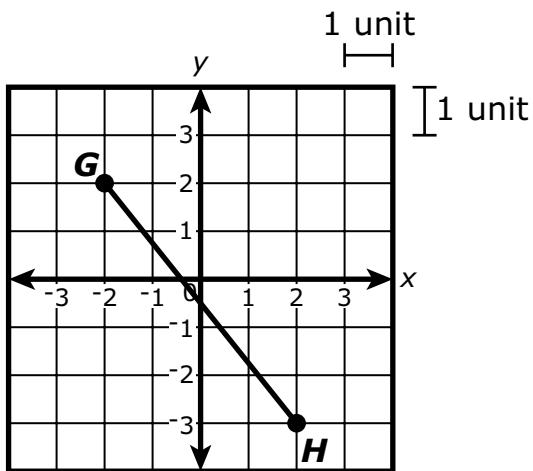


Corine will translate line segment ST 4 units to the right and then 4 units down. After the transformations, what will be the length, in units, of the image of line segment ST ?

Enter your answer in the answer boxes at the top of the answer grid **and** completely fill the matching circles.

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(\circ)								
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- 17 Line segment GH is graphed on this coordinate plane.

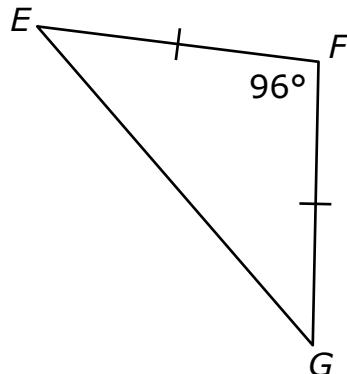


Line segment GH has a length of k units.

Which of the following equations can be used to determine k , the length in units of line segment GH ?

- Ⓐ $2^2 + 3^2 = k^2$
- Ⓑ $4^2 + 5^2 = k^2$
- Ⓒ $k^2 + 2^2 = 3^2$
- Ⓓ $k^2 + 4^2 = 5^2$

- 18 Isosceles triangle EFG and one of its angle measures are shown in this diagram.



Triangle RST , not shown, is congruent to triangle EFG .

Which of the following are the measures, in degrees, of the interior angles of triangle RST ?

Select the **three** correct answers.

- (A) $m\angle R = 42^\circ$
- (B) $m\angle R = 96^\circ$
- (C) $m\angle S = 42^\circ$
- (D) $m\angle S = 96^\circ$
- (E) $m\angle T = 42^\circ$
- (F) $m\angle T = 96^\circ$

This question has two parts.

19 **Part A**

A student graphed an equation of this form on a coordinate plane.

$$y = mx + b$$

Which of the following statements about the graph is **not** true?

- (A) The graph is a straight line.
- (B) The slope of the graph is m .
- (C) The graph crosses the x -axis at $(0, b)$.
- (D) The graph crosses the y -axis at $(0, b)$.

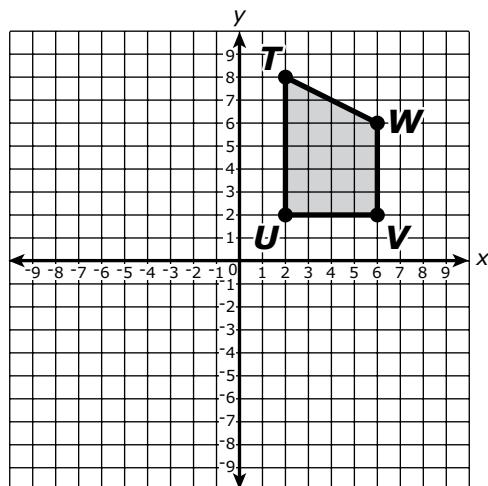
Part B

Which of the following equations are linear functions?

Select the **two** linear equations.

- (A) $y = x^2$
- (B) $y = -x$
- (C) $y = \frac{-2}{x}$
- (D) $y = -3x$
- (E) $y = 3\sqrt{x}$

- 20 Quadrilateral $TUVW$ is shown on this coordinate plane.



Quadrilateral $TUVW$ will be rotated 180° clockwise about the origin.

What will be the coordinates of the image of point V after the rotation?

- Ⓐ $(-6, -2)$
- Ⓑ $(6, -2)$
- Ⓒ $(2, -6)$
- Ⓓ $(2, 6)$

Massachusetts Comprehensive Assessment System Grade 8 Mathematics Reference Sheet

CONVERSIONS

1 cup = 8 fluid ounces	1 inch = 2.54 centimeters	1 pound = 16 ounces
1 pint = 2 cups	1 meter \approx 39.37 inches	1 pound \approx 0.454 kilogram
1 quart = 2 pints	1 mile = 5280 feet	1 kilogram \approx 2.2 pounds
1 gallon = 4 quarts	1 mile = 1760 yards	1 ton = 2000 pounds
1 gallon \approx 3.785 liters	1 mile \approx 1.609 kilometers	
1 liter \approx 0.264 gallon	1 kilometer \approx 0.62 mile	
1 liter = 1000 cubic centimeters		

AREA (A) FORMULAS

square	$A = s^2$
rectangle	$A = bh$
	OR
	$A = l w$
parallelogram	$A = bh$
triangle	$A = \frac{1}{2}bh$
trapezoid	$A = \frac{1}{2}h(b_1 + b_2)$
circle	$A = \pi r^2$

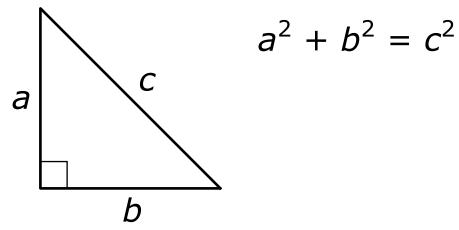
CIRCLE FORMULAS

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	$V = \frac{1}{3}\pi r^2 h$
right circular cylinder	$V = \pi r^2 h$
right prism	$V = Bh$

PYTHAGOREAN THEOREM



Grade 8 Mathematics
Spring 2023 Released Operational Items

PBT Item No.	Page No.	Reporting Category	Standard	Item Type*	Item Description	Correct Answer**
1	4	<i>The Number System and Expressions and Equations</i>	8.EE.C.7	SR	Solve a linear equation by collecting like terms.	C
2	4	<i>Geometry</i>	8.G.C.9	SR	Find the volume of a cylinder given its diameter and height.	C
3	5	<i>Geometry</i>	8.G.A.2	SR	Determine which transformation on a triangle will result in an image that is not congruent to the original figure.	D
4	5	<i>The Number System and Expressions and Equations</i>	8.NS.A.2	SR	Approximate the value of a square root by showing how to find its location on a number line.	B,E
5	6–7	<i>Functions</i>	8.F.B.4	CR	Use the linear relationship represented in a table to determine the y-intercept and slope; to write the equation of the line; and to determine whether a given point falls on the line.	
6	8	<i>The Number System and Expressions and Equations</i>	8.EE.A.4	SR	Solve a real-world problem that involves performing operations on two numbers expressed in scientific notation.	B
7	8	<i>The Number System and Expressions and Equations</i>	8.EE.C.8	SR	Determine the number of solutions to a system of equations.	A
8	8	<i>The Number System and Expressions and Equations</i>	8.EE.A.1	SR	Apply the properties of negative integer bases and exponents to identify the signed values of expressions.	C
9	9	<i>The Number System and Expressions and Equations</i>	8.NS.A.1	SR	Determine which statements about decimal expansions and their fraction equivalents are true.	B,C,F
10	9	<i>The Number System and Expressions and Equations</i>	8.EE.A.2	SR	Evaluate the cube root of a small perfect cube.	A
11	12	<i>The Number System and Expressions and Equations</i>	8.EE.B.5	SR	Determine which graph represents a proportional relationship in a real-world context.	A
12	13	<i>Geometry</i>	8.G.B.7	SR	Use the Pythagorean theorem to find the missing side length of a right triangle in a real-world problem.	B
13	14–15	<i>Statistics and Probability</i>	8.SP.A.1	CR	Given a scatter plot, determine if there are outliers in the data, describe the association represented by the data, and make a prediction based on the data.	
14	16	<i>Geometry</i>	8.G.B.6	SR	Given the lengths of two sides of a right triangle, determine the possible length of the third side by using the Pythagorean Theorem.	B,C
15	16	<i>The Number System and Expressions and Equations</i>	8.EE.C.8	SA	Create two linear equations, each involving the same two variables, to solve a real-world problem.	270
16	17	<i>Geometry</i>	8.G.A.1	SA	Determine the length of a line segment after a series of transformations.	8
17	18	<i>Geometry</i>	8.G.B.8	SR	Use the Pythagorean Theorem to determine which equation represents the length of a line segment that is graphed on a coordinate plane.	B

PBT Item No.	Page No.	Reporting Category	Standard	Item Type*	Item Description	Correct Answer**
18	19	<i>Geometry</i>	8.G.A.5	SR	Determine the angle measures of a triangle that is congruent to a given triangle.	A,D,E
19	20	<i>Functions</i>	8.F.A.3	SR	Interpret the equation $y=mx+b$, and decide whether given functions are linear or not linear.	C;B,D
20	21	<i>Geometry</i>	8.G.A.3	SR	Determine the coordinates of the image of a vertex of a quadrilateral after it has been rotated about the origin.	A

* 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 2023 Unreleased Operational Items

PBT Item No.	Reporting Category	Standard	Item Type*	Item Description
21	<i>The Number System and Expressions and Equations</i>	8.NS.A.2	SR	Determine between which pair of integers the square root of a given number lies.
22	<i>Statistics and Probability</i>	8.SP.A.3	SA	Use the equation of a linear model derived from data to solve a real-world problem.
23	<i>The Number System and Expressions and Equations</i>	8.EE.A.1	CR	Use the properties of exponents to find equivalent expressions.
24	<i>The Number System and Expressions and Equations</i>	8.NS.A.1	SR	Identify an irrational number from a list of numbers.
25	<i>The Number System and Expressions and Equations</i>	8.EE.C.8	SR	Determine the coordinates of the solution of a system of equations.
26	<i>The Number System and Expressions and Equations</i>	8.EE.A.1	SR	Use the properties of exponents to identify equivalent expressions.
27	<i>The Number System and Expressions and Equations</i>	8.EE.B.5	SR	Interpret a proportional relationship on a graph, and identify and interpret the slope of the graph.
28	<i>The Number System and Expressions and Equations</i>	8.EE.A.2	SR	Determine which radical expression is a rational number.
29	<i>Geometry</i>	8.G.A.1	SA	Determine the effects of a translation and a rotation on the angles and sides of a quadrilateral.
30	<i>The Number System and Expressions and Equations</i>	8.NS.A.1	SR	Identify rational numbers from a list of radical expressions.
31	<i>Functions</i>	8.F.B.4	SR	Use the linear relationship represented in a table of values to solve a real-world problem that involves determining the y-value for a given x-value.
32	<i>Statistics and Probability</i>	8.SP.A.3	SR	Use the equation of a linear model derived from data to solve a real-world problem.
33	<i>Statistics and Probability</i>	8.SP.A.2	SR	Justify why a line drawn through data on a scatter plot is suitable as a line of best fit.
34	<i>Functions</i>	8.F.B.4	SR	Given a real-world context, interpret the rate of change from an equation.
35	<i>Geometry</i>	8.G.A.1	CR	Given a polygon and its image after a transformation, verify congruence by analyzing properties of both polygons; describe a series of transformations that would result in the same image of the polygon.
36	<i>Functions</i>	8.F.A.1	SR	Given a set of points on a coordinate plane, determine which point should be removed in order to create a function.
37	<i>Functions</i>	8.F.A.1	SR	Determine which set of coordinate pairs represents a function.
38	<i>Functions</i>	8.F.A.2	SR	Compare properties of two functions represented algebraically and in a table, and choose a correct statement interpreting each function's rate of change and initial value.
39	<i>Geometry</i>	8.G.C.9	SA	Find the volume of a sphere given its radius.
40	<i>Geometry</i>	8.G.A.4	SR	Determine which transformation on a given figure would result in an image that is similar but not congruent to the figure.

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