



MASSACHUSETTS DEPARTMENT OF
ELEMENTARY AND SECONDARY
EDUCATION

*Release of Spring 2021
MCAS Test Items*

from the

*Grade 8 Mathematics
Paper-Based Test*

June 2021

**Massachusetts Department of
Elementary and Secondary Education**



This document was prepared by the
Massachusetts Department of Elementary and Secondary Education
Jeffrey C. Riley
Commissioner

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Overview of Grade 8 Mathematics Test

The spring 2021 grade 8 Mathematics test was a next-generation assessment that was administered in two primary formats: a computer-based version and a paper-based version. The vast majority of students took the computer-based test. The paper-based test was offered as an accommodation for students with disabilities who are unable to use a computer, as well as for English learners who are new to the country and are unfamiliar with technology.

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.

In 2021, due to the COVID-19 pandemic, the Department reduced testing time for students in grades 3–8 through a session sampling approach, in which each student took only a portion of each MCAS assessment. Instead of taking two sessions in each subject, individual students took one session each.

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 five MCAS reporting categories, which are identical to 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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9	<input checked="" type="radio"/>	9	9	9	9	9

- 1 Consider this equation.

$$x^3 = 27$$

Which of the following values of x makes the equation true?

Ⓐ 3

Ⓑ 9

Ⓒ $\frac{1}{3}$

Ⓓ $\frac{1}{9}$

- 2 Susan wants to hire one of two mechanics to repair her car. Each mechanic charges a one-time fee in addition to an hourly rate.

Mechanic A charges a one-time fee plus \$35 per hour. A repair made by Mechanic A that takes 5 hours to complete will cost a total of \$225.

This table shows the total cost, including the one-time fee, for repairs made by Mechanic B that take different numbers of hours to complete.

Mechanic B

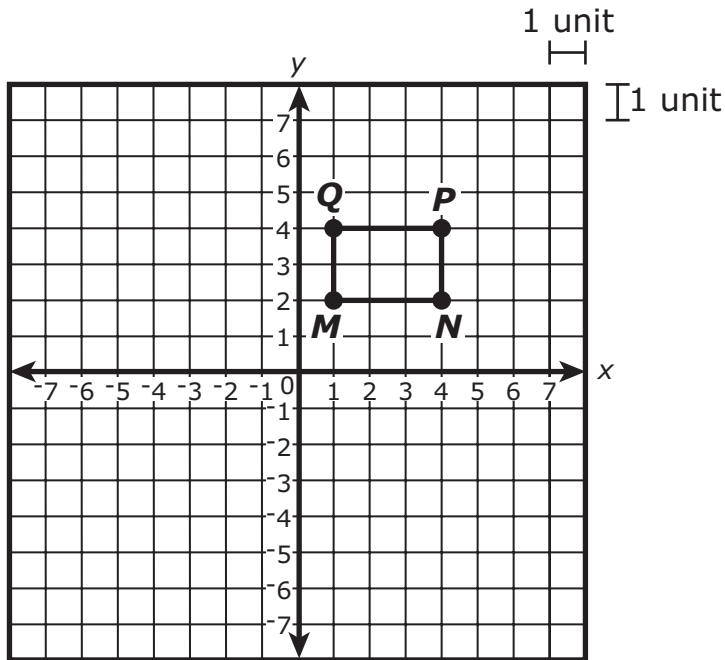
Time (hours)	Total Cost (dollars)
1	80
2	120
3	160
4	200
5	240
6	280

How much more money, in dollars, does Mechanic A charge for the one-time fee than Mechanic B charges?

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

⊖							
•	•	•	•	•	•	•	•
0	0	0	0	0	0	0	0
1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2
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5	5	5	5	5	5	5	5
6	6	6	6	6	6	6	6
7	7	7	7	7	7	7	7
8	8	8	8	8	8	8	8
9	9	9	9	9	9	9	9

- 3 Rectangle $MNPQ$ is shown on this coordinate plane.



Which of the following transformations of rectangle $MNPQ$ would create an image that is similar but **not** congruent to rectangle $MNPQ$?

- Ⓐ a translation 4 units up and 2 units right
- Ⓑ a 90° clockwise rotation, followed by a reflection over the x -axis
- Ⓒ a dilation by a scale factor of 1 with the center at the origin, followed by a translation 5 units left
- Ⓓ a reflection over the y -axis, followed by a dilation by a scale factor of 2 with the center at the origin

- 4 What number multiplied by the expression 5×10^3 is equivalent to the expression 5×10^6 ?

Ⓐ 3
Ⓑ 100
Ⓒ 1,000
Ⓓ 5,000

- 5 Which of the following equations are linear functions?

Select the **three** linear functions.

Ⓐ $y = x^2 - 1$
Ⓑ $y = 2x + 1$
Ⓒ $y = \frac{1}{2}x - 5$
Ⓓ $y = \frac{1}{3}x^2$
Ⓔ $y = -x$

- 6 Consider this system of equations.

$$\begin{aligned} p &= 2n \\ p - 5 &= 1.5n \end{aligned}$$

What value of n makes the system of equations true?

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

⊖							
⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙
0	0	0	0	0	0	0	0
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6	6	6	6	6	6	6	6
7	7	7	7	7	7	7	7
8	8	8	8	8	8	8	8
9	9	9	9	9	9	9	9

- 7 Consider this number.

$$4.0\overline{83}$$

Which of the following statements about the number is true?

- Ⓐ It is an integer because the decimal repeats.
- Ⓑ It is a whole number because the decimal repeats.
- Ⓒ It is a rational number because the decimal repeats.
- Ⓓ It is an irrational number because the decimal repeats.

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

- 8** A. Consider this equation.

$$x - 4 = 16$$

What is the solution to the equation? Show or explain how you got your answer.

- B. Write a linear equation in one variable that has infinitely many solutions. Show the process of simplifying the equation to prove that it has infinitely many solutions.

- C. Consider this equation.

$$3(4 + x) = 7x - 2(2x + 3)$$

How many solutions does the equation have? Show or explain how you got your answer.

- D. Consider this equation.

$$\frac{3}{8}x - 6 = \frac{1}{2}(4 - x)$$

How many solutions does the equation have? Show or explain how you got your answer.

8

- 9 This table represents a linear relationship between x and y .

x	y
-2	1
-1	3
0	5
1	7
2	?

What is the value of y when $x = 2$?

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

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- 10** The lengths of three sides of a triangle are 3, π , and $\sqrt{5}$. Which list shows the lengths in order from least to greatest?

- Ⓐ 3, π , $\sqrt{5}$
- Ⓑ 3, $\sqrt{5}$, π
- Ⓒ $\sqrt{5}$, 3, π
- Ⓓ $\sqrt{5}$, π , 3

Grade 8 Mathematics

SESSION 2

This session contains 10 questions.

You may use your reference sheet during this session.
You may use a calculator during this session.



Directions

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EXAMPLES

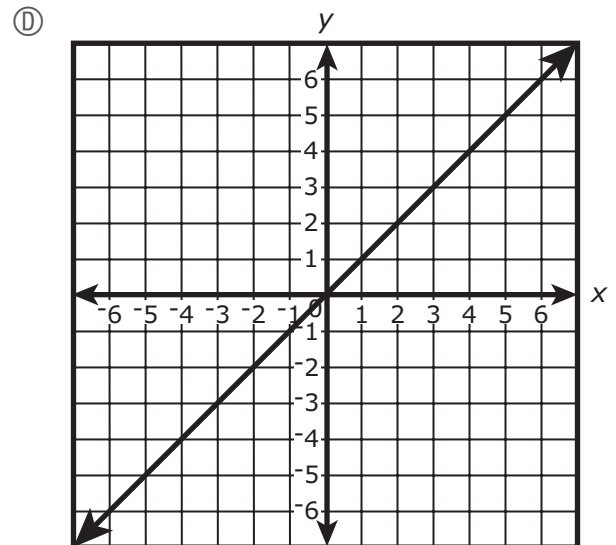
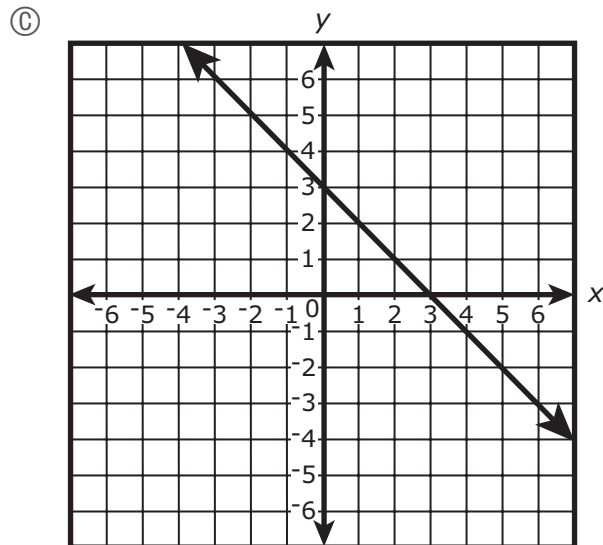
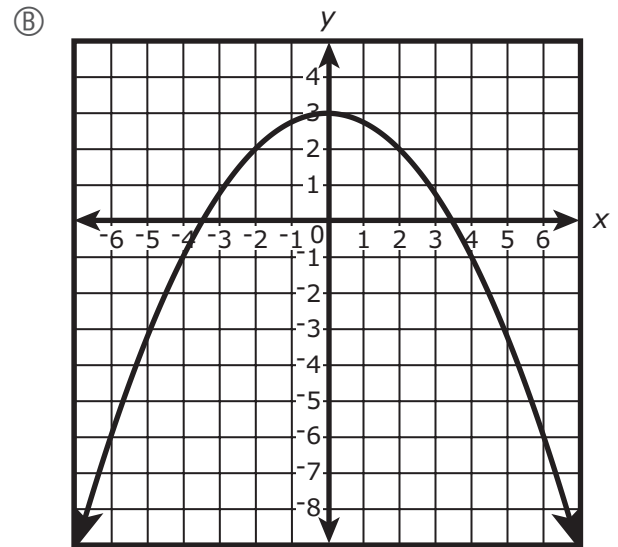
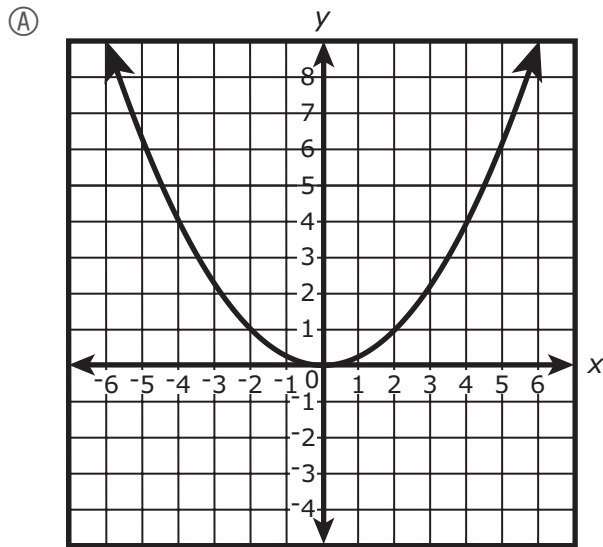
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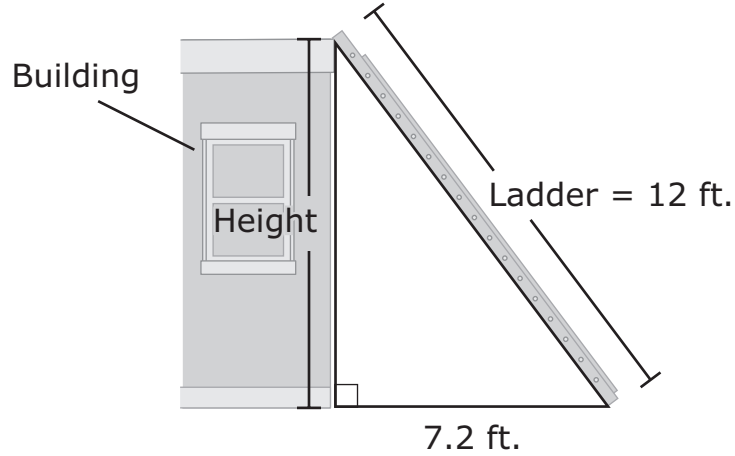
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- 11 Which of the following graphs represents an increasing linear function?



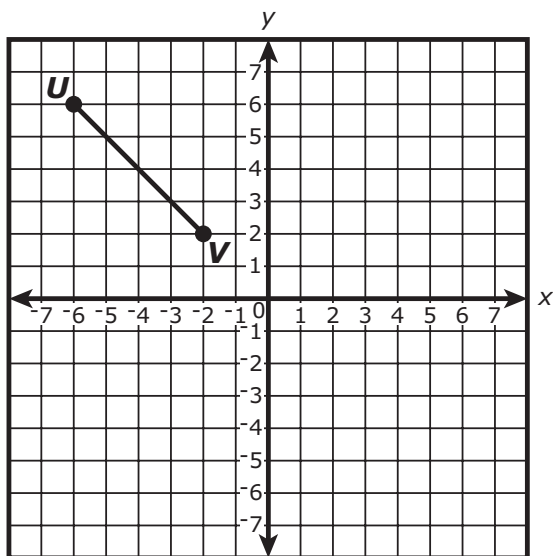
- 12 A ladder is placed against the outside wall of a building, as shown.



Which of the following equations shows the relationship between the height of the building, the length of the ladder, and the distance between the building and the bottom of the ladder?

- Ⓐ $4.8^2 + 7.2^2 = 12^2$
- Ⓑ $4.8^2 + 9.6^2 = 15.4^2$
- Ⓒ $7.2^2 + 9.6^2 = 12^2$
- Ⓓ $7.2^2 + 12^2 = 15.4^2$

- 13** Line segment UV is shown on this coordinate plane.



Point W , not shown, lies on line segment UV . The coordinates (x, y) represent point W .

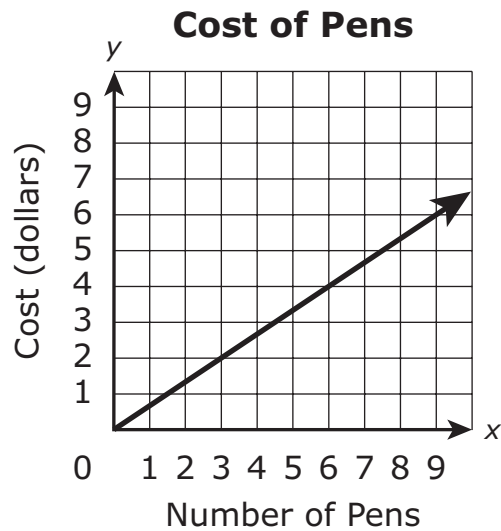
Line segment UV will be reflected over the y -axis. After the reflection, what will be the coordinates of the image of point W ?

- Ⓐ $(-y, x)$
 - Ⓑ $(y, -x)$
 - Ⓒ $(x, -y)$
 - Ⓓ $(-x, y)$
- 14** A line passes through the point $(2, 10)$ and has a y -intercept of 4. Which of the following equations represents the line?

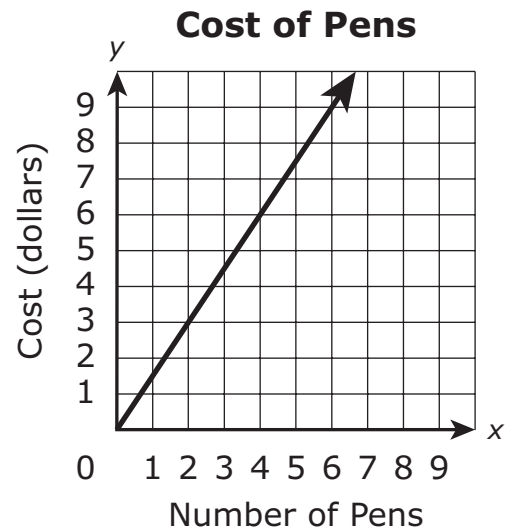
- Ⓐ $y = 2x + 4$
- Ⓑ $y = 3x + 4$
- Ⓒ $y = 4x + 3$
- Ⓓ $y = 5x + 3$

- 15 Pens cost \$1.50 each at a school store. Which graph represents y , the cost, in dollars, of purchasing x pens at the store?

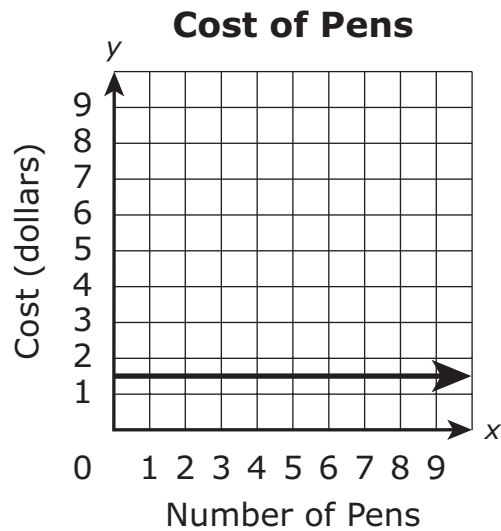
(A)



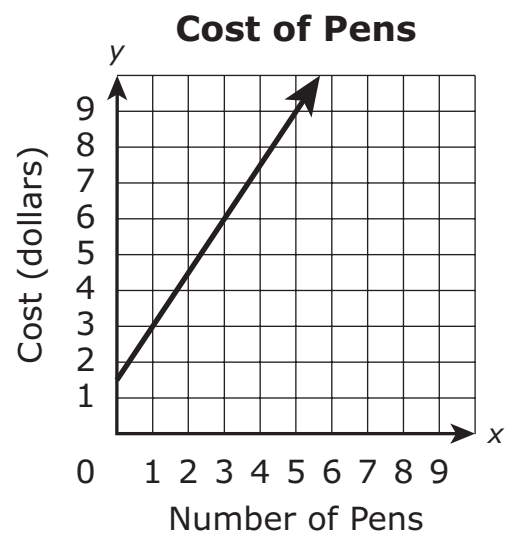
(B)



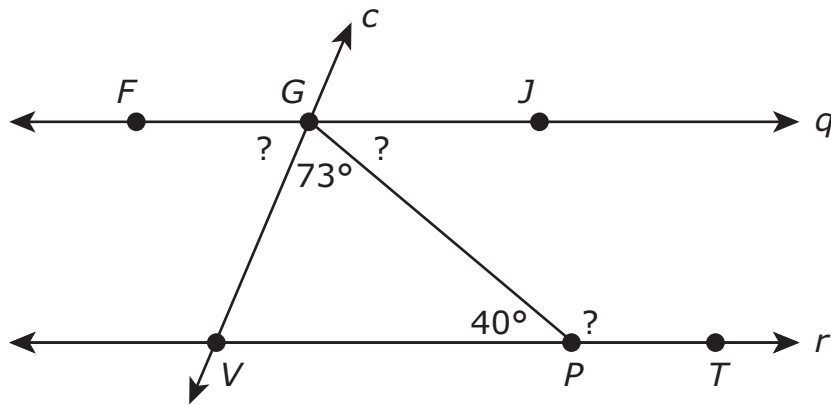
(C)



(D)



- 16 Parallel lines q and r are intersected by transversal line c , as shown in this diagram.



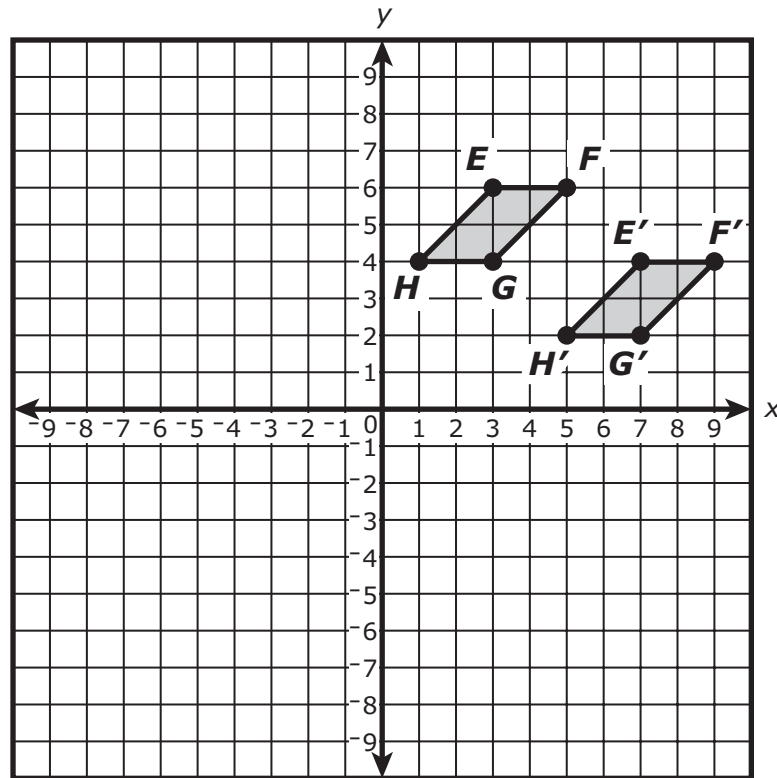
Based on the diagram, what are the measures of angles FGV , JGP , and GPT ?

Select the **three** correct answers.

- Ⓐ The measure of angle $FGV = 67^\circ$.
- Ⓑ The measure of angle $FGV = 73^\circ$.
- Ⓒ The measure of angle $JGP = 40^\circ$.
- Ⓓ The measure of angle $JGP = 73^\circ$.
- Ⓔ The measure of angle $GPT = 107^\circ$.
- Ⓕ The measure of angle $GPT = 140^\circ$.

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

- 17 Parallelogram $EFGH$ was transformed to create its image, parallelogram $E'F'G'H'$, as shown on this coordinate plane.



- A. Describe the transformation that was performed on parallelogram $EFGH$ to create parallelogram $E'F'G'H'$. Show or explain how you got your answer.
- B. Is parallelogram $EFGH$ congruent to parallelogram $E'F'G'H'$? Explain your reasoning.
- C. Parallelogram $E'F'G'H'$ will be reflected over the x -axis to create its image, parallelogram $E''F''G''H''$.

Will parallelogram $E''F''G''H''$ be congruent to parallelogram $EFGH$? Explain your reasoning.

Write your answers on the next page.

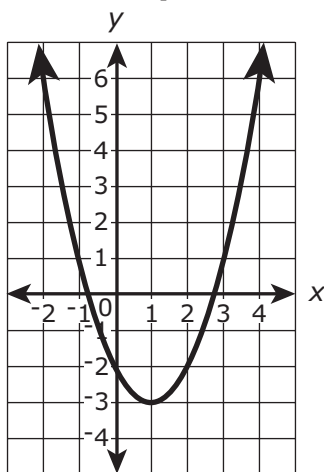
17

This question has two parts.

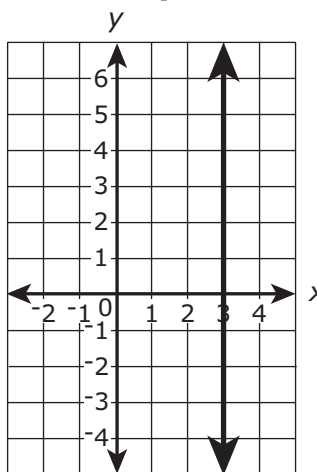
18 Part A

Consider these graphs.

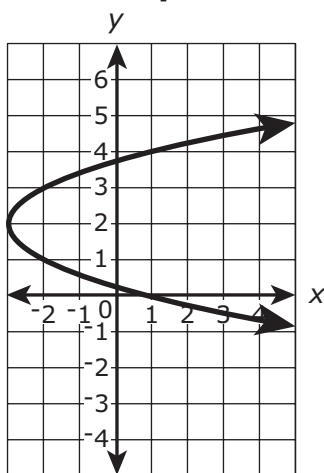
Graph 1



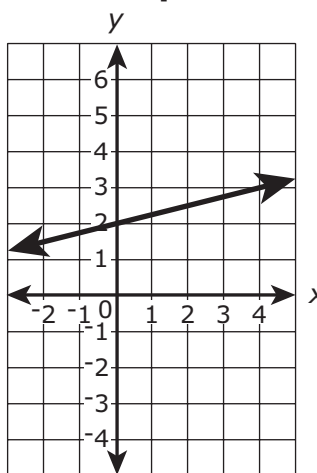
Graph 2



Graph 3



Graph 4



Which statement about the graphs is true?

- Ⓐ Only Graph 1 and Graph 2 represent y as a function of x .
- Ⓑ Only Graph 1 and Graph 4 represent y as a function of x .
- Ⓒ Only Graph 2 and Graph 4 represent y as a function of x .
- Ⓓ Only Graph 3 and Graph 4 represent y as a function of x .

Part B

The relationship between the x and y values in this table is not a function. One of the values of x is missing from the table, as shown.

x	7	12	?
y	-6	-1	8

What is **one** value of x that could replace the missing value in the table to show that y is **not** a function of x ?

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

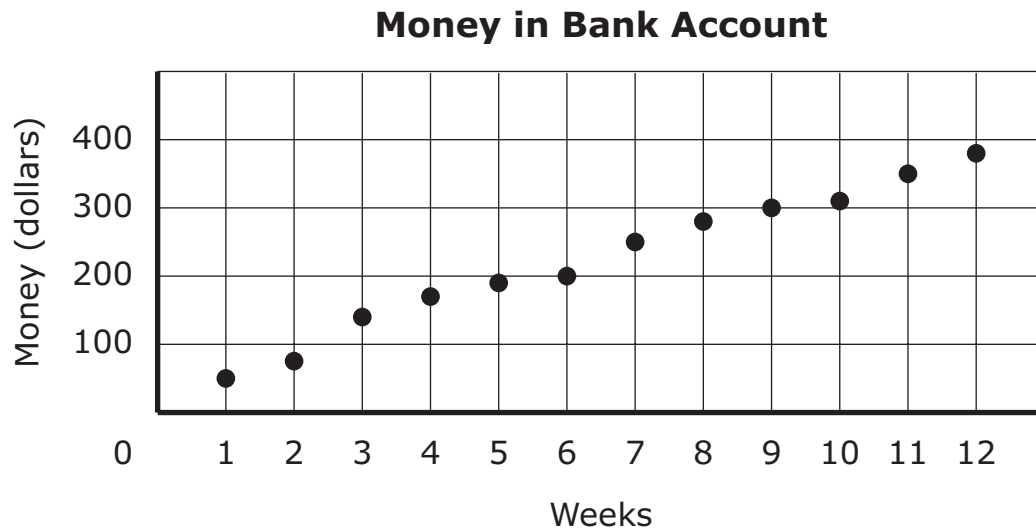
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6	6	6	6	6	6	6	6
7	7	7	7	7	7	7	7
8	8	8	8	8	8	8	8
9	9	9	9	9	9	9	9

- 19** A candle is in the shape of a cylinder. The candle has a diameter of 6 inches and a height of 5 inches.

What is the volume of the candle? (Use 3.14 for π .)

- Ⓐ 94.2 cubic inches
- Ⓑ 141.3 cubic inches
- Ⓒ 150.7 cubic inches
- Ⓓ 188.4 cubic inches

- 20 This scatter plot shows the total amount of money in a bank account at the end of each week for a period of 12 weeks.



Which of the following statements is true about the scatter plot?

- Ⓐ The scatter plot shows one outlier.
- Ⓑ The scatter plot shows clustered data.
- Ⓒ The scatter plot shows a positive linear association.
- Ⓓ The scatter plot shows a negative linear association.

Massachusetts Comprehensive Assessment System Grade 8 Mathematics Reference Sheet

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)

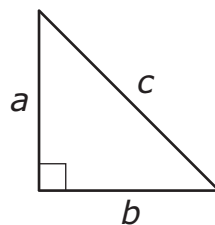
sphere $V = \frac{4}{3}\pi r^3$

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

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

right prism $V = Bh$

PYTHAGOREAN THEOREM



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

Grade 8 Mathematics
Spring 2021 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.A.2	SR	Determine the cube root of a given number.	A
2	5	<i>Functions</i>	8.F.A.2	SA	Compare the initial values of two linear functions, one defined in text and the other in a table.	10
3	6	<i>Geometry</i>	8.G.A.4	SR	Determine which transformations of a figure result in a figure that is similar but not congruent.	D
4	7	<i>The Number System and Expressions and Equations</i>	8.EE.A.3	SR	Given two numbers, each expressed as a single digit multiplied by an integer power of 10, determine by what value one of the numbers must be multiplied to obtain the other.	C
5	7	<i>Functions</i>	8.F.A.3	SR	Determine whether given equations are linear or nonlinear functions.	B,C,E
6	8	<i>The Number System and Expressions and Equations</i>	8.EE.C.8	SA	Determine one of the values of the solution to a pair of linear equations.	10
7	9	<i>The Number System and Expressions and Equations</i>	8.NS.A.1	SR	Determine whether a number is rational or irrational.	C
8	10	<i>The Number System and Expressions and Equations</i>	8.EE.C.7	CR	Solve linear equations in one variable and create a linear equation, given the number of solutions.	
9	12	<i>Functions</i>	8.F.B.4	SA	Find the missing y -value in a table containing (x, y) values that represent the relationship in a linear function.	9
10	13	<i>The Number System and Expressions and Equations</i>	8.NS.A.2	SR	Determine which list orders rational and irrational numbers from least to greatest.	C
11	16	<i>Functions</i>	8.F.B.5	SR	Determine which graph represents an increasing linear function.	D
12	17	<i>Geometry</i>	8.G.B.7	SR	Choose which equation shows the relationship between the side lengths of a right triangle in a real-world context.	C
13	18	<i>Geometry</i>	8.G.A.3	SR	Determine the coordinates of the image of a point on a line segment after the line segment has been reflected over the y -axis.	D
14	18	<i>The Number System and Expressions and Equations</i>	8.EE.B.6	SR	Determine which equation represents a line, given a point on the line and its y -intercept.	B
15	19	<i>The Number System and Expressions and Equations</i>	8.EE.B.5	SR	Determine which graph represents a given proportional relationship based on a real-world context.	B
16	20	<i>Geometry</i>	8.G.A.5	SR	Determine the measures of three angles shown in a diagram consisting of parallel lines intersected by a transversal.	A,C,F
17	21	<i>Geometry</i>	8.G.A.2	CR	Describe the transformation on a quadrilateral that produced a given image and demonstrate an understanding of the preservation of congruence.	
18	23–24	<i>Functions</i>	8.F.A.1	SA	Determine which graphs represent functions, and find the missing x -value in a table of (x, y) values that would show that y is not a function of x .	B;7 or 12
19	25	<i>Geometry</i>	8.G.C.9	SR	Determine the volume of a cylinder in a real-world context.	B
20	26	<i>Statistics and Probability</i>	8.SP.A.1	SR	Determine which statement is true about a scatterplot's pattern of association.	C

* 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 2021 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.1	SR	Determine the decimal equivalent of a rational number expressed as a fraction.
22	<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.
23	<i>The Number System and Expressions and Equations</i>	8.NS.A.2	SR	Identify a point on a number line that corresponds to the approximate location of an irrational number.
24	<i>Functions</i>	8.F.B.5	SR	Determine which graph represents a linear function that has the same y-intercept as $y = x$ and passes through a given point.
25	<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.
26	<i>The Number System and Expressions and Equations</i>	8.EE.A.4	SR	Solve a real-world problem by performing operations with numbers expressed in both scientific and decimal notation.
27	<i>Geometry</i>	8.G.A.1	SR	Choose the graph that shows the image of a triangle after a reflection and determine which statements about the sides, angles, areas, and perimeters of the triangle and its image are true.
28	<i>The Number System and Expressions and Equations</i>	8.EE.C.8	SR	Determine the number of solutions to a system of equations.
29	<i>The Number System and Expressions and Equations</i>	8.EE.A.1	SR	Apply the properties of integer exponents to identify an equivalent expression.
30	<i>The Number System and Expressions and Equations</i>	8.EE.B.6	SR	Determine the equation of a line graphed on a coordinate plane.
31	<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.
32	<i>Geometry</i>	8.G.A.2	SR	Determine which transformation of a triangle will result in an image that is not congruent to the triangle.
33	<i>Statistics and Probability</i>	8.SP.A.4	CR	Complete a two-way table, summarize real-world data on two categorical variables, and then compare an additional two-way table to the completed table.
34	<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.
35	<i>The Number System and Expressions and Equations</i>	8.EE.B.5	SR	Determine which equation represents a proportional relationship in a real-world context.
36	<i>The Number System and Expressions and Equations</i>	8.EE.C.7	SR	Determine the number of solutions for two different one-variable equations.
37	<i>Geometry</i>	8.G.A.2	SR	Determine which sequence of transformations of a quadrilateral results in a given image.
38	<i>Geometry</i>	8.G.B.7	SR	Use the Pythagorean theorem to find the missing side length of a triangle in a mathematical problem.
39	<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.
40	<i>Geometry</i>	8.G.A.1	SR	Determine which graph shows a line segment and its image after a reflection over the x-axis.

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