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

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.

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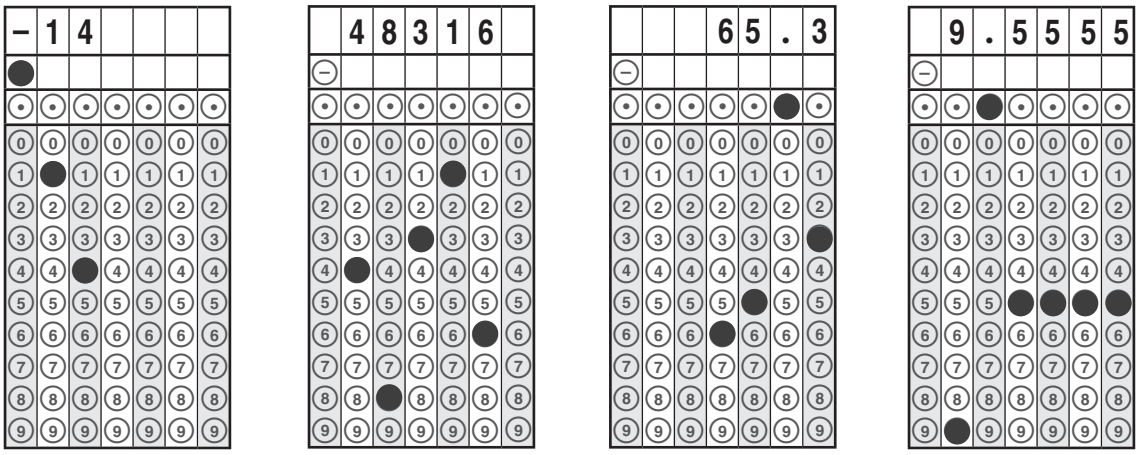
8. See below for examples of how to correctly complete an answer grid.

EXAMPLES



MASSACHUSETTS DEPARTMENT OF ELEMENTARY AND SECONDARY EDUCATION

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 ≈ 3.785 liters
1 liter ≈ 0.264 gallon
1 liter = 1000 cubic centimeters

1 inch = 2.54 centimeters
1 meter ≈ 39.37 inches
1 mile = 5280 feet
1 mile = 1760 yards
1 mile ≈ 1.609 kilometers
1 kilometer ≈ 0.62 mile

1 pound = 16 ounces
1 pound ≈ 0.454 kilogram
1 kilogram ≈ 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)

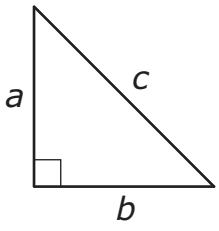
sphere . . . . . $V = \frac{4}{3}\pi r^3$

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

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

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

PYTHAGOREAN THEOREM



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

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.

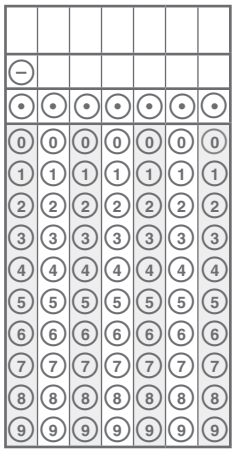
This table shows the total cost, including the one-time fee, for repairs made by Mechanic B that take different numbers of hours to complete.

Mechanic B

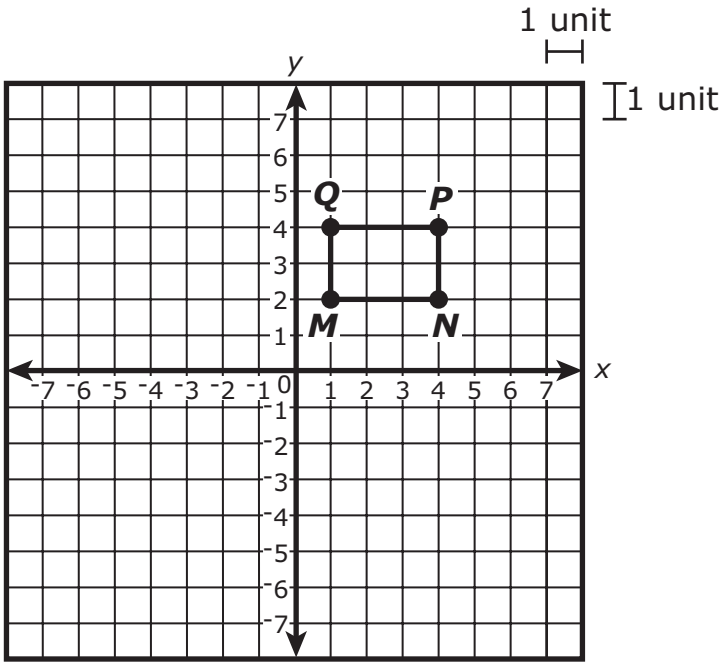
Time (hours)	Total Cost (dollars)
1	80
2	120
3	160
4	200
5	240
6	280

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.



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.

Ⓐ $y = x^2 - 1$

Ⓑ $y = 2x + 1$

Ⓒ $y = \frac{1}{2}x - 5$

Ⓓ $y = \frac{1}{3}x^2$

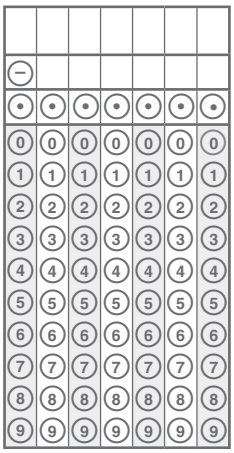
Ⓔ $y = -x$

6 Consider this system of equations.

$$p = 2n$$
$$p - 5 = 1.5n$$

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.



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.

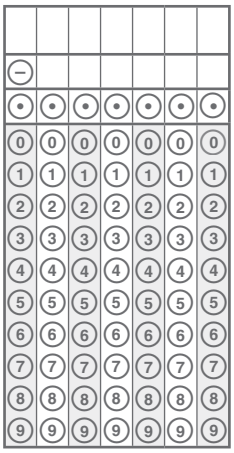
8

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.



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

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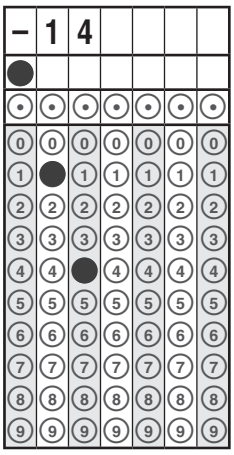
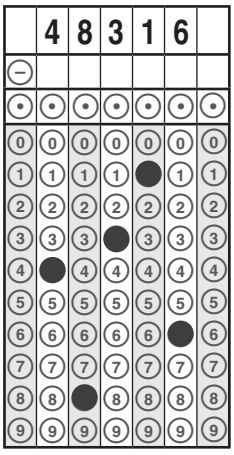
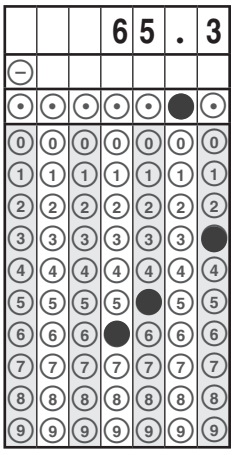
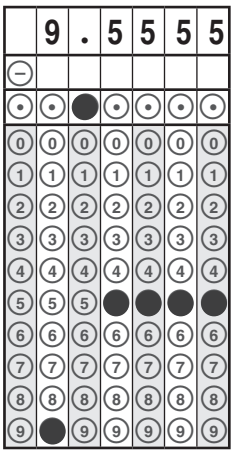


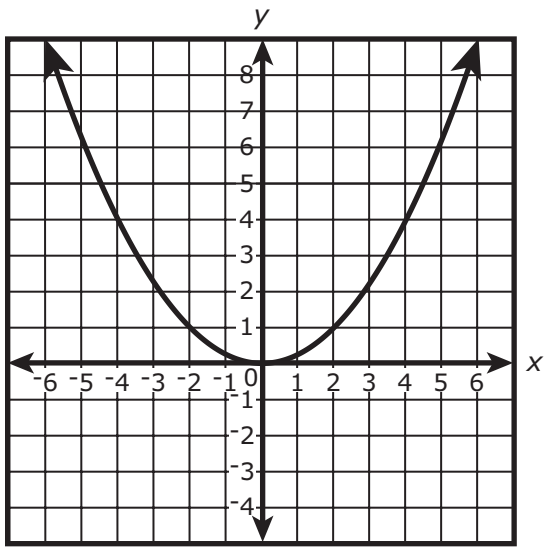




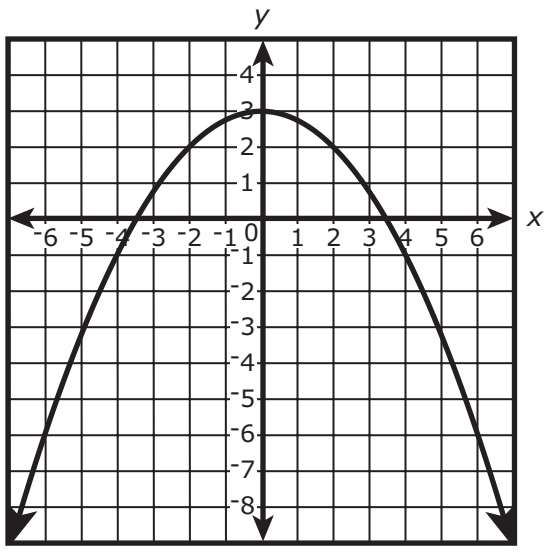


11 Which of the following graphs represents an increasing linear function?

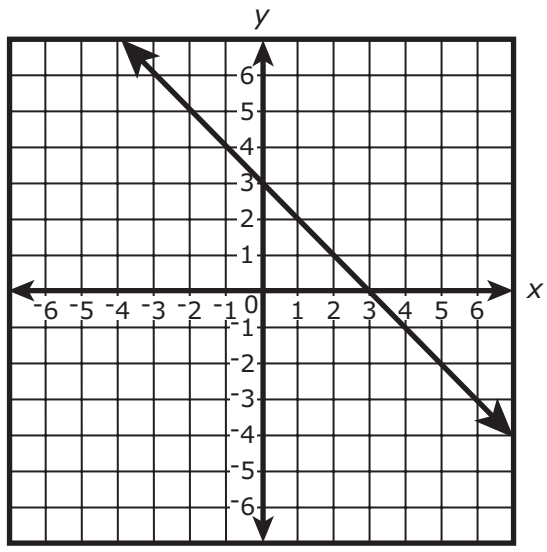
Ⓐ



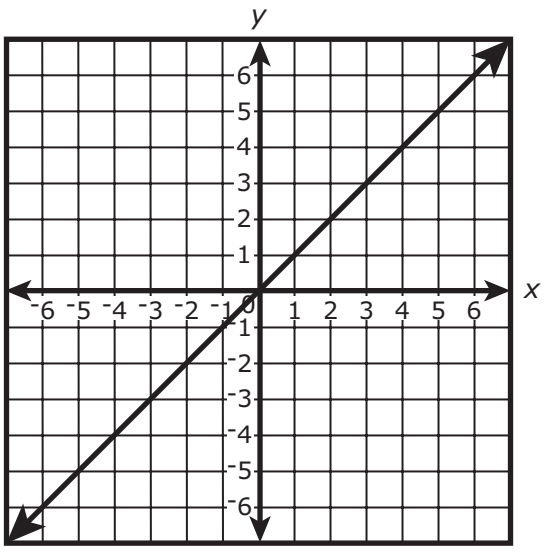
Ⓑ



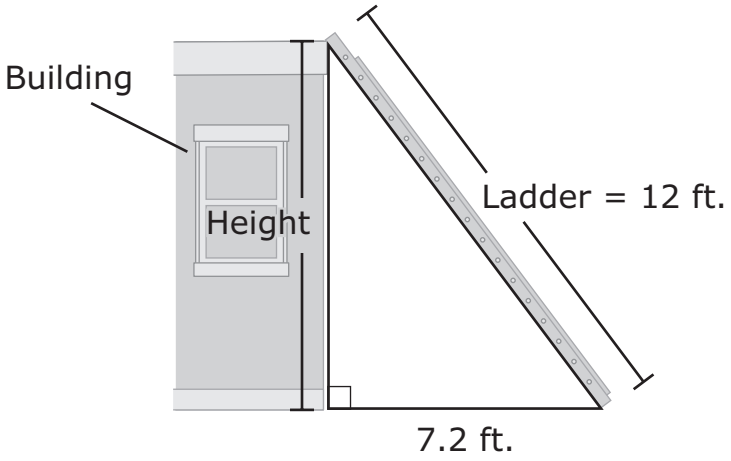
Ⓒ



Ⓓ



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?

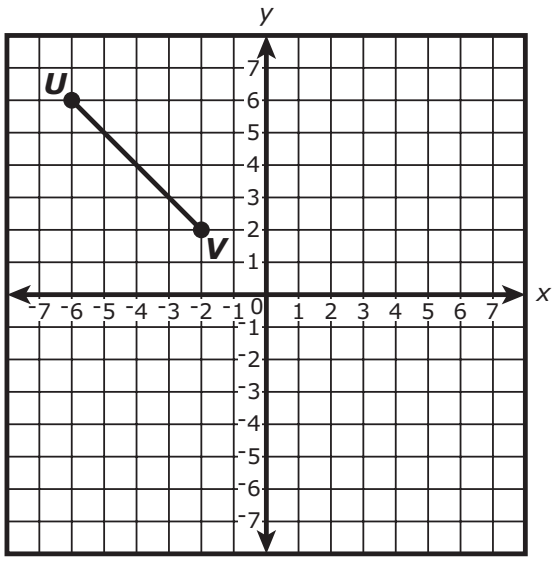
Ⓐ $4.8^2 + 7.2^2 = 12^2$

Ⓑ $4.8^2 + 9.6^2 = 15.4^2$

Ⓒ $7.2^2 + 9.6^2 = 12^2$

Ⓓ $7.2^2 + 12^2 = 15.4^2$

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?

Ⓐ $y = 2x + 4$

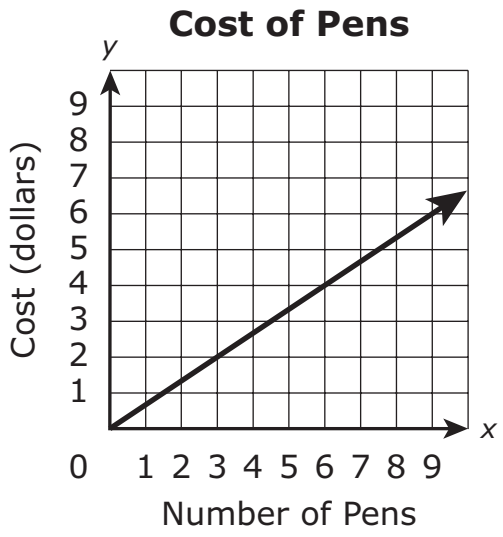
Ⓑ $y = 3x + 4$

Ⓒ $y = 4x + 3$

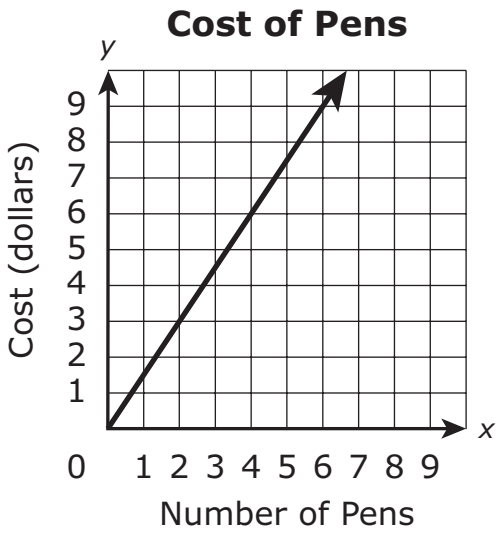
Ⓓ $y = 5x + 3$

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?

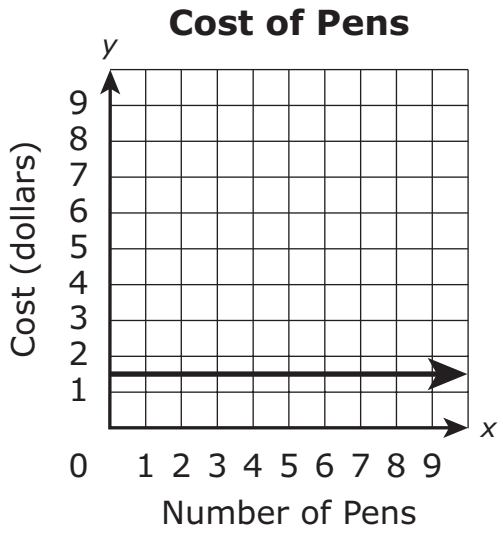
Ⓐ



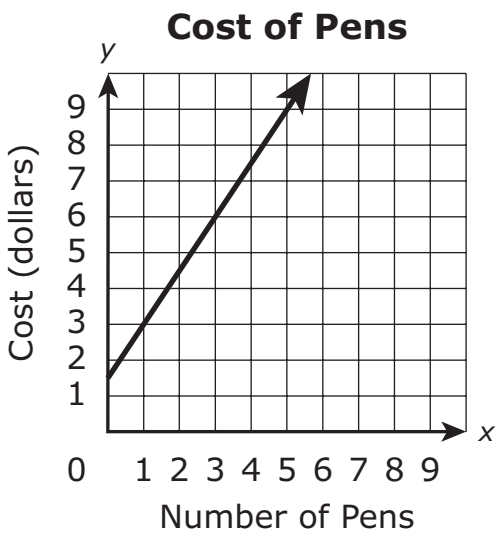
Ⓑ



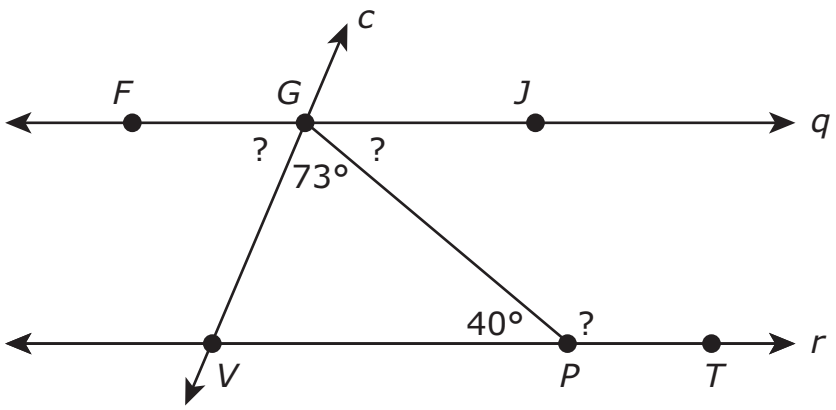
Ⓒ



Ⓓ



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°.

Ⓑ The measure of angle *FGV* = 73°.

Ⓒ The measure of angle *JGP* = 40°.

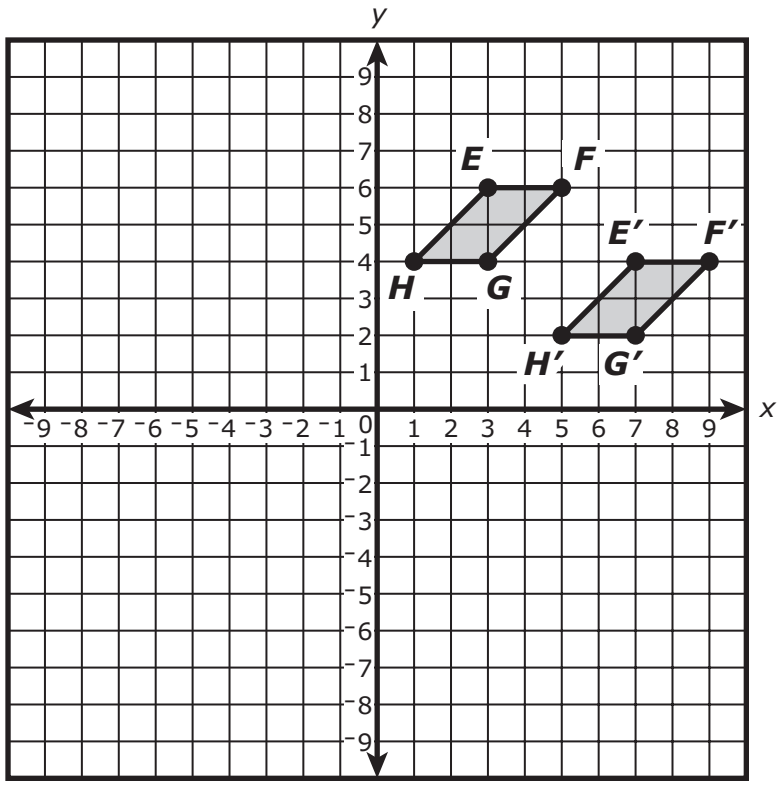
Ⓓ The measure of angle *JGP* = 73°.

Ⓔ The measure of angle *GPT* = 107°.

Ⓕ The measure of angle *GPT* = 140°.

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.

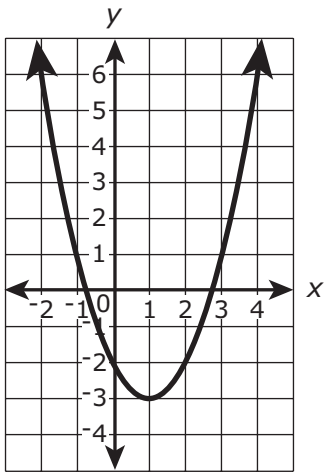
17

This question has two parts.

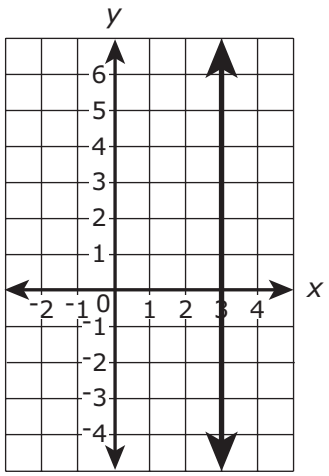
18 **Part A**

Consider these graphs.

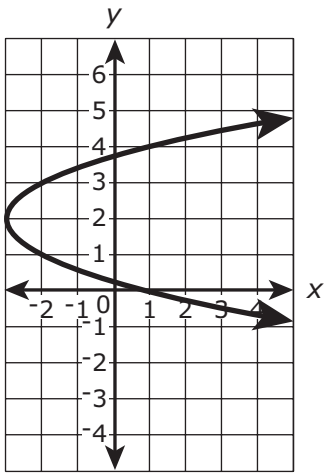
Graph 1



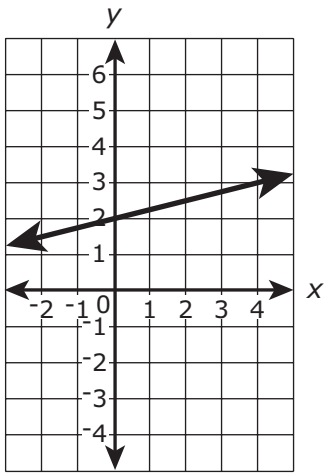
Graph 2



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*.

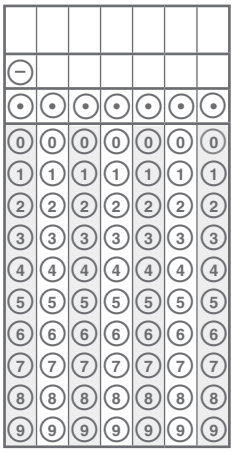
Part B

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.



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.)

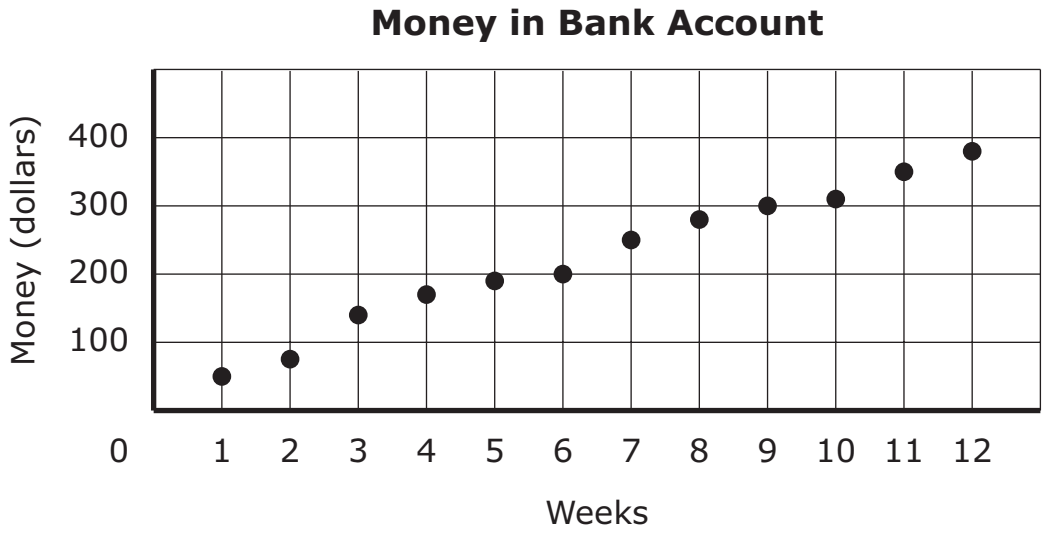
Ⓐ 94.2 cubic inches

Ⓑ 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.

Grade 8 Mathematics
Spring 2021 Released Operational Items

PBT Item No.	Page No.	Reporting Category	Standard	Item Type*	Item Description	Correct Answer**
1	4	*The Number System and Expressions and Equations*	8.EE.A.2	SR	Determine the cube root of a given number.	A
2	5	*Functions*	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	*Geometry*	8.G.A.4	SR	Determine which transformations of a figure result in a figure that is similar but not congruent.	D
4	7	*The Number System and Expressions and Equations*	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	*Functions*	8.F.A.3	SR	Determine whether given equations are linear or nonlinear functions.	B,C,E
6	8	*The Number System and Expressions and Equations*	8.EE.C.8	SA	Determine one of the values of the solution to a pair of linear equations.	10
7	9	*The Number System and Expressions and Equations*	8.NS.A.1	SR	Determine whether a number is rational or irrational.	C
8	10	*The Number System and Expressions and Equations*	8.EE.C.7	CR	Solve linear equations in one variable and create a linear equation, given the number of solutions.	
9	12	*Functions*	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	*The Number System and Expressions and Equations*	8.NS.A.2	SR	Determine which list orders rational and irrational numbers from least to greatest.	C
11	16	*Functions*	8.F.B.5	SR	Determine which graph represents an increasing linear function.	D
12	17	*Geometry*	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	*Geometry*	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	*The Number System and Expressions and Equations*	8.EE.B.6	SR	Determine which equation represents a line, given a point on the line and its y-intercept.	B
15	19	*The Number System and Expressions and Equations*	8.EE.B.5	SR	Determine which graph represents a given proportional relationship based on a real-world context.	B
16	20	*Geometry*	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	*Geometry*	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	*Functions*	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	*Geometry*	8.G.C.9	SR	Determine the volume of a cylinder in a real-world context.	B
20	26	*Statistics and Probability*	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	*The Number System and Expressions and Equations*	8.NS.A.1	SR	Determine the decimal equivalent of a rational number expressed as a fraction.
22	*Functions*	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	*The Number System and Expressions and Equations*	8.NS.A.2	SR	Identify a point on a number line that corresponds to the approximate location of an irrational number.
24	*Functions*	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	*The Number System and Expressions and Equations*	8.NS.A.2	SR	Determine between which pair of integers the square root of a given number lies.
26	*The Number System and Expressions and Equations*	8.EE.A.4	SR	Solve a real-world problem by performing operations with numbers expressed in both scientific and decimal notation.
27	*Geometry*	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	*The Number System and Expressions and Equations*	8.EE.C.8	SR	Determine the number of solutions to a system of equations.
29	*The Number System and Expressions and Equations*	8.EE.A.1	SR	Apply the properties of integer exponents to identify an equivalent expression.
30	*The Number System and Expressions and Equations*	8.EE.B.6	SR	Determine the equation of a line graphed on a coordinate plane.
31	*The Number System and Expressions and Equations*	8.EE.C.8	SA	Create two linear equations, each involving the same two variables, to solve a real-world problem.
32	*Geometry*	8.G.A.2	SR	Determine which transformation of a triangle will result in an image that is not congruent to the triangle.
33	*Statistics and Probability*	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	*Geometry*	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	*The Number System and Expressions and Equations*	8.EE.B.5	SR	Determine which equation represents a proportional relationship in a real-world context.
36	*The Number System and Expressions and Equations*	8.EE.C.7	SR	Determine the number of solutions for two different one-variable equations.
37	*Geometry*	8.G.A.2	SR	Determine which sequence of transformations of a quadrilateral results in a given image.
38	*Geometry*	8.G.B.7	SR	Use the Pythagorean theorem to find the missing side length of a triangle in a mathematical problem.
39	*The Number System and Expressions and Equations*	8.EE.B.5	SR	Determine which graph represents a proportional relationship in a real-world context.
40	*Geometry*	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).